FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA

8th

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OF SCHOOL OF SCIENCE AND TECHNOLOGY EDUCATION (SSTE)

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CONFERENCE PROCEEDINGS

THEME:

EMERGING TRENDS IN STEM AND TVET IN THE 21ST CENTURY

DATE 6th – 8TH OCTOBER, 2021

FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA

8th INTERNATIONAL CONFERENCE OF SCHOOL OF SCIENCE AND TECHNOLOGY EDUCATION (SSTE)

VIRTUAL CONFERENCE

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ACKNOWLEDGEMENTS

Local Organizing Committee of the 8th International Conference of School of Science and Technology Education (SSTE), Federal University of Technology, Minna, appreciates the Management of the University for the Unflinching Support given to the team which led to the success of this Conference. We also wish to express our profound gratitude for the assistance rendered by the University Management especially in disseminating information relating to this Conference using the University website, Campus News, and FUT Search FM.

Thank the Dean, School of Science and Technology Education (SSTE) for hosting this Conference despite the economic situation and the COVID-19 Pandemic in the country. His encouragement, advice, and moral support gave the Local Organizing Committee the strength to complete this task and make sure the Conference is successful.

Sincerely thank the academic staff of the School and University Community for their essential roles played towards the success of the Conference. We thank the non-teaching staff for their roles which contributed to the success of this Conference.

Efforts of the Editorial Board are commendable for making sure that the Book of Proceedings was ready. We appreciate the efforts of the Keynote presenter, Lead Paper presenters, and others for attending this Conference despite their tight schedule.

We also commend the undergraduate and postgraduate students of the School for sparing their time for participating in all the events. Above all we thank God Almighty for the strength given to the LOC members to discharge their enormous tasks.

PREFACE

Science, Technology, Engineering and Mathematics (STEM) and Technical and Vocational Education and Training (TVET) are very relevant in the 21st-century education. 21st-century education is about giving students the skills they need to succeed in this new world and helping them develop the confidence to practice those skills. The 21st-century skills focus more on making sense of that information, sharing and using it in smart ways. A focus on STEM and TVET could help in equipping students for life and work in the 21st Century.

STEM and TVET are considered critical as they tend to removes boarder between the disciplines by making the students to comprehend the world as a whole rather than in parts. STEM is interdisciplinary approach to learning where rigorous academic concepts are coupled with real world lessons while TVET takes individuals into account by providing all kinds of skills (or jobs).

Hence, the theme of this conference is apt and provides opportunities where experts brainstorm so that international communities can benefit from one another and also respond to emerging trends in *STEM* and *TVET* in the 21st Century. It is worthy to note that, proper implementation of the 21st-century STEM and TVET issues would have a greater influence on the quality of manpower injected into the labour market which may determine the economic growth of any nation.

The theme and sub-themes of this conference, "Emerging Trends in *STEM* and *TVET* in the 21st Century" are based on the prevailing circumstance in education sectors in developing nations. I am sure this conference has provided an avenue for researchers and educators to share their ideas on the 21st-century emerging trends in STEM and TVET that can enhance quality education and self-reliance in underdeveloped and developing nations across the world. I hope the theme and sub-themes meet the needs of the stakeholders in education.

The sub-themes are:

- STEM and TVET for Economic Diversification
- STEM and TVET for Human Resource Development
- STEM and TVET for National Security
- Curricular and Assessment issues in STEM and TVET
- Entrepreneurship in STEM and TVET
- Gender Equality/ Issues STEM and TVET
- STEM and TVET for Life-Long Learning and Skills
- STEM and TVET for Special Education
- Instructional Approaches in STEM and TVET
- ICT in STEM and TVET
- Communication in STEM and TVET
- STEM and TVET for Global health Challenges
- STEM and TVET for Innovative Technology and Engineering Education
- STEM and TVET as Solution to COVID-19 Pandemic

The Local Organizing Committee is thankful to the participants of 2021 conference for their contributions. God bless you all.

Dr. I. Y. Umar
LOC Chairman

A WELCOME ADDRESS GIVEN BY PROF. AMOSA ISIAKA GAMBARI, DEAN, SCHOOL OF SCIENCE AND TECHNOLOGY EDUCATION, FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA, NIGERIA, AT THE OPENING CEREMONY OF THE 8TH INTERNATIONAL CONFERENCE OF THE SCHOOL. 1ST – 5TH OCTOBER, 2021

Protocol

It is with great delight that i warmly welcome you all, on behalf of the staff and students of the school of science and technology education (SSTE), Federal university of technology, Minna, to the 8th international conference of the school. I am glad that you all found time to be part of this ceremony to usher in another moment of robust deliberations on issues bothering on the progress of our immediate society in Nigeria and elsewhere in Africa and beyond.

I extend my warm welcome to our distinguished Keynote Speaker, Professor Joseph De-Beer of North West University, South Africa and our lead paper presenters, Professor Aloysius Uzoagulu of Enugu State University of Science and Technology, Dr. Islam Alhaji Abdou of Science, STEM and Bioethics Education, Egypt, and Professor Binyao Zheng of Kennesaw State University, USA. These carefully sourced and selected scholars are true representatives of 21st century resource persons in science and technology education. They are chosen because of their passion and dedication to the development of the individual through science and technology education and of the society at large. I appreciate all participants who are connected to us from different parts of the world and we believe that together, we shall make the conference a success.

STEM and TVET are two very significant areas in science and technology education which deal directly with human capacity development for the advancement of the larger society. These are areas that have what it takes to build up or destroy the future of an individual or a society.

But, education is all about the development of the individual to the benefit of the society. Science and Technology Education is factor to the technological growth and stability of every economy irrespective of its size or status. It is, therefore, of great importance to expose our generations to what it takes to grow and develop in this 21st century. Thus, this international conference is organised to bring together world experts to deliberate on emerging trends in STEM and TVET in the 21st century world of technology which are considered driving factors of economic growth and development.

The sub-themes of this conference were carefully extracted from the main theme ***Emerging Trends in STEM and TVET in the 21st Century*** to cover the major areas of impact of science and technology education globally including Covid-19 pandemic. The conference has great interest in capacity building and innovation as modern trends emerge in STEM and TVET.

This conference also covers current and fundamental issues relating to research and innovations in education which seeks to unravel the currency of the trends in science and technology to align education seekers to the realities of the time. This conference is, therefore, an avenue to bring together academic researchers and teachers of no mean reputation to deliberate on the new trends and the future of science and technology, globally. Global knowledge and experience in top level research that can engender scientific knowledge will be shared, presented and discussed internationally focusing attention on recent outstanding academic breakthroughs in science and technology education.

The urgent needs of education in the present, are necessary skills designed to move learners to the top of the ladder of scientific breakthrough in education and technology. Hence, the various sub-themes cover such interests from both local and international perspectives to equip both teachers, learners, education providers and policy makers to revolutionalise and renew initiatives.

Nigeria is struggling to make in-road into the league of technologically developed Nations, the impact is still far from being felt. The slow motion being experienced in the field of education can be attributed to archaic curriculum being circulated and used in schools. This type of curriculum that has little to show in the current dispensation of technological initiatives in science and technology cannot translate any learner to a scientist. Such obsolete learning can bedevil the good and spirited proposals of scientific development and equally weaken economic viability.

No society can rise beyond the level of her educational system, meaning that, every country is confined to the extent of her educational provisions and aspirations. A disadvantaged curriculum produces a disadvantaged populace in a disadvantaged economy.

Nigeria is still waiting for a curriculum where new things in science and technology will be enshrined, where provisions for laboratory furniture or technology study materials are provided, where students have trending tables and chairs for reading and writing, where teaching materials are provided and where technological development will be ensured.

These challenges are issues that this conference will address and proffer solutions to. With full knowledge of emerging trends in STEM and TVET in the 21st Century, lasting solutions are expected to emerge from this conference, where economic security strategies will be unveiled to enable science and technology education run on smooth wheels.

Ladies and gentlemen, you are welcome once again to this conference. I express my heart felt gratitude to the Vice Chancellor of this great and dynamic University and his management team for standing by us in every of our conferences. I am grateful to my colleagues in the School of Science and Technology Education and to our dear students for their support at every stage of the preparation for this conference. To all our participants, I wish you successful sessions and a fruitful outcome.

Thank you very much for your attention.

A WELCOME ADDRESS PRESENTED BY THE VICE CHANCELLOR, PROFESSOR ABDULLAHI BALA, AT THE OPENING CEREMONY OF THE 8TH INTERNATIONAL CONFERENCE OF THE SCHOOL OF SCIENCE AND TECHNOLOGY EDUCATION, FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA, ON 6TH OCTOBER, 2021

PROTOCOL

It is my pleasure to welcome every participant, on behalf of the Governing Council, Management, Staff and Students of Federal University of Technology, Minna, to the 8th edition of the annual International Conference of the School of Science and Technology Education (SSTE) of our distinguished University. I specially welcome the Keynote Speaker, Professor Josef De-Beer and the eminent lead paper presenters, Professor Aloysius Uzoagulu of Nigeria, Dr. Islam Alhaji Abdou of Egypt and Professor Binyao Zheng of United States of America.

This 8th SSTE International Conference is a unique one being the first to go virtual, a signal of greater things ahead. The conference theme "**Emerging Trends in STEM and TVET in the 21st Century**" offers another opportunity to education Technology experts to explore global emerging trends in the education industry which is regularly shaped and reshaped by Technology. It provides a platform for scholars in academia to explore greater opportunities through well researched and exhaustively articulated and documented research efforts to unveil various pedagogical challenges frustrating effective teaching and learning in today's world of science and technology. It is also an avenue for both local and international academic and research communities to share their breakthroughs in teaching and learning research as well as explore opportunities for further developments in science and technology education, not only in Nigeria but also in the world at large.

The conference presentations will provide direction to further incorporate and integrate greater and healthier methodologies into teaching and learning in STEM and TVET to reflect the 21st century skills and learning.

It is becoming evident now that the state of education in Nigeria, Africa and the world is facing pedagogical challenges that need innovative interventions to address. The current quality of education, especially in Science and Technology, has not taken Nigeria far and has no promise of doing so. This Conference is, therefore, designed to unmask and rearrange the methodological shortcomings hindering effective teaching and learning by affording brainstorming opportunities to local and international participants on the emerging global trends in Science and Technology education. The redemptive conference sub-themes have been built to address these challenges in various areas of developmental endeavour. What Nigeria needs now is the restoration of the glory of education through emerging trends in the 21st century classroom practices. This will mark the beginning of new things in STEM and TVET in a country zealously seeking for technological solutions to her numerous domestic problems.

The beginning of new things in STEM and TVET will be driven by the identification of the relevant skills needed to acquire the much desired technological innovation to upgrade learning abilities and competencies of students. Pedagogy explores the processes by which society deliberately transmits its accumulated knowledge, skills and values from one generation to another. The major methodological concern in the mind of education stakeholders is how to educate students in various institutions of learning to meet their corporate and individual needs. The ability to overcome this methodological concern will be based on willingness to overcome the teething concerns by meeting the educational goals set by the student and the teacher, and also the strategies put in place to achieve those goals. Also, such factors as the educator's own philosophical beliefs, the curriculum provision and the availability or no availability of technological devices can affect the ability to overcome those learning concerns.

The emerging trends in STEM and TVET in the 21st Century is robust technology application which drives humanity to major discoveries unlike in the old analogue world, ruled by ancient pedagogies. The world is moving on the fast lane and no learner will be left behind. I, therefore, challenge this conference to offer to our society the best and nothing but the best trends emerging now in Science and Technology education through 21st century pedagogies. The teachers of our children need to be placed in a position to produce world renown scientists and technology experts who can in turn pass the competencies to the future generations of scientific achievers. The Universities and other education providers should be willing and able to adopt emerging innovative trends and key into the accruing benefits for the survival and advancement in knowledge to the benefit of society. All hands must be on deck to ensure that our future generations align with the realities of the 21st century by ensuring genuine technological immersion.

At this juncture, let me congratulate the Dean of the School of Science and Technology Education, Professor Amosa Isiaka Gambari on his doggedness to see that this conference becomes a reality. I sincerely appreciate the efforts of the Conference Organising Committee and the entire staff of the School for their relentless efforts towards the success of this conference. Please, accept my best wishes.
Ladies and gentlemen, I welcome you once again to this International Conference, have a very fruitful and rewarding occasion. Enjoy your day.

Thank you for your attention.

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Keynote address for the 8th SSTE International Conference,
Nigeria, 6 – 8 October 2021

The affordances of indigenous knowledge in STEM and TVET education: What nascent research tells us

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Abstract
This paper explores the affordances of indigenous knowledge in the STEM classroom. From a perspective of embodied, situated and distributed cognition, it is argued that contextualization of curriculum themes through such epistemological border-crossing could support conceptual development in learners, and also sensitize students about career and entrepreneurial opportunities. The paper further investigates the shared tenets that western science and indigenous knowledge have in common, and also highlights differences, e.g., the holistic nature of indigenous knowledge (also encompassing metaphysical aspects), in contrast to reductionist western science. This opens up the debate on whether indigenous knowledge should be validated using the heuristics of western science, and the paper shares various viewpoints on this conundrum. The value of problem-based learning when exploring indigenous knowledge is further highlighted, and how it could enhance self-directed learning in the classroom. Nascent research on the use of the Rationality Index of Plant Use (RIPU) heuristic is shared, and how this could be a valuable tool in the STEM classroom to enhance scientific literacy and critical thinking. Research shows that STEM teachers are often not adequately equipped to infuse indigenous knowledge in their teaching, and the paper makes suggestions for pre- and in-service teacher education.

Keywords: STEM education; indigenous knowledge; contextualization; self-directed learning; problem-based learning; nature of science; pedagogical orientation.

Introduction: Trends in STEM education research
The Covid-19 pandemic has catapult renewed interest in the role of blended learning, and the affordances of online teaching and learning in science education. However, there are also more perennial issues that continue to dominate educational research in STEM fields, e.g., fostering inquiring learning in the classroom, and the incorporation of more engaging pedagogies as part of STEAM (Science, Technology, Engineering, Arts and Mathematics) (White et al., 2019; Petersen et al., 2019). Another trend in science education during the last two decades, is the affordances of indigenous knowledge in the science classroom. In this paper, the focus will be on indigenous knowledge, and the value of epistemological border-crossing in the STEM classroom. Indigenous knowledge holds affordances to address the high unemployment figures in many African countries, as nascent research fields such as ethnobotany and ethnopharmacology provide a spectrum of new career and entrepreneurial opportunities. South Africa's unemployment rate rose to 34% in the second quarter of 2021 (https://tradingeconomics.com/south-africa/unemployment-rate). In Nigeria the picture is just as bleak, as the unemployment rate rose to 33.3% during the Covid-19 pandemic (Bloomberg, 2021). De Beer (2019a) claims that the inclusion of indigenous knowledge in the natural sciences classroom will alert students to both career and entrepreneurial opportunities that exist in a complex 21st century.

Epistemological border-crossing in the STEM curriculum: The affordances of indigenous knowledge for self-directed learning
Indigenous knowledge is described by Battiste (2002:2) as "a complex set of technologies developed and sustained by indigenous civilizations. Often oral and symbolic, it is transmitted through the structure of

indigenous languages and is passed on to the next generation through modelling, practice and animation, rather than through the written word". Rankoana (2017:63) again offers the following description of indigenous knowledge: "A systematic body of knowledge acquired by local people through the accumulation of experience, informal experiment, and understanding of their environment". There are various opinions on the inclusion of indigenous knowledge in the STEM curriculum. This is to a large extent due to the epistemological differences between indigenous knowledge and western science. Science is mostly based on a mechanical worldview, and indigenous knowledge on an anthropomorphic worldview (Ogunniyi, 2004). Whereas western science is objective and reductionistic, indigenous knowledge has as characteristics that it is holistic and includes metaphysical perspectives (Cronje, 2015). Ogunniyi and Ogawa (2008:178) state that indigenous knowledge systems hold a "redemptive, holistic and transcendental view of human experience with the cosmos". For this reason, many people think of indigenous knowledge as promoting pseudoscience (De Beer, 2019a), as it is contrasted with characteristics such as positivism, objectivism, reductionism, rationalism and modernism, typifying western science (Sjöström, 2007). However, Cronje, De Beer & Ankiewicz (2015) emphasize the shared tenets between western science and indigenous knowledge. The latter authors show that both knowledge systems are empirical (nature is real, observable and testable), inferential (there is a clear distinction between observations and deductions) and tentative (subject to change). However, indigenous knowledge is holistic, also including a metaphysical (spiritual) dimension. It is this holistic and metaphysical characteristic that is often the reason for the marginalization of indigenous knowledge in the science classroom, as many teachers are of the opinion that it could promote pseudoscience (De Beer, 2019a).

There are essentially three different perspectives on the infusion of indigenous knowledge in the STEM classroom (Taylor & Cameron, 2016; Zinyeka, Onwu & Braun, 2016):

(a) The **inclusive perspective** views indigenous knowledge as part of science. Based on the shared tenets between the two knowledge systems (both are objective, empirical, creative and inferential), little distinction is made between 'western' science and indigenous knowledge.

(b) The **exclusive perspective** sees indigenous knowledge and western (natural) science as two different epistemologies. Onwu and Mosimege (2004:6) are of the opinion that it is not wise to subject indigenous knowledge to the same verification techniques used in the natural sciences: "I don't think we should be looking at IKS with the same lens of judgment as we would with western science. When I say this I am not suggesting that we should just accept without questioning or verification the rigorous standards that tend to be used in the Western system. In fact, IKS or some of the components thereof have equally rigorous standards of validation and measures that also characterize it. I am suggesting that the two systems are different and therefore require different forms of verification. These verification methods and processes can actually be equated and be made to be similar standards, however they have to be appropriate for each system, otherwise we would compromise one system at the expense of another, and in the process lose the beauty of what the two systems could provide alongside each other". The danger of this perspective is of course that indigenous knowledge could easily be marginalized in the STEM curriculum.

(c) Personally, I subscribe to the third perspective, which views natural (western) science and indigenous knowledge as having **intersecting domains**, as shown in Figure 1. This perspective acknowledges the differences between indigenous knowledge and western science, but also recognizes that there are a number of shared tenets between these knowledge systems. This perspective emphasizes that the shared tenets of the two knowledge systems should be the focus in the STEM classroom. De Beer and Van Wyk

(2019) provide, as an example, the utilization of the Kirby-Bauer technique in the science classroom, where the students can explore the antimicrobial activity of plants that are traditionally used for medicinal purposes. Students will start by formulating hypotheses (e.g., if this medicinal plant is effective in treating a sore throat, it must possess active ingredients able to kill pathogenic bacteria causing the symptoms). This can be tested in the school laboratory, using an adapted Kirby-Bauer technique (Mitchell & Cater, 2000). A simple way of determining the sensitivity of a microorganism to an antimicrobial substance (such as an alkaloid in the medicinal plant), is to use agar plates that are inoculated with microorganisms and to let the active substances in the plant material diffuse into the agar medium (De Beer & Whitlock, 2009). By engaging in such a Kirby-Bauer technique, students are tapping into the syntactical nature of natural science, to validate this indigenous knowledge.

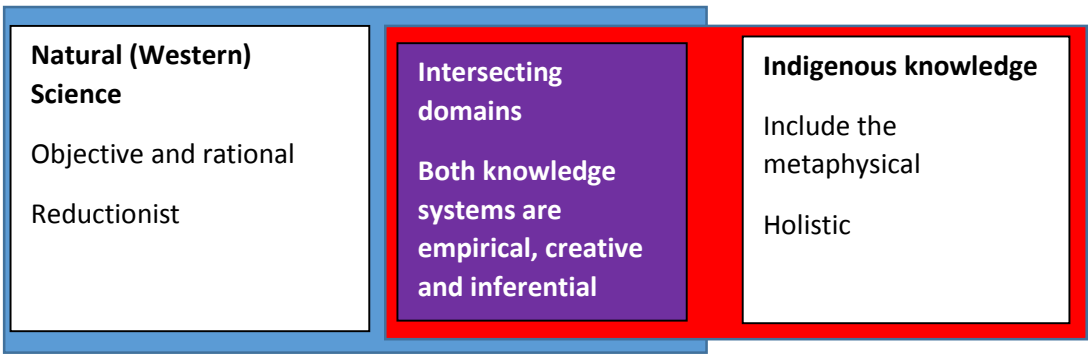

Figure 1. The intersecting domain perspective on the relation between western science and indigenous knowledge

Having said this, it is important to note that there are two schools of thought, in terms of validating indigenous knowledge. One argument is that indigenous knowledge should not be measured or validated against western scientific knowledge or criteria as a "golden standard", as the practice would further strengthen the perceived superiority of western science, and might be disempowering and disrespectful in terms of the holders of indigenous knowledge. The contrasting argument is that there are many examples of mutualistic relationships between indigenous knowledge holders and western scientists, working together in projects. Very often, the indigenous knowledge holders perceive the validation of their indigenous knowledge by western scientists as empowering, and that it created respect for the rigour of indigenous knowledge in broader society.

I would like to further dwell on this discourse, as it has profound consequences for STEM education. Authors such as Widdowson and Howard (2008:242) sadly describe indigenous knowledge as "junk science". These authors are of the view that "ideas derived from indigenous expression require scientific testing before they are accepted as knowledge" (Matsui, 2015:11). It is in all probability this skepticism that leads to the urge amongst western scientists to validate indigenous knowledge claims, using the heuristics of western science. Gratani et al. (2011:2) describe an alternative perspective on the issue of validation: "That the validity of one knowledge system must be confirmed by another raises issues over the equality of such an approach. The risk is that the superiority currently held by scientific knowledge is perpetuated".

In this paper, I would like to further analyse this dichotomy. An interesting example of the integration of western science and indigenous knowledge, is described by Gratani et al. (2011). Aboriginal holders of indigenous knowledge in the Wet Tropics of Queensland in Australia teamed up with western researchers,

to test traditional fishing poisons for the control of the invader fish, tilapia. The joint research confirmed that the poisons traditionally used were effective at immobilizing the fish. In this study, the indigenous knowledge holders indicated that they did not find the validation process disrespectful, but "instead empowering and necessary for their indigenous knowledge to be understood and appreciated by scientists" (Gratani et al., 2010:1). In my own work with traditional knowledge holders in the Northern Cape in South Africa (De Beer, 2012; De Beer, 2020) I had similar experiences, of how the mutualism between western scientists and traditional knowledge holders could be characterized by mutual respect and appreciation for the value-adding by the other partner.

In the South African context, it is also important to recognize that research into the safety of African medicinal plants is very important. Poisoning due to traditional medicines is not uncommon in South Africa, and between 8,000 and 20,000 people die annually due to poisoning related to muthi medicines (Fennell et al., 2004). In a study conducted by Ramchundar and Nlooto (2017), 79.5% of traditional healers in KwaZulu-Natal in South Africa expressed a willingness to cooperate with western researchers in analysing the medicinal plants that they use. Based on such research, there is a compelling argument for epistemological border-crossing in the STEM classroom, and subscription to the 'intersecting domains' perspective.

The cooperation between indigenous knowledge holders and western scientists, and the potential to develop entrepreneurial skills

The cooperation between indigenous knowledge holders and western researchers hold promise to develop entrepreneurial opportunities and create awareness of career options. Van Wyk (2011) indicated that many plant species used by cultural groups hold potential to be commercialized. In South African context, a few examples include *Agathosma betulina* (buchu), *Aloe ferox* (bitter aloe), *Artemisia afra* (African wormwood), *Aspalathus linearis* (rooibos tea), *Lippia javanica* (fever trea) and *Sutherlandia frutescens* (cancer bush). *Lippia javanica*, the fever tree, provides an interesting case of how local communities could benefit from indigenous knowledge. Indigenous knowledge holders, predominantly Tsonga people, in the Giyani district in Limpopo, South Africa, have been using the fever tree as an insect repellent for decades (De Beer, 2019a). The Council for Scientific and Industrialized Research (CSIR) has been working with the local community in Giyani, and has registered a patent on the use of *Lippia javanica* as an insect repellent. Community members are involved in making candles using the oils of the fever tree. The volatile oil of the plant contains myrcene, caryophellene, linalool and ipsdienone, and research has shown that the plants extracts compare well in terms of the efficacy with Diethyltoluamide (DEET), the best-known commercial mosquito repellent (Van Wyk & Gericke, 2018). However, the *Lippia javanica* extracts do not have the side effects of DEET. This is an example of how localized (indigenous) knowledge, with global application, could empower local communities through the commercial exploitation of such knowledge.

De Beer (2019b) shows how nascent research in ethnobotany and pharmaceutical fields could provide future career- and entrepreneurial opportunities for learners. Examples include the testing of antimicrobial activity of plants, safety and toxicity of plant extracts, food security and food cultivation, plants used in the beverage and cosmetic industries, as well as its use in ethno-veterinary sciences. Such a focus in the STEM and TVET classroom could contribute to the erosion of the staggering high unemployment figures in African countries.

Speight Vaughn and Mdakane (2019) flag the importance of research ethics, and ensuring that indigenous knowledge of cultural groups is not exploited. When indigenous knowledge finds commercial applications, it is important to firstly acknowledge the intellectual property rights of the holders of the knowledge, but also to ensure that there is benefit sharing. I would like to illustrate this with an example of San indigenous knowledge. San peoples are amongst the oldest communities in South Africa. Historically, the San were hunters in dry areas in South Africa, such as the Karoo and Kalahari. Traditionally, *Hoodia gordonii* was

used to sustain them on their hunting journeys. Apart from providing much needed water, the plant is also known to suppress hunger. The South African government secured the patent for the commercial use of *Hoodia* as a dietary medicine (fighting obesity). Speight Vaughn and Mdakane (2019:322) state that "social and political shifts that recognize indigenous knowledge as national and academic assets may not be sufficient in stemming ontological violence against historically oppressed groups of people". It is of utmost importance that ethical issues regarding the commercialization of indigenous knowledge is also discussed in the classroom. Andries Steenkamp, a respected leader in the San community, once commented "come through the door, not the window", as a metaphor to describe research ethics when it comes to indigenous knowledge (Speight Vaughn and Mdakane, 2019:319). Apart from a focus on the career- and entrepreneurial opportunities that indigenous knowledge unlocks, educators should also focus on ethical aspects related to indigenous knowledge.

What does research on indigenous knowledge border-crossing in the science classroom tell us?

During the past two decades, several researchers have worked on epistemological border-crossing in the STEM classroom, and the affordances of indigenous knowledge. Herewith some research insights in terms of the infusion of indigenous knowledge in the STEM classroom.

1.1. Indigenous knowledge perspectives in STEM curriculum themes accentuates the connection between science and the (local and global) community, and address issues of social responsibility, justice and sustainability (Rankoana, 2007; Speight Vaughn & De Beer, 2020). It holds affordances to address the affective domain (De Beer & Whitlock, 2009).

1.2. Many scholars advocating for the inclusion of indigenous knowledge in the STEM curriculum, justify such epistemological border-crossing from an embodied, situated and distributed cognition (ESDC) perspective. An ESDC framework posits that cognition is not limited to the processing of internal information, but embedded physiologically in action, situated in the sociocultural world and distributed among agents and artefacts (Hardy-Vallee & Payette, 2008). ESDC approaches provide multimodal learning experiences, which can support conceptual development, and provide students with more nuanced understandings of STEM fields (Chahine, 2013).

1.3. Indigenous knowledge can be effectively introduced in STEM curriculum themes utilizing problem-based learning approaches (Petersen et al., 2019; De Beer, 2019). Examples include engaging students in antimicrobial testing of medicinal plants, the saponification process during the making of soap, or traditional brewing practices. De Beer and Mentz (2016) claim that the holders of indigenous knowledge are mostly self-directed learners who attempt to solve authentic problems in their communities, and indigenous knowledge systems are therefore best introduced in utilizing problem-based and self-directed learning principles. This holds potential to provide students with better understanding of the tenets of science (the syntactical nature of natural sciences).

1.4. STEM teachers generally show a lack of nuanced understanding of indigenous knowledge and its affordances in the classroom (De Beer & Dudu, 2021; Petersen, Golightly & Dudu, 2019; Sebotsa, 2020). Researchers such as Abd-El-Khalick, Bell and Lederman (1998) and Petersen et al (2019) have shown that the views that teachers hold of science (and in this context, indigenous knowledge), influence their selection of pedagogies/ their pedagogical orientations. If teachers do not view indigenous knowledge as having an empirical basis, little inquiry learning is likely to take place in the classroom (De Beer, 2019a). For this reason, there should be a strong focus on indigenous knowledge in both pre- and in-service teacher education.

1.5. Indigenous knowledge provides a good platform for learners to explore the tenets of the natural sciences. In the next paragraph, I will provide a specific example stemming from my research in the Northern Cape in South Africa, amongst Khoisan indigenous knowledge holders.

Nascent research on the Rationality Index of Plant Use (RIPU) and exploring the tenets of science, indigenous knowledge and pseudoscience

De Beer (2020) developed an instrument, the Rationality Index of Plant Use (RIPU) heuristic, that could be used to assess the rationality of a particular plant use. (This could of course also be used with ethnozoology examples of animal use, or even commercial medicines). Most indigenous knowledge systems also have metaphysical ("magic") plant uses, where the particular plant use is questionable. The RIPU consists of a set of questions (see the left-hand column in Table 1), that would result in an overall statistical measure (index) of the rationality of a specific use for a given plant (whether it is medicinal or magical use). The RIPU is limited to plant uses that have a biological and pharmacological basis. Symbolic and ritual uses are excluded, although these uses often make rational sense, but there is no chemical basis to assess the plant use. A score of 0 – 0.3 would mean that such plant use is totally irrational, and that it should be rejected based on a lack of evidence or plausible hypotheses. (This could of course be revisited later based on new evidence). An index score of between 0.4 and 0.7 indicates that further investigation and evaluation (e.g., phytopharmacological analysis) is needed. A score between 0.8 and 1.0 indicates that such plant use is highly rational, based on a solid base of research publications and phytopharmacological studies.

The RIPU instrument also holds affordances for the STEM classroom, as it could scaffold students' learning about the tenets of science, indigenous knowledge and pseudoscience. De Beer and Van Wyk (2021) show that the RIPU tool could be used in a problem-based and cooperative learning activity, where students engage with scientific literature to find support for a hypothesis, or to nullify it. During such a learning activity, students will work in small cooperative learning groups of four or five, and they will engage with scientific literature (peer reviewed journals) in finding evidence for efficacy of plant-, animal or commercial medicine use. It is important that such learning should comply with the elements of cooperative learning identified by Johnson and Johnson (1999), namely positive interdependence, individual accountability, face-to-face promotive interaction, social skill development, and group processing.

In Table 1 it is shown how students would answer each of the questions in the RIPU instrument, based on engagement with scientific journals, and how they would allocate a score to each item (right-hand column). A total of 28 out of a possible score of 30 is converted to an index value of 0.93, and this shows that the medicinal use of *Agathosma betulina* is very rational, as there is scientific evidence supporting its use.

Table 1: Determining the Rationality Index of Plant Use of *Agathosma betulina*

Item in the RIPU questionnaire	**Discussion: measuring the plant use against the criterium**	**Score**
1.1. **How many original anecdotes have been published?** * None = 0 * One or two only = 1 * Three to ten = 2	Buchu is part of Khoisan indigenous knowledge, and can be considered as a cultural keystone species. The San mixed buchu with animal fat, and rubbed it on their bodies, for both cosmetic and protection reasons (Forbes, 1986; Van Wyk, Van Oudtshoorn & Gericke, 2013; Moolla et al., 2007). Recorded medical uses include stomach problems	4

* Eleven to twenty = 3 * More than twenty-one = 4	(Dykman, 1891; Moolla, 2006), as a substance to clean wounds (mixed with vinegar) (Van Wyk, Van Oudtshoorn & Gericke), for treating kidney and urinary tract diseases (Bruneton, 1995; Rafsanjany et al., 2013), rheumatism, and for external application on wounds and bruises (Watt & Breyer-Brandwijk, 1962). Moolla et al. (2007) and Simpson (1998) also list uses such as treating fevers, colds, flu, and as antibacterial and antifungal agent, insect repellent, deodorant, and as a tonic to promote general well-being. Watt and Breyer-Brandwijk (1962) and Moolla (2005) also list its use in treating cholera. De Beer & Van Wyk (2011a) reported on its use for treating ulcers. In a recent book, Huisamen (2019) showed that the plants hold anti-ageing, anti-diabetic and anti-obesity properties. The latter author also claims anti-hypertensive and cardioprotective effects of *Agathosma*. Tabassum and Ahmad (2011) also refer to the plant's use in the treatment of hypertension. Famewo et al. (2017) indicate that the plant holds potential as an anti-mycobacterial agent, in the fight against tuberculosis.	
1.2. **Were these anecdotes published in accredited, peer-reviewed publications?** * No, it was published in grey/ low impact journals = 1 * Yes, it was published in respected peer-reviewed publications = 2	The plant's uses and chemistry are described in high-quality publications, e.g., Van Wyk et al. (2013) 'Medicinal Plants of South Africa', Van Wyk & Wink's 'Phytomedicines, herbal drugs and plant poisons' (2015), and in accredited journals such as the South African Journal of Botany. There are also post-graduate theses that studied *Agathosma*, e.g., that by Moolla (University of the Witwatersrand).	2
1.3. **How many unpublished anecdotes have been recorded?** * One to ten = 1 * Eleven to twenty = 2 * More than twenty-one = 3	In all probability, many. De Beer and Van Wyk, for example, have recorded anecdotes during their 2009 – 2011 ethnobotanical survey of the Agter-Hantam, in Middelpos, that has not been published as yet.	3
2. **Is there a workable (plausible) hypothesis for the plant's use(s)?** * No = 0 *It is possible to speculate on the merit of the plant use = 1 * The hypothesis is unpublished (or published in grey literature) = 2 * The hypothesis is published in low-impact journals = 3 * The hypothesis is published in high-quality journals, but there are still unanswered questions = 4	Buchu was traditionally used as a tonic. The hypothesis that polyphenolics, that could act as anti-oxidants, and provide a feeling of wellness, has been investigated by Moolla (2005). Moolla et al. (2007) also tested the hypothesis that the active ingredients (such as phenolic substances) in *Agathosma* have antimicrobial properties, that could be effective against pathogens. Huisamen (2019) tested the hypothesis that buchu extracts could enhance the uptake and metabolism of glucose, and that it could hold anti-diabetic properties. This is also supported by the work of Paddy et al. (2015). Li & Wenqin (2018) hypothesized that the plant might hold potential as an anti-acne cream. Rafsanjany et al. (2013) hypothesized that plant extracts might be effective against urinary tract infections due to its anti-adhesive effects against the	5

* Confirmed hypothesis, published in high-quality journals = 5	binding of uropathogenic *Escherichia coli* on bladder cell surface.	
3. **Chemical evidence** * The chemistry is unknown = 0 * Little is known on its chemistry = 1 * The chemistry is known, but irrelevant to its use = 1 * The chemistry is known, and is related to its use = 3 * The chemistry is very well recorded, and clearly linked to its specific use; there is no doubt on its effectiveness = 5	The major active ingredients in the essential oils of the plant are isomenthone and diosphenol (Kaiser, Lamparsky & Schudel, 1971; Posthumus & Van Beek, 1996; Van Wyk, Van Oudtshoorn & Gericke, 2013). Many other researchers have worked on the chemical analysis of the essential oils and non-volatile fractions of *Agathosma*, such as Fluck et al. (1961), Lamparsky and Schudel (1971), and Moolla, Van Vuuren, Van Zyl and Viljoen (2007). Coumarins are phenolic substances that were found to have antimicrobial properties, and that can stimulate macrophages, to eliminate infection (Cowan, 1999; Moolla et al., 2007). Huisamen (2019) studied the anti-diabetic properties of buchu.	5
4. ***In-vitro* evidence for the plant use (pre-clinical tests)** * No *in-vitro* tests have been done = 0 * Little or doubtful *in-vitro* testing was done = 1 * Some *in-vitro* testing supports the specific plant use = 2 * Extensive *in-vitro* testing has been done, with varied results, or results indicating limited effectiveness = 3 * There is good evidence of rigorous *in-vitro* testing that supports the plant use = 5	The toxicity profile of non-volatile compounds and essential oils were tested on human kidney epithelium, by using a microculture tetrazolium cellular viability assay (Moolla, 2005). Moolla et al. (2007) have found buchu extracts to be active against four pathogens (*Staphylococcus aureus*, *Bacillus cereus*, *Klebsiella pneumoniae* and *Candida albicans*). Moolla et al. (2007) have determined the toxicity of the plant using the MTT assay, and found the plant extracts not toxic at concentrations up to 100 µg/ml. The latter authors further tested the influence of seven alkaloids (including skimmianine) against the A2780 human ovarian cancer cell line, and it was shown it had weak cytotoxic activity (Moolla et al., 2007:591). *In-vitro* studies on human blood cells showed that buchu extracts enhance the uptake and metabolism of glucose (Huisamen, 2019). Rafsanjany et al. (2013) did *in-vitro* work on the plant's ability to prevent urinary tract infections. Famewo et al. (2017) did *in-vitro* work on the plant's anti-mycobacterial ability and potential use to treat tuberculosis. Geetha et al. (2012) screened the plant against various bacteria, and also showed its potential use in treating urinary tract diseases.	5
5. ***In-vivo* evidence for the plant use** * No *in-vivo* testing has been done = 0 * Some evidence of *in-vivo* testing in animals = 1 * Good evidence of *in-vivo* testing in animals = 2 * Some evidence of *in-vivo* testing in humans = 3 * Sufficient evidence of *in-vivo* testing in humans, with either	In contrast to *Lessertia frutescens*, far less *in-vivo* work has been done on *Agathosma* (especially in humans). Huisamen (2019) engaged in *in-vivo* work, to investigate the potential of buchu extracts as an anti-diabetic substance. Wistar rats were used in the experiment, and the result showed that *Agathosma* could be effective in alleviating pre-type 1 diabetes. Huisamen (2019:50) cautions however that it must still be tested to determine its efficacy in humans. Lis-Balchin, Hart & Simpson (2001) studied the pharmacological action on guinea-pig ileum and antimicrobial activity on microorganisms.	4

mixed results, or indicating limited effectiveness = 4 * Very good evidence of *in-vivo* testing in humans, indicating the efficacy of the plant use = 6		
Total score	A score of 28/30, thus is the **RIPU 0.93**	28

From: De Beer, 2020, pp 98-101.

The use of *Agathosma betulina* for medicinal reasons is highly rational, based on plausible hypotheses that were tested *in-vitro* and *in-vivo*. This activity in the science classroom could assist students to become more scientific literate citizens and critical consumers (De Beer & Van Wyk, 2021). By engaging in the RIPU activity, students (a) realize that scientific findings are communicated in high-quality peer-reviewed journals; (b) they have to use scientific findings to accept or nullify hypotheses; (c) and in the process they develop more nuanced understandings of the nature of science, and how it differs from pseudoscience. In the current Covid-19 context, and clinical tests on vaccines, students will also develop more nuanced understandings of the *in-vitro* and *in-vivo* work done on potential medicines.

Recommendations and conclusion

Despite the fact that indigenous knowledge systems sustain millions of people economically, socially and spiritually, it is often marginalized in the STEM classroom. Odora Hoppers (2004) called this exclusion of indigenous knowledge in the STEM curriculum "knowledge apartheid". The epistemological border-crossing in the STEM classroom, where indigenous knowledge is infused in 'western' curriculum themes, hold affordances to address affective learning outcomes, conceptual development, more nuanced understandings of the tenets of science, and developing awareness of the career and entrepreneurial opportunities stemming from indigenous knowledge. However, research shows that many teachers are not adequately trained in such border-crossing, and that "lip-service" is often paid to indigenous knowledge in the classroom (De Beer, 2019a). The incorporation of indigenous knowledge in the STEM and TVET curriculum should also address the syntactical nature of the STEM field. This asks for nuanced teacher understanding of the tenets of science and the tenets of indigenous knowledge, as such knowledge would influence the pedagogical choices that the teacher makes. It is therefore important that the tenets of respectively science and indigenous knowledge should receive adequate attention in both pre- and in-service teacher education programmes. Researchers such as De Beer (2019a), Mentz & De Beer (2019) and Petersen at al. (2019) have shown that short learning programmes for teachers are most often effective in developing capacity to engage in such border-crossing. However, these researchers also highlight the so-called "wash-out" effect (Zeichner & Tabachnick, 1981), where in-service teachers, after such professional development opportunities, return to their old practices in their classrooms, and there is often little evidence of transfer of newly acquired knowledge and skills to the post-intervention classroom. De Beer (2019 a,b) shows that systemic pressures, e.g., the focus on preparing students for summative assessment opportunities, and the full STEM curriculum, are often reasons why teachers- trained in border-crossing- still marginalize indigenous knowledge in their teaching.

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EMERGING TRENDS IN STEM AND TVET IN 21ST CENTURY
BY

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Protocol

Introduction

I had a chat some couple of years ago as I stood before the counter curiously waiting to be paid by a bank cashier and I asked the young man what he studied in the university. He replied "Chemical Engineering" and I didn't know when I shouted amazingly at him: what are you doing here? A trained and qualified chemical Engineer turned to be a bank cashier. The training he acquired in chemical engineering has been integrated into the banking industry. Skill pliability and integration have become a global trend in this 21st century.

Benneth and O'Neale (1998) wrote:

> An Engineer needs a well-developed understanding of the various science disciplines, mathematics and technology to support and provide context for their engineering designs and applications. A chemist is likely to self-identify as a chemist but will often need an in-depth understanding of other science disciplines, technology and mathematics to proper perform their duties P.5

The occupational boarders have been broken in the 21st century. The society's need for labour force, which produces knowledge and makes innovations, has resulted in a transformation in education. With the latest industrial and technological innovations and development, societies have been in a new quest to be able to cope with the global development, to compete within the economic and technological arena, and as consequence of these quests, it has been realized that education is of great importance in the success of the societies sustainable development (Nilay, Nurdan & Havva, 2018). In fact, education is now expected to provide hard and soft skill to learners to form competent human resources as they can compete internationally (Milaturrahmah, mardiyana, & Pramudya, 2017). Education needed in the 21st century is the one that is able to provide the students learning experiences such that the learners have the ability to solve problems, think deeply, manage projects and use various tools of technology and information.

One of the main objectives of the 21st century education, which raises individuals that society needs, should be to resource qualified labour force that will provide the development of the society by maintaining the economic, social, scientific and technical demands. In order for a country to be able to reach this goal, it has to design its curriculum by which the individuals and society's social, economic, cultural and global requirements can be met and in such a manner that the individual can cope with the local and global changes and advances (Nilay, Nurdan & Havva, 2018)

In this regards, many countries which like to develop technologically and have an advanced economy have adopted the educational strategy that paves the way to build a society that acquires better technical skills, competence and knowledge which can be considered as essential 21st century skills for lifelong learning. An education considered critical is one that removes the boarders between the disciplines by making the students to comprehend the world as a whole rather than in parts (Lantz, 2009). An educational initiative is needed that can provide all students with critical thinking skills that would make them creative problem solvers and ultimately more marketable in the work force, hence making a shift in professional boundaries (Florida Association of Teacher Educators, 2014).

STEM:

What is STEM? It is an acronym that stands for: Science, Technology, Engineering and Mathematics. These are defined as:

Science: the systematic study of the nature and behavior of the material and physical universe based on observation, experiment, measurement, and the formulation of laws to describe the facts on general terms. (Science, 2012).

Technology: The branch of knowledge that deals with the creation and the use of technical terms and their interactions with life, society and the environment drawing upon subjects such as Industrial arts, engineering, applied science and pure science (Technology, 2012).
Engineering: The art or science of making practical application of the knowledge of pure science as physics or chemistry as in the construction of engines, bridges, buildings, mines, ships and chemical plants (Engineering, 2012)
Mathematics: a group of related sciences including algebra, geometry and calculus, concerned with the study of numbers, quantity, shape and space, and their interrelationship by using a specialized notation (Mathematics, 2012)

STEM has been defined as an interdisciplinary approach to learning where rigorous academic concepts are **coupled** with real world lessons (Dixon & Hutton, 2016) as students apply science, technology, engineering, and mathematics in context that make connections between school, community, work, and the global enterprise-enabling the development of STEM literacy, and with it the ability to compete in the new economy (Tsupros, Kohler & Hallinen, 2009).

It emphasizes an ability to apply understanding of how the world works within and across the four inter-related domains of science, technology, engineering and mathematics (Toulmin & Megham 2007). The pursuit of STEM is to discover the relationship of disciplines and establish the fact that they all inter-relate and indeed should not sharply isolate each other. The purpose of STEM is to prepare the learners for jobs and possibly to compete with others from different parts of the world.

STEM blends the four subjects in order to teach 21st century skills that will enable individuals succeed in the workforce. It uses interdisciplinary and applied approach to deliver its contents. The students need to learn and be able to solve problems, find and use evidences, collaborate on projects and develop critical thinking. They are empowered by STEM to use and apply their creativity, knowledge and critical thinking skills.

STEM is the purposeful integration of various disciplines used to solving real-world problems (Labor, Reid & Yamamoto, 2009). It is an interdisciplinary skill that overlaps concepts and processes. Wang, Moore, Roehrig & Park (2011) explained that multi-disciplinary integration requires students to connect components from different subjects taught in different classes at different times, where inter-disciplinary integration can begin with real-world problems. STEM is a paradigm, a model, a pattern and a template of the 21st century. It creates interdisciplinary learning and provides the achievement in science, Technology, Engineering and mathematics. STEM major objective is integration of subjects and invariably occupations.

TVET

What is TVET? It is an acronym that stands for: Technical, Vocational, Education and Training. They are defined as:
Technical: Subject matters that are technical in nature, relating to hard ware and software including trouble shooting practices and engineering processes, skills that lead to the protection of physical components and facilities.
Vocational: Occupations or an employment often referring to as hands-on skills within professional trades
Education: Formal education starting from primary schools and including post-secondary education such as colleges, polytechnics and universities.
Training: Informal education, also called lifelong learning or continuing education often used in initiatives of reskilling or up skilling company staff or a wider workforce.

According to the definition by UNESCO and the International labour organization (ILO), TVET refers to "aspect of the educational process involving, in addition to general education, the study of technologies and related science, and the acquisition of practical skills, altitudes, understanding and knowledge relating to

occupants in various sectors of economic and social life" (UNESCO & ILO, 2001). In addition to technical knowledge and aptitude, increasing emphasis is on 'softer' skill such as communication, negotiation and teamwork. TVET is dispensed in public and private educational establishments or other forms of formal or informal instruction aimed at granting all segments of the society access to life-long learning resources. In many developing countries, the primary goal of TVET is to prepare youths for the work-force, making it a primary part of educational agenda (Dixon and Hutton, 2016).

Recent trends in developed countries that use TVET have seen it becoming integrated in the educational system. These educational initiatives constitute responses to the global technological revolution, which demands higher levels of education and technological skills for the 21st century (Fawcett, EL Sawi & Allison, 2014). TVET facilitates economic growth by increasing the productivity of workers and the returns from increased output, far exceed the cost of training direct or indirect, leading to economic growth (Hoeckel, 2008). TVET also facilitates social-economic development by enhancing the capacity of individuals to adopt practices that are socially worthwhile (McGrath, 2011).

In essence, TVET stands for education and training that is technical in nature and it aims at providing skills for a person related to a profession, in order for the individual to get a job and be able to provide a livelihood. TVET professionals and practitioners include among others: electricians, plumbers, building workers, heavy equipment operators, telecom technicians, automotive service personals, aviation maintenance technicians, machine operators, mechatronics and automation experts, industrial maintenance technicians and various technical workers in industry. The list is endless. The TVET is also an important tool in the hand of government to reduce the rate of unemployment, to provide workforce to private and public sectors and attract foreign investors.

The inclusiveness of TVET is unique and distinguishes it from other types of education; it takes individuals into account by providing all kinds of skills (or jobs) possible and available in the society. It recognizes an individual as a credible and useful member of the society, contributing to the growth and development of the society in which he or she dwells. It recognizes both hard and soft skills as equal in building up a civilized society. It encourages individuals to place values on any skills that is available and holds the equality of all vocations or occupations. Dignity in labour is fundamental to TVET ideology and emphasis is on the use of the heart, the head, and the hand.

TVET aims to developing the broad range of personal capabilities that characterize an educated man and provides a broad based knowledge to ensure critic-creative thinking as well as develop capacities for effective communication and inter personal relations.

The 21st century

The 21st century is the first century of the 3rd millennium. It began on January 1, 2001 and will end on December 31, 2100. It is the first century of the 3rd millennium (Definitions 21st century, 2021) Nobody knows for certain what the century holds for humanity. However, through science and research man can predict the outcomes of the future. Already, inquisitive researchers are forcasting, speculating and imagining what the future will be. The century has ushered in a whole new digital world, the computer world and it has turned the world or humanity around. The previous centuries of humanity and ancient world will be amazed at what 21st century is offering to man.

In this century, there has been the rise of a global economy and third world consumerism which has implications for STEM and TVET. There is also a deepening global concerns over terrorisms: terrorist attacks spreading over the globe, after the September 11, 2011 attack on United State of America. There is as never before, increase in evils, wickedness, killings, kidnappings, rapes, theft, ritual killings, cultism, witchcrafts, violence, protests embezzlements, the list is endless. Further, in this century there is an increase

in private enterprises, entrepreneurship ventures, collapse of occupational and trade boundaries, unemployment rates, economic contraction, inflation and industrial collapse. All these have implications for TVET and STEM especially in the world of work.

More visibly, there has been an increase in technological innovations, in particular information, communication and technology (ICT) and is developing with astronomical speed. There will be more and more development and innovations in this, and other sectors. Effort must be made to foster deeper learning in STEM and TVET through the purposeful integration of rigorous academic content with experiences (Sarn, colon & Brad, 2019) that internationally and automatically cultivate the skills, mindset and literacies needed for students to become lifelong learners and contributors in our ever changing world.

The 21st century will demand an education, STEM and TVET, that will give students the skills, knowledge and competence they need to succeed in this new world and helping them to grow the confidence to practice the skills with so much information readily available to them. The knowledge society of the 21st century, dominated by ICT and where labour market demands, are constantly changing, providing STEM and TVET programmes as central to the efforts towards sustainable developments.

Emerging Trends in STEM

Emerging is a word described as becoming suddenly important or newly formed (Turnbull, 2010) and to emerge is to come to view, to come out of a situation, and to become known or to come forth. Also, trend is an inclination in a particular direction, to tend or stretch in a particular direction.

Emerging trends in STEM or TVET connotes what in the coming years, will be the focus or their driving force or the path they would be following to ensure their objectives are met. In future, what STEM and TVET will be pursuing and what will be the expected challenges; what will be the general direction; and the inclination of their development and goals. In fact, what will trail their future is the emerging trends.

It can be difficult to forecast the emerging trends and influences in STEM due to the rapidly changing nature of the technologies (Raupp, 2017) that form STEM pedagogy. Science and technology regulate the STEM advances, acceleration and development. There is a shift towards recognizing the power and importance of scientific innovation as we look towards solution to the multiple challenges of our modern times. Some of the emerging trends are listed below:

1. **Greater trends in Advanced courses in science and mathematics.**
   This is a trend that seems like it will only increase as educators and administrators continue to invest in a mindset that values the power of prepared educators and priorities, meaningful rich opportunities for students into engaging in STEM and the real world (Raupp, 2017). We can light the way towards global solutions through the provisions of STEM.

2. **Future workforce engineered by STEM**.
   Workforce of tomorrow is prepared today by STEM. Careers and technical pathways in future are aligned with STEM education. Private, public and non-profits sectors are discussing strategies for building a strong STEM workforce that can fit into the future of the 21st century.

3. **Engaged and networking practices communities of practice.**
   There is a probability of having networking practices among individuals, groups and communities to extract STEM benefits. STEM networking activities will boost and grow the program and its capabilities to ensure the desired popularity and practice.

4. **Continued strain in the system.**
   Due to low pay and a strong denial of a consistent salary, public school teachers quit their jobs for a greener pasture. Educational system will continue to be strained, people getting in and out of the system. There could be acute shortage of qualified teachers.

5. **Increased access to free or low-cost collaborative technology.**
   This will make for more dynamic and group-driven classroom work. It will better prepare students for the experiences of working together for a more common goal. A team work for technological solution will thrive.

6. **Silicon Valley technocrat's influence on STEM education.**
   Silicon Valley technocrat will continue to exercise a major influence on STEM. Companies such as Googles will continue to positively grow their employment pipeline. And, individual services or their products will continue to become less important rather they will be more committed to digital literacy and self-directed learning.

7. **Educational experiences that include inter-disciplinary approaches to solving grand challenges.**
   STEM education produces educational experiences that are inter-disciplinary in approach to solving and overcoming challenges. Thus, learning that generates critical thinking approach shall be promoted.

8. **Increase in the learning spaces.**
   It is expected that there will be an increase in the learning horizon. Flexible and inclusive learning spaces will develop and will be supported by innovative technologies. Knowledge through STEM will increase astronomically.

9. **Improved perception of teaching.**
   Many places especially in Africa, the perception of people towards teaching is poor. But with STEM, there shall be an improved perception towards teaching. STEM brings many subjects together and presents knowledge of them to harvest their potentials

10. **Schools will be seen as places where students and teachers thrive.**
    STEM education will emphasize deep understanding in the knowledge of its four subjects – science, technology, engineering and mathematics. The students and their teachers will be aspiring to know better, thus teaching and learning will improve.

11. **Schools Investing in multi – use maker space.**
    It is predicted that schools will begin to invest in multi spaces. That is, students can engage in hands – on problem solving through experimentation, robotics, coding and low-tech group activities. And, such activity models the experience of solving engineering problems in the real world.

Emerging Trends in TVET

Technology is developing and changing fast every day. We can hardly predict with precision the trends in TVET. However, some emerging trends in TVET are listed below:

1. **Cross-Disciplinary Technology Integration**
   There could be cross-disciplinary technology integration which aims at integration of Innovations based on human needs. In terms of industrial development, individual technologies cannot satisfy needs that are more and more strongly connected to social and human aspirations.
2. **Sustainable Development**
   TVET takes on a complex and distinctive character with respect to sustainable Development. It constantly includes elements of sustainability especially in conserving scarce training materials and waste materials disposal.
3. **Global Economy Workforce**
   TVET has the capacity for lifelong learning. It provides useful skills for life. Some of its approaches and strategies include adaptability, presentation of practical skill, communication, working collaboratively and awareness at global issues.
4. **Facilitation of Learning**
   There will be the facilitation of learning through many facilities. Educators should be transformed from those who impart knowledge to those who facilitate learning. Curriculum will be transformed from the mechanism to deliver facts to mechanism to promote and facilitate learning and thinking.
5. **Internet Influence**
   The influence of the blossom development of the internet on the future global economy grows deeper every day. The Network creates unlimited business opportunities. The explosive growth on the quality and quantity of information available will become more urgent issues, continuously and shaking up real-world behavior pattern.
6. **TVET is a Master Key**
   Director-General of UNESCO writes that TVET must be a master key that can alleviate poverty, promote peace, conserve the environment, improve the quality of life for all and help to achieve sustainable development. The trend here is that as TVET is reoriented, it will make notable contribution in the world's pursuit for sustainability development.
7. **Change in Population structure**
   Aging and migration bring change in labour force. Increase in average life span and declining birth rates are creating aging societies. TVET curriculum is inclusive in nature and can provide for both the aged and the young.
8. **Economy Globalization**
   The change in the global value chain requires new thinking. Economic Globalization is obviously another trend. Talent, capital and knowledge will continue to flow around the world faster and faster, and the influence of international organizations and multinational corporations will continue to increase. These have effects on TVET.

9. Natural Resource Usage Efficiency

In the next 10years, resources such as water, oil and food will continue to have different degrees of influence. Efforts will continue to be made to reasonably utilize water resources, successfully develop alternative energy sources, stabilize food supplies as these contribute to economic growth. The natural resources will impact on the economy which invariable will boost the growth of TVET.

10. Capacity Building in TVET

Skills such as cognitive, interpersonal, attitudes, values, work habits and enterprise, innovation and creativity are very much embedded in capacity building in TVET. Possession of Generic skills has become a pre-requisite in new work places. To augment and enhance learning outcome in TVET, Higher order thinking Skills (HOTS) are introduced to advance critical thinking, and analysis and problem solving.

11. Technical Competence of TVET Practitioners

Technically competent practitioners are of great importance due to future technological development of the 21st century. Innovation, creativity, knowledge-based, higher order thinking skills and foundation life skills will continue to trail this century, as well as TVET.

12. Reorientation of TVET Curriculum

Our curriculum needs to be reoriented towards sustainability. The principles of 6Rs-Reduce, Reuse, Renew, Recycle, Repair and Rethink – should be maintained. Employable skills and informed sector skills are largely considered to advance poverty reduction mechanism and create gainful opportunities particularly in unorganized sectors.

13. Innovation Technological Workforce

The workforce will be workers relying on digital tools, creativity, and in an ability to work collaboratively with people from all over the world.

STEM INTERWINED WITH TVET

TVET experts have recognized that the technological trades rely on the knowledge embedded traditionally in science, technology, engineering and mathematics (STEM) disciplines. It is STEM that drives TVET. Science and mathematics in particular are the knowledge base of the practice of TVET.

Science and mathematics are among the two subjects that form the acronym of STEM and they are rooted in making STEM education a program of educational pedagogy. They are basic in technology and engineering disciplines. The same applies to TVET. Science and mathematics are required for one to follow the pathway of TVET. Therefore, STEM and TVET are intertwined. STEM lays the foundational knowledge for TVET and teaches the underlying principles of its practice. It is speculated that occupations related to STEM and TVET will add millions of jobs or more in near future.

Conclusion

In this 21st century, emerging trends in STEM and TVET will continue to evolve as the world continues to experience changes in education, science, climate and environment, politics and governance, health and man. The predictions about the changes can only have root from research and intelligence quest. The onus is on man to wait, watch and research on the evolution of nature.

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The Ark of Salvatıon, Implementıntıng Model for Stem Educatıon

Islam Alhag Abdou

Introduction

In this age, I think the world needs an ark for salvation; natural disasters, starvation in many countries, no peace in others, weak justice among people, low level of religious and ethical values, and materialism is dominant. It is the biggest challenge on this earth. We see few highest economic and military countries while the majority are suffering from the absence of security, justice, or the basic needs of a good life. Rich minority countries are in competition to produce high-tech devices, weapons, medicine, or to have the

patenting DNA or RNA for creating new forms of life. Harm or benefit doesn't matter for some!. And the majority is still paying for weapons, food, medicine, or asking for infrastructure, aid, and support!It means that the required salvation ark must include values, science, technology, engineering, art, and mathematics (VSTEAM) for acheiving the balance in this universe. Allah/ God sent prophets and messengers in order to guide mankind to the path of goodness and warning from punishment. And human must follow the pure religious instructions included at the original holly books; Bible, Torah, and Quran to spread goodness and stop doing harm on the earth. These books have common views of the main events related to the story of the prophet Noah and his people.

So this introduction includes some main ideas; the importance of the stories in Quran; the main features of the story of Noah and his Ark, the nature of VSTEAM education and the last part is the research questions.

Functions of the Story in Quran:
In Quran, stories have certain goals; some of these goals can be found in the Quran itself such as in chapter/ Surah No.12, verse 111:

"In their stories there is truly a lesson for people of reason. This message cannot be a fabrication, rather it is a confirmation of previous revelation, a detailed explanation of all things, a guide, and a mercy for people of faith"

The relating of stories is one of the key ways in which the Qur'an seeks to further the spiritual development of Muslims. The stories of the Qur'an are historically true, providing us with a summary of the experiences of past nations and peoples. We learn about how they lived, what they did, and what reward they received from Allah for their actions. We learn not just about Prophets and righteous people, but also about polytheists and evildoers, as well as about the consequences of their actions. In short, the Qur'an's stories teach us about certain universal laws that govern the fate of nations and peoples. So, for instance, if we, as a nation, want to avoid the fate that befell nations of the past, we must avoid committing the same mistakes that they made.

The Noble Qur'an provides us with vivid descriptions of the lives of various historical individuals and peoples. It is up to us, then, to contemplate their lives and to benefit from the myriad of lessons that their stories contain. We should emulate those historical figures who strove patiently to uphold the truth and who, in spite of the hardships they temporarily endured, achieved ultimate success: Forgiveness from Allah and Paradise. Conversely, we should avoid imitating those who turned away from Allah; and consequently were made to suffer miserable lives, and, what is worse, were doomed to an eternity in the Hellfire.

And the following are the main features of the superiority, magnificence and aims of the Qur'an's stories:

Their divine source,
Their exact correspondence with what actually took place historically,
Mentioning the key parts of stories,
Telling the same story in a variety of ways, for achieving different targets,
To establish the monotheism/ oneness of Allah, and to order human beings to worship Allah Alone,
Confirming the truthfulness of the prophet's mission,
Establishing the reality of resurrection after death,
Strengthening the faith and resolve of the prophet and of true believers,
Teaching Muslims important lessons about Prophets and about the people to whom they were sent,
Pointing out the end destinations of the people of past nations,
Providing spiritual development for believers: such issues are given life when we hear about them being applied by righteous people from the past. Thus we are encouraged to improve as Muslims when

we hear about the strong faith of Ibrahim the patience of Yusuf, the determination of Moses, the consistency and steadfastness of Noah, and so on.
Promoting justice and righteousness in society, and forbidding the spread of corruption and evildoing.
Reminding Muslims about their eternal Struggle against their most despised and dangerous of foes: Shaitaan (the Devil)
Helping Muslims overcome hopelessness and depression.
Pointing out Allah's ability to make miracles occur.
Pointing out the favors with which Allah blessed Prophets and Others Among His Righteous Servants (Ibn Katheer, (ND); Kemas Abdul Hai (2017); Maḥmūd Al Dosary, 2019; Salah Al-Khalidy,1998)

Through the following text, I will present the key ideas of the story of Noah and his Ark. The religious books in Christianity, Jewish, and Islam have common views of certain events; with no comparison I am focusing through this text on these general sides. (Farjana Sultana Chowdhury 2016; Michael L. Rodkinson 1918; Salah Al-Khalidy 1998; Carlos A. Segovia 2015, Ibn Katheer, (ND);)

The story of the prophet "Noah" in the Quran[1] is clear and tells us about the main reasons and justification for building the Ark of salvation; The prophet Noah calls his family and people to worship the only one God/ Allah and avoid worshiping others… but some of them believed in him and follow the righteous bath and others refused denied … He did all his best warning and guiding them to return back to the bath of goodness. But no way had Allah punished them by sinking during the flood, where no mountain would be seen to save his son. The Qur'anic verses in chapter
71/ Surah of Noah verses (1:28) and in Surah 'Hud" clearly describe the events and depict the nature of disbelievers, the nature that the call to God did not increase except to flee from Him, and which elicits all means of blocking and opposing this call. They deafened their ears with their fingers, covered themselves by their clothes, and their insistence and arrogance was complete. And since these people who filled the earth at that time were in this manner of belief, God sent a messenger from among themselves, Noah peace be upon him, to warn them before a painful punishment comes.

In Quran[2] chapter/ Surah Nuh/Noah (71. 1,2) "Verily, We sent Nuh (Noah) to his people (Saying): "Warn your people before there comes to them a painful torment."1, "He said: "O my people! Verily, I am a plain warner to you"2.

Therefore, Noah began to build the Ark by collecting the required and available materials;

In chapter/Sorah Hud / 11. 36: 38 "And it was inspired to (Noah): none of your people will believe except those who have believed already. So be not sad because of what they used to do 36. "And construct the ship under Our Eyes and with Our Inspiration, and address Me not on behalf of those who did wrong; they are surely to be drowned" 37. And as he was constructing the ship, whenever the chiefs of his people passed by him, they made a mockery of him. He said: "If you mock at us, so do we mock at you likewise for your mocking" 38. Sorah Hud (36: 38) Naoh built the Ark and collect all believers and all geneses of organisms on the ship/Ark: in Chapter/Surah Al-Mu'minun 23, verses 23-29

"So We inspired him (saying): Construct the ship under Our Eyes and under Our Revelation (guidance). Then, when Our Command comes, and the oven gushes forth water, take on board of each kind two (male and female), and your family, except those thereof against whom the Word has already gone forth. And address Me not in favour of those who have done wrong. Verily, they are to be drowned"27. "And when you have embarked on the ship, you and whoever is with you, then say: "All the praises and thanks be to

[1] There is only one universal original Arabic version of Quran.
[2] Surah Nuh - 1-28 | Quran.com

Allah, Who has saved us from the people who are *Zalimun* (i.e. oppressors, wrong-doers, polytheists, those who join others in worship with Allah, etc.) 28. "And say: "My Lord! Cause me to land at a blessed landing-place, for you are the Best of those who bring to land" 29.

Then the Ark left the place towards "Judi" mountain, as Quran tells us in Surah of Hud 11, verse 44:

"And it was said: "O earth! Swallow up your water, and O sky! Withhold (your rain)." And the water was diminished (made to subside) and the Decree (of Allah) was fulfilled (i.e. the destruction of the people of Nuh (Noah). And it (the ship) rested on Mount Judi, and it was said: "Away with the people who are *Zalimun* (polytheists and wrong-doing)!"(11. 44)

Based on the story of Noah and his Ark, many scholars in various fields still think deeply and publish their efforts about the story of Noah and the Ark; those studies have been done to investigate several sides of the story; theology, language, history, archeology, geography, saftey, paleoanthropology, geology, flood /water and disasters, physics, engineering design and architecture, floods and factors related to it, Aging and is it possible to live more than 120 years?, the characteristics of the Ark which made it able to carry the prophet Noah, his people and all kinds and species of the creatures. (Harndi Gundogar & Ömer Yildirim, 2008; D Gon, B Hyun, & S Hong. April 1, 1994; Tim Lovett, Jun 7, 2013) The Story is full of STEM education features and more; the Challenges, the knowledge, the Capstone, and the Engineering Design as I discuss later.

The Nature of VSTEAM Education

As mentioned, we can found many studies in many fields related to STEM. But here, the cornerstone is the interaction of these fields or integration, interdisciplinary, multidisciplinary, systemic, and or synergetic. In this section, I will give some light on the nature of the suggestion acronyms VSTEAM education.

I think that the approach of STEM as performances is not new; Allah/God gave "Adam" the ability to learn everything. So, there were many practices related to integrated sciences very early in the history of mankind on the earth; when man discovered the relation between rocks or stones and fire or by using stone to invent knives and weapons. Or all practices of Prophet Noah during building the Ark to save believers and all kinds of life. Also, all the inventions through the Islamic and Arabic civilizations refer to all concepts related to STEM education culture and more. But STEM culture as terms and names raised recently; UNESCO and its affiliated countries, including Egypt, have developed plans and strategies for the development of integrated science education in various forms, as indicated by the series of UNESCO reports entitled "New Trends in Integrated Science Teaching" in 1971. , 1973, 1974, 1977, 1979. This series was preceded by several reports that dealt with each science independently. For example, we find "new trends in teaching biology, another for mathematics, a third for physics, and so on." (See, for example, Judit Reay 1979; Sheila Haggis & Philip Adey, 1979; Richmond, P. E.,1974)

The interest in integrated sciences may trace its roots back to the ages of the Arab-Islamic scientific civilization, which lasted for more than eight centuries, presenting science and useful applications to humanity in the various fields of life: They introduced science and scientific outlook to the advancement of Islamic Civilization. This Islamic science and technology reaching Europe via Sicily and Spain awoke it from the Dark Ages in which it was slumbering. The period between the seventh to the fifteenth centuries is considered as the 'Golden Age of Islamic Civilisation'. During this period there was great emphasis on the pursuit of knowledge. Consequently, some individuals lived scholarly and pious lives, such as Ibn Sina, Al Khwarizmi, and Al-Biruni, who in addition to excellence in the study of religious texts also excelled in mathematics, geography, astronomy, physics, chemistry, and medicine. At this time Islam was not just a set of religious beliefs, but a set of ideas, ethics, and ideals encompassing all aspects of human life. This resulted in the establishment of Islamic civilization. Thus the motivating force of this civilization was its

Islamic faith (used here both in the spiritual and temporal sense) and its language was Arabic. While the progress of scientific knowledge in Europe languished during the Dark Ages, science flourished in the Golden Age of Islam. The renaissance that subsequently occurred in Europe might not have taken place without the contribution of Muslim science in the preceding period. This was acknowledged by Sarton who wrote: Contributions of Islamic scholars to the scientific enterprise from the second half of the eighth to the end of the eleventh century, Arabic was the scientific, the progressive language of mankind. It is sufficient here to evoke a few glorious names without contemporary equivalents in the West: Jabir Ibn Haiyan, al[1]Kindi, al-Khwarizmi, al-Farghani, al-Razi, Thabit ibn Qurra, al-Battani, Hunain ibn Ishaq, al-Farabi, Ibrahim ibn Sinan, al-Masudi, al-Tarabi, Abu ibn Wafa, Ali ibn Abbas, Abu-l-Qasim, Ibn al-Jazzar, al-Biruni, Ibn Sina, Ibn Yunus, al-Karkhi, Ibn al[1]Haitham, Ali ibn Isa, al-Ghazzali, al-Zarqali, Omar Khayyam! Many Muslims scholars in the Golden Age of Islam studied nature in the context of the Quran. The Quran depicted the relationship between nature and man, and this inspired Muslim scholars to study natural phenomena, to know about God and the universe. Islam's contribution to the scientific enterprise was complex and rich and it spanned over three continents and nearly a millennium of time. (vid. Yasmeen Faruqi, 2006; Ludlow & Bahrani, 1978; Tim Wallace-Murphy, *2006;* Al-Hassan & Hill, 1986; Georg Sarton1927; Ayidin Saili, 2008)

Science and its applications have been passed to the West with knowledge, methodology, and values, but I think the West ignored ethics and morals especially religious instructions. so new rational trends have emerged; calling for the necessity of linking science and technology with society or STS, or linking science and technology with the environment (STE), religion (STR) or values (STV), and scientific branches and fields of study have emerged such as "Bioethics" which links the biological sciences with the values and ethics of society, or "Physics Ethics" which links the physics sciences and its applications to the values of society. The educational institutions, especially the school and the university, had to address all the negative consequences of the extremes of some scientific applications or experimental research practices and to present enlightening programs to advance man anywhere, improving his life, purifying his vision of the universe and the environment around him, and spreading goodness (Macer, 1998., Islam Al-Rifaey, 2002, 2005)

STEM Education

Based on various literature (National Research Council, 2011; Brene` Bradley, 2020; Richard Myhill, 2020; Office of Inspector General, U.S, 2018; Costello et al, 2020; Elaine Hom, 2014; Boersma & Eijkelhof, 2006; Watanabe, T. & Huntley, M, 1998; Sheila Haggis & Philip Adey, 1979; Chief office of Education, 2016; Michael Timms et al. 2018; Australian Curriculum, Assessment and Reporting Authority, jun 2018; Gerhard Schaefe, 1996; Inspectorate – Department of Education, 2020; National Research Council, 2011; Laura Rodriguez Amaya ; Araceli Martinez Ortiz; Judy Loredo, 2018; NGSS Lead States, 2013;Melanie Laforce et al. 2014; Bernard Sadusky, 2012; Kim Davis et al, ND; North Cross School , 2007; Edward M. Reeve, 2015; European Commission/EACEA/Eurydice, 2014; Beatty Alexandra, 2011; The Council of the European Union, 2009; Engineering Design Process, 2021; Hafiz & Ayop, 2019;) Integrated science education (STEM/STEAM/VSTEAM). is the acronym for Science, Technology, Engineering and Mathematics (STEM). It is an approach to teaching and learning science, engineering, and mathematics with integrating knowledge content based on performance standards. These standards define The nature of behavior consistency and its integration with the knowledge content of STEM fields, which are expectable from outstanding STEM students; participation in the inquiry process, logical reasoning practice, collaboration, and practicing of scientific research skills. STEAM denotes the inclusion of the Arts. It is necessary to add the values to keep the scientific activity on the right way toward goodness. A STEM education program may include curriculum from career clusters other than engineering and computer science (such as healthcare science, agricultural science, biotechnology, food, and nutrition science). Some programs, recently, are focusing on research projects, capstones, to take part in facing the Coved 19 crisis. STEM education is relying on a rigorous curriculum that integrates subjects as opposed to

teaching them separately. STEM education's integration of hands-on, real-world learning tasks, coupled with academic theory, helps students master rigorous math and science concepts. STEM education incorporates several researched-based best practices proven to improve student achievement: Inter-disciplinary instruction, Problem, and project-based learning, Inquiry-based learning, Collaborative learning, Laboratory investigations, Research project, and Real-world experiences via work-based learning opportunities. STEM education builds greater capacity in teachers through content-specific, rigorous, and ongoing professional development and training.

Goals of STEM Education:
The big challenges in STEM education are the desire to make lifelong learning and learner mobility a reality; Improve the quality and efficiency of provision and outcomes; and Promote equity and active citizenship. In addition to fostering in-depth knowledge of math and science, STEM education increases achievement by equipping students with: Critical and analytical thinking skills, scientific thinking skills, using computer skills, Proficiency at solving non-routine problems, High-level of self-confidence, communication skills, Project management experience, teamwork, leadership skills, supports the development of life skills, ingenuity and promotes empathy for issues including sustainability and the natural environment. Those skills are strongly required to succeed in higher education and to build the workforce which is needed during the twenty-first century.

It is also critical for learners at all levels—early learning, primary and post-primary— to have opportunities to make tangible links with real-life problems to advance their STEM learning in a meaningful way. Hands-on activities are critical for positive learning outcomes. Students must learn and apply VSTEAM;
*Integrate knowledge to answer complex questions,
*Apply knowledge in research projects and capstones,
*Develop solutions for challenges and real-world problems,
*Interpret and communicate VSTEAM information to investigate global and local issues,
*Engage in inquiry and logical reasoning,
*Practicing science aprocesses skills SAS and engineering design process EDP,
*Cooperate and collaborate through various groups,
*Communicate successfully through their groups,
*Apply technology strategically,
*Values and ethics must be the context of all these activities.

That means there is a necessity to provide STEM schools with high-level and well-educated leadership and skilled teachers, all required equipment, and facilitate the related activities for making the teaching and learning environment suitable for those outstanding students.

STEM Teachers:
Teachers must have the following competences which are important for teaching integrated science.
*Developing personal and social responsibility,
*Deeply understanding of the nature of science,
*Developing critical, scientific, creative, and engineering design process skills,
*Perseverance and patience in dealing with solving problems or any related situation,
*Regulatory ability to pass decisions,
*Teamwork and independence,
*High level of perception and understanding facts,
*Practical skills which are related to STEM,
*Expression and communication: for well guidance, clear presentation and language.

Components of STEM Curriculum

Based on multiple sources as mentioned before, STEM curriculum may consists of the following elements:

* ***Learning outcomes,*** Aims, objectives, which is arisen from challenges, big ideas, and NGSS? They are extracted into standards and, criteria by curriculum specialists and experts. (Learning outcomes, Aims & Objectives)

* ***Content***: similarly, based on learning outcomes), integrated, segregation, multidisciplinary, interdisciplinary, and systemic approaches.

* ***Strategies and methods of Teaching & Learning***: the following are the famous strategies which are used in the field of STEM/VSTEAM education.
  - Co-Operative Learning,
  - Collaborative Learning,
  - Constructivism,
  - Brain-based learning,
  - Multi-intelligence-based learning,
  - Problem-based learning,
  - Field visit,
  - Real and virtual lab activities,
  - Technical & Vocational Education and Training. TVET
  - Technology and Education, T & E.
  - Career Technology Education. CTE.
  - Outdoor Learning Activities LOA: are essential in addition to classroom activities.
  - Laboratories: are essential for developing research, science process skills, and practical skills in biology, chemistry, physics, geology & mechanics.
  - Fabrication laboratories FabLabs: help students in acquiring skills related to computer assimilation, engineering design process, and transforming scientific ideas designs, models, and conceptions from theoretical or abstract form into concrete or a product. So FabLabs are tools for sustainable development.
  - Project-based learning; The Capstone (VSTEAM, Journals, Prototype, and Poster as a final report)

  - **Engineering design process** EDP: it includes the following main steps: (UNIKO Media Group (ND); The Welding Institute, 2021; Hafiz & Ayop, 2019)

- Define the Problem
What is the problem that needs to be solved? What is the design product for, and why is it important to find a solution? What are the limitations and requirements? Engineers and students through this stage need to ask these types of critical questions regardless of what is being created.

- Brainstorm Possible Solutions
Good designers brainstorm possible solutions before opting to start a design, building a list of as many solutions as possible, let the ideas flow.

- Research Ideas / Explore Possibilities for your Engineering Design Project

Use the updated knowledge and experience of others to avoid the problems faced by others and explore possibilities. You should speak to people from various backgrounds, including users or customers. You may find some solutions that you had not considered.

- Establish Criteria and Constraints
Having listed potential solutions and determined the needs of the project alongside your research, the next step is to establish any factors that may constrain your work. This can be done by revisiting the requirements and bringing together your findings and ideas from previous steps.

- Consider Alternative Solutions
You may wish to consider further solutions to compare the potential outcomes and find the best approach. This will involve repeating some of the earlier steps for each viable idea.

- Select an Approach
Once you have assessed your various options you can determine which approach best meets your requirements. Reject those that don't meet your requirements.

- Develop a Design Proposal
Having chosen your approach, the next step is to refine and improve the solution to create a design proposal. This stage can be ongoing through the length of your project and even after a product has been delivered to customers.

- Make A Model Or Prototype
Use your design proposal to make a prototype that will allow you to test how the final product will perform. Prototypes are often made from different materials than the final version and are generally finished to a lesser standard.

- Test And Evaluate
Each prototype will need testing, re-evaluation and improvement. Testing and evaluation allows you to see where any improvements are needed.

- Refine the Design
Once testing has been completed, the design can be revised and improved. This step can be repeated several times as more prototypes are created and evaluated.

- Create The Solution
After your refinements have been completed and fully tested, you can decide upon and create your finished solution. This may take the form of a polished prototype to demonstrate to customers.

- Communicate The Results
The final stage is to communicate your results. This can be in the form of a report, presentation, display board, or a combination of methods. Thorough documentation allows your finished product to be manufactured to the required quality standards

****5 Es Strategy*: (**Francis Vigeant (May 14, 2017); Lena Ballone & Duran Bowling, 2004)
As a learning cycle approach in the classroom helps to facilitate inquiry practices because learning cycles focus on constructivist principles and emphasize the explanation and investigation of phenomena, the use of evidence to back up conclusions, and experimental design. Although there are several variations of

learning cycles, the one that is highlighted in this manuscript as a method to support inquiry-based teaching is the 5E Instructional Model (Bybee & Landes, 1990)

The 5Es Model and Next Generation Science Standards NGSS: If it is to be of use with the Next Generation Science Standards, the 5E instructional model must move from a traditional model of instruction to a next generation model of instruction. Specifically, here is how it looks for each of the Es:

"***Engage***" transitions from "I tell them or show them" to helping students reflect on what they already know and ask questions about what they don't yet understand, which propels them toward an initial feeling of dissatisfaction.

"***Explore***" moves away from thoughts such as "I give them," "I demonstrate," or "They look at a model" and toward students themselves unpacking the problem, developing a model, and gathering data.

"***Explain***" no longer means turning and talking, having a carousel discussion, or asking questions like "What did" and "What was." Now, it means digging deeply into where the question has been answered or the problem solved, and using evidence to support claims.

"***Elaborate***" is less about reading, watching or introducing new ideas, and more about forging the incredibly valuable concept-to-self, concept-to-concept and concept-to-world connections that help tie anchor and investigative phenomena together.

"***Evaluate***" cannot simply mean vocabulary assessments or graded anymore; now it means reflecting critically on the investigative process, the hypothesis, and the anchor phenomena.

***VSTEAM Education Evaluation**:
Comprehensive evaluation for all the curriculum elements, students, and leadership: diagnostic, formative, summative and a special period, at the end of each semester for evaluating the prototypes and the capstone groups in a scientific fair environment.

It may be so clear that there is a strong trend towards STEM education among the progressive counties, which makes it a priority for the developing counties. And through my experience in the field of science education the field of STEM education, there are many reasons to give importance to VSTEAM Education. Such the lack of skilled workforce in STEM areas, most girls avoid these majors even in progressive countries, the shortage of inventors, innovators, creators, applying science and using technology for unclean purposes, and various challenges facing the high and low-income countries. Also, I realized that there is a low level of understanding of VSTEAM education culture among parents, teachers, students, and society around the school I have found general shortcomings among many categories of the educational community - about the understanding and practicing of scientific thinking, methodology, and scientific attitudes, as well as a lack of awareness of STEM education culture, which seen as an obstacle to the acquisition of STEM schools concept or the nature of what is known, in Egypt, schools of excellence in science and technology.

A**s** known, at least in my society, many people are reluctant to try new things or innovations; alienated, avoid seeking it, and rely on what they are familiar with and what they knew well. So far, most of the educational categories in Egypt are looking at STEM schools as a black box; the vagueness of their aims, school life, and their literacy.

And Because of the positive attitudes of people towards religion and historical stories specially about Prophets, fore example Noah and his Ark, the idea of this paper raised in my mind; I think It may achieve

deep understanding of VSTEAM consepts and perfect matching or emulation. Also, it may lead to implementing concepts and terminology of VSTEAM education, make the educational community in all stages aware of and accept it, and know that it is necessary to read the original holy books daily and perfectly with reflection and deep understanding.

So this article aims to discuss a historical, comprehensive, and heaven capstone, the oldest capstone on the earth, where the Prophet Noah Peace be upon him (PBUH), lead the believers in building the Ark for facing the challenges of disbelievers and the flood. And I suggest a model for VSTAEM education based on the story of the prophet Noah and his Ark. In the following section is my trial to answer these questions:

Research Questions:
*What are the features of the proposed model?
*How to use this model in VSTEAM education?
*What are the benefits of this model?

Methodology:
The research method is descriptive, analytical, inductive, and deductive; I think that I read materials related to the two big core ideas of the research; Noah's project and STEM literacy. Investigate and find relations in between by observing critically, reflexing, analyzing, and matching or emulating. Then it is probably to implement some traits, elements, or procedures of the historical model/system in the new system/STEM literacy. The last stage may lead to creation and innovation or produce a unique solution for a certain problem.
It means that the theoretical model is built based on multidisciplinary and various fields; religious literacy, Christian, Jewish and Islamic resources, particularly in the Holy Quran. And the STEAM education-related literature.

MODEL FEATURES:
There are various definitions of the term "model" in different fields, philosophy of science, methodology, science, mathematics, and computer sciences. (James Jaccard & Jacob Jacoby, 2010; Stephen Downes, 2011; Hodges, Wilfrid, 2020; Nilsen, P, 2015; VanLehn, K. et al, 2015; Frigg et al. 2006; Civilization Dialogue, 2019; Bert P.M. Creemers, Leonidas Kyriakides and Pam Sammons, 2010; Glen Bull et al., 2017)

Here, I suggest this definition: A model is a form of a collection, abstract, and reduction of a big number of facts, concepts, laws, principles, or generalizations in order to present the internal relationship in between, simplifying the understanding of a phenomenon, explain some sides of a theory, or simplifying the reality; The model has different kinds; it may be theoretical which begin with a mind/ concept map, material like a plane or a train models, computational or mathematical model. And it is acceptable for a model to include more than one form; when an inventor or a researcher transforms the theoretical form into an engineering design and begins to produce a prototype from the available materials and tools using the computer and other machines.

Based on the idea of learning through historical reconstruction, The term model is related to the term emulation thats because emulation includs matching and building some kinds of models; theoritical, materialistic, mathematical, or computiaional. Emulation includes hardware/materialistic and software/simulation. İn nighteen century the good model or invention is emulated to a new copy the mechanists improved it and remix old elements with new others to make an innovation or new invention. (Gabriel Keith Harris, 2015; Glen Bull et al., 2017). So this model has some Implementations of elements, ideas, or procedurs or what is called remixing.

Components of the Proposed Model: The Ark of Salvation / Ark System shown in Figure (1. a) & STEM Literacy/ STEM system Figure (1. b);

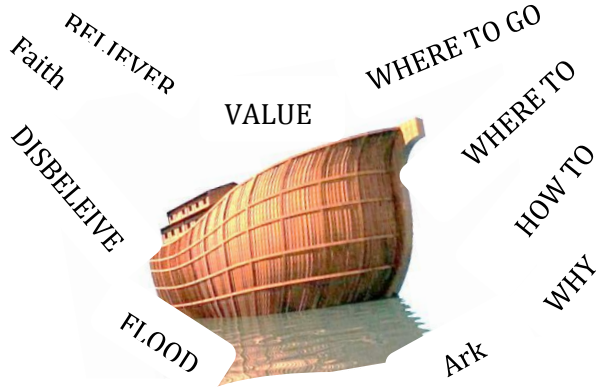

Figure** (1. a)* ***NOAH's Ark

The Ark of Salvation, Figure (1. a): it involves main big ideas and concepts as listed below:

*Believers, who believe in only one God/ Allah, following the Prophet Noah (PBUH), religious instructions, and doing a good deed.

*Argumentation and ethics: kindness, claim & evident, Desire & Intimidation, objectivity, and other ways,

*Divine source-Based Values: faith, cooperation (during building the Ark), open-mindedness, patience, persistence, objectivity, mercy & kindness.

*Disbelievers: some people worship other Gods, couldn't do harm or good for them.

*Areas of Ark Building/departure, Palestine or other, and the final destination are refer to many branches of knowledge: geology, topography, geography, and climatology.

*Building the Ark: includes some other concepts and subjects; physics, mathematics, engineering design, arts, internal and external design, natural resources, environment, marine and water, flood, challenges, faith, persistence…

*Environment: sustainability, conservation, biostatistics, Biology (Botany & Animal) and agriculture. It was a miracle with the Prophet Noah for saving all kinds of life.

STEM Literacy/ STEM system: here, Figure (1. b), is a collection of the main concepts of STEM education literacy:

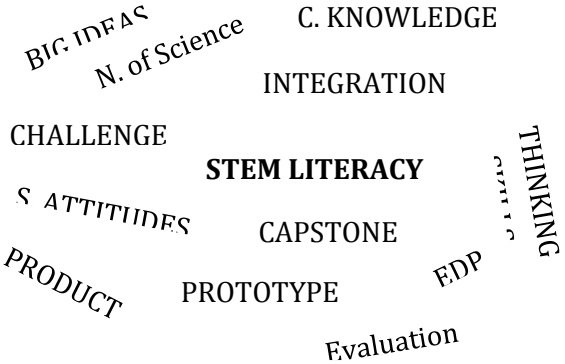

Figure (1. b) STEM Syestem

*Big Ideas / Challenges/ NGSS,

* Related various fields of knowledge,

*Knowledge/content,
*Learning outcomes, aims and objectives,
*Teaching & learning strategies: inquiry, discovery, cooperative, constructivism, problem-based learning, project-based learning, 5Es…
*Thinking skills; scientific, critical, & creative.
*Capstone/ integration, engineering design process, prototype,
*Human and Philosophical –based values & attitudes.
*Evaluation; comprehensive; diagnostic, formative, and summative…

Applying the Model in VSTEAM Education:
The following lines present the steps of how to apply the model in VSTEAM education environment; it can be done by using rubrics or chick list:

Analyzing all elements of the historical/original system (the Ark of salvation or any other invention.
Analyzing all details of the current system/ STEM literacy.
Reduce and filter to focus only on the crucial and required components of each.
Observe the peculiar sides of the historical system.
Match or emulate between the two operations to make use of the best things in each.
Evaluate the defferences, similarities, advantages and disadvantages.
Implement and apply the unique elements in developing, if applicable, the historical one or improving the current system/ STEM literacy or a new capstone or the new research project. This last step may lead to the creation or producing a brilliant invention[3]

Benefits of the Model:
I think using this model may help in achieving the following goals:
*Enhancing the attitudes and familiarity with integrated science, VSTEAM, among stakeholders and people who are already interested in STEM fields.
*Developing the level of faith, religious values and positive attitudes among peoples in dealing with the universe. Some of these values are patience, objectivity, persistency, goodness, open-mindedness, and cooperation.
*Assure on the monotheist/oneness which means there is no God but Allah; the Creator; this conception was the main reason for building the Ark of salvation.
*Deeping and stretching the concept of integration; When thinking how the Ark had manufactured, carried most kinds of organisms in the environment and many others around, and sailed through gigantic waves like a mountain..!!
*Fighting or striving to serve and save believers, all organisms, and the message of God/Allah on the earth.
*Improving thinking skills; scientific, logical, critical, reflection, metaphysical, and creative.
*Facilitate understanding the concepts of VSTEAM education.
*Develop positive attitudes towards integrated sciences (VSTEAM) as a major of study, a field of work, and a big reason for sustainable development.
*As a religious story, it will be respectful from all age stages and all levels of education.
*Also, telling stories attracts all categories of people, even those who are suffering from illiteracy.

Fınal Remarks:
There are some points can be highlighted here in this section:
*Believers must differentiate between what is its source is divine or a humankind effort.

[3] NB. All the steps must be integrated in the engineering design process.

*If we read, objectively, the original holly books with understanding, learning, and acting as the pure instructions in Bible and Quran; I think we will reduce the required time to explore and invest the environmental resources to spread goodness.

*Believers must do their bests and much effort in using their abilities for facilitating life on the earth. But they must realize the existence of a great power, they can only worship and obey, Allah/God,

*In Islamic instructions, particularly in Quran, the stories and narrations include various aims; such as to serve as an example, model, to explain the facts, to cause thinking, knowledge, and learning, to create peace, etc.

*Similarly, the remembrance of these messages in stories or descriptions in the Quran has some enriching effects such as developing logical and reasoning thinking skills, using the human feelings to reinforce thinking, and practicing the" beautifying" as an educational method for strengthening the emotional dimension of personalities aspects.

*These religious stories are for learning and taking lessons from the past to mend this life, adjust our existence on the earth in the future, and prepare for our eternity/ infinity life.

*The Ark of salvation is not limited to the Ark of the Prophet Noah (PBUH) itself. But it is a symbol that refers to any story like it in Quran, other pure holly books, or any hard situation and crisis facing mankind on this life such as Tsunamy or Cov 19!

*Also, this symbol may include any other invention in the history of science and technology or in our lif in general.

*There is a positive relationship between salvation and the level of faith in this world or hereafter.

*I think if we need justice, peace, clean and healthy environment, quality in our current life, and paradise in our hereafter, we must, as a step, insert values in all our activities. And follow divine ethical standards, practice any subject value-laden, not value-free, and aiming goodness in any behavior.

*Here the situation needs much more effort because we are not prophets; prophets have direct support and special knowledge from the Creator!!

*Noah (PBUH) had no science, technology, or any branch of nowadays advancement, so the big lesson is to rely on God/Allah and his support before depending on our tools or power. Allah possesses absolute power.

*In this digital, nanotechnology, and genome age; high-level scientists and Nobel prize winners still know little about this universe! And Quran refers to this truth.[4]

The following illustration in figure (2) shows the main features of the proposed model[5]:

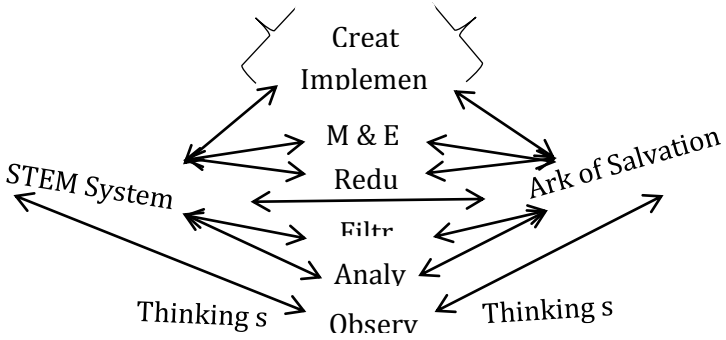

Figure 2. Ark of Salvation Model for VSTEAM Education

[4] In chapter/Surah 17. Verse. 85: And they ask you, [O Muḥammad], about the soul. Say, "The soul is of the affair [i.e., concern] of my Lord. And you [i.e., mankind] have not been given of knowledge except a little.

[5] Create: Creativity/ creative; implement: implementation; M & E: Matching and Emulation; Redu: Reduction; Filtr: Filtration; Analy: Analysis; Observ: Observation; Thinking S: Thinking Skills.

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STEM Education in the U.S.

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Development of STEM Education in the U.S.

STEM is a curriculum targeting on educating students in four specific disciplines — science, technology, engineering and mathematics. Away from the traditional approach of delivering the four disciplines separately, STEM education initiates an interdisciplinary and applied approach integrating them into a cohesive learning paradigm based on real-world applications.

The United States has historically been a leader in science, technology, engineering, as well as mathematics. However, fewer students have been focusing on these topics in recent decades. To make the changes, the Obama administration announced the 2009 "Educate to Innovate" campaign to motivate and inspire students to excel in STEM subjects. The goal is to get American students

from the middle of the pack in science and math to the top of the pack in the international arena (Hom, 2014). During his tenure, Obama had pushed for STEM education and endorsed for more public and private partnerships, more career training at community colleges and for more American innovation (Urmila, 2020).

The International Council of Associations for Science Educators has urged member countries to work together to improve access to, and the quality of, STEM education to prepare all students for global citizenry. In the USA, the National Science Foundation (NSF) has played a significant role in the STEM education movement by calling for research related to science, mathematics, engineering, and technology. The NSF first used the term "SMET" which was later revised into the more euphonic "STEM" in the early 2000s. With several studies on the state of STEM learning issued by the U.S. government, the number of schools designated as STEM-focused increased. Meanwhile, numerous legislative actions emerged related to computer science, STEM teachers, and STEM as career and technology (CTE) education (Holmlund et al., 2018).

Since late 2010's, it has become a consensus in the U.S. that school students need to be prepared to solve problems, make sense of information, and know how to gather and evaluate evidence to make decisions. As stated by the U.S. Department of Education (2021), if we want a nation where our future leaders, neighbors, and workers can understand and solve some of the complex challenges of today and tomorrow, and to meet the demands of the dynamic and evolving workforce, building students' skills, content knowledge, and literacy in STEM fields is essential.

The effort for STEM education is to meet the need of the job market. According to a report by the website STEMconnector.org, by 2018, projections estimated the need for 8.65 million workers in STEM-related jobs in the U.S. The manufacturing sector is facing an alarmingly large shortage of employees with the necessary skills, and the COVID-19 pandemic has made such shortage more urgent. This paper introduces some major strategies the United States adopts in order to advance the STEM education in K-12 schools to address this need.

Strategy for STEM Education in the U.S.

In December 2018, the U.S. Department of Education published the STEM Education Strategic Plan, *Charting a Course for Success: America's Strategy for STEM Education*. The plan set out a federal strategy for the next five years based on a vision for a future where all Americans will have lifelong access to high-quality STEM education. The plan also represented an urgent call to action for a nationwide collaboration with learners, families, educators, communities, and employers—a "North Star" for the STEM community as it collectively charts a course for the nation's success (US Department of Education, 2021). Recent actions and accomplishments have included, but not limited to, the following:

1) Curriculum and Instruction

The United States, with its preference for local control, has the critical work of initiating curriculum and creating standards left to individual states. Where a traditional curriculum is limited to isolated math and science lessons, a true STEM curriculum is interdisciplinary and hands-on. The curriculum helps students to connect what they learn in different classes and explore engineering, technology, and medical applications. Students are encouraged to explore the world around them as they think outside the box to solve problems or create something new (Yeti Academy, 2021)

Research in STEM learning over the past two decades investigated what makes for effective, engaging STEM education. Among the key factors, it capitalizes on students' early interests and experiences, identifies and builds on what they know, and provides opportunities to engage in the practices of science and mathematics to sustain their interest (STEM Smart, 2021).

Blended learning environment has been identified as an effective instructional approach which separates STEM from the traditional science and math education to show students how the scientific method can be applied to everyday life. Blended learning has been widely applied by U.S. teachers to help students in computational thinking and focus on the real world applications of problem solving. Researchers, like Hom (2014) and Urmila (2020), believed that STEM education begins while students are very young. Hom (2014) summarized a suggested curriculum that should start from elementary stage:

Elementary school — STEM education focuses on the introductory level STEM courses, as well as awareness of the STEM fields and occupations. This initial step provides standards-based structured inquiry-based and real world problem-based learning, connecting all four of the STEM subjects. The goal is to pique students' interest into them wanting to pursue the courses, not because they have to. There is also an emphasis placed on bridging in-school and out-of-school STEM learning opportunities.

Middle school — At this stage, the courses become more rigorous and challenging. Student awareness of STEM fields and occupations is still pursued, as well as the academic requirements of such fields. Student exploration of STEM related careers begins at this level, particularly for underrepresented populations.

High school — The program of study focuses on the application of the subjects in a challenging and rigorous manner. Courses and pathways are now available in STEM fields and occupations, as well as preparation for post-secondary education and employment. More emphasis is placed on bridging in-school and out-of-school STEM opportunities.

There are many ways to increase student interest and motivation in science, mathematics, and engineering. STEM Smart (2021) recommended the following: Relate science to students' daily lives; Employ hands-on tasks and group activities; Use authentic learning activities; Incorporate novelty and student decision-making into classroom lessons; Ensure that STEM curricula focus on the most important topics in each discipline.

2) Training Teachers

For a better future of STEM education, we need well-trained and enthusiastic teachers who are able to bring their first-hand know-how in mentoring children. Teachers should get professional development opportunities from time to time that will help catalyze their passion and talent for teaching STEM (Urmila, 2020). Effective STEM instruction is the exception in the vast majority of U.S. schools. It is typically facilitated by extraordinary teachers who overcome a variety of challenges that stand between vision and reality (STEM Smart, 2021).

Thus, the very critical factor for a successful STEM education lies in the quality of teachers who take on the STEM curriculum. With such awareness, institutions and programs have been initiated in the U.S. to meet the demands.

"M.ED. in STEM Education – You set the pace." This is the enrollment slogan of a purely online program of American College of Education (ACE), located in Indianapolis, the U.S.

Similarly, the University of Texas at El Paso has made its Online Graduate Certificate in STEM Education available. The program connects to innovative approaches to teaching and learning science, technology, engineering, and mathematics (STEM).

These and many more programs across the United States are designed to prepare for opportunities in a high-demand field in education.

3) Federal Budget and Funding Support

The Obama administration's 2014 budget invests $3.1 billion in federal programs on STEM education, with an increase of 6.7 percent over 2012. The investment was made to recruit and support STEM teachers, as well as to support STEM-focused high schools with STEM Innovation Networks. The budget also invested into advanced research projects for education, to better understand next-generation learning technologies (Hom, 2014).

Recent U.S. federal funding has helped creating opportunities for research projects, teacher training, and curriculum development. The Fiscal Year (FY) 2021 funding season officially kicked-off on October 1, 2020, at a time when the country was experiencing severe COVID-19 pandemic.

In spring 2020, the U.S. Department of Education announced two new grant applicant resources to advance STEM research projects and programs across the county. Most recently, in July 2021, the Department released a notice inviting applications for FY21 early-phase projects. The program provides funding to create, develop, implement, replicate, or take to scale entrepreneurial, evidence-based, field-initiated innovations to improve student achievement and attainment for high-need students; and rigorously evaluate such innovations. (US Department of Education, 2021).

4) Remove Disparity in Pay and Gender

Remove disparity in pay and gender is another effort. A more women-friendly career in the tech industry is the need of the day. Also, with demand for data analysts, software engineers and web developers expected to outstrip supply by 2025, efforts are afoot to equip women to reap the benefits. Women and girls are now encouraged to get into STEM fields, hopefully the figure will dramatically go up (Urmila, 2020).

STEM jobs do not all require higher education or even a college degree. Less than half of entry-level STEM jobs require a bachelor's degree or higher. However, a four-year degree is incredibly helpful with salary — the average advertised starting salary for entry-level STEM jobs with a bachelor's requirement was 26 percent higher than jobs in the non-STEM fields, according to the STEMconnector report (as cited in Hom, 2014.)

Uncertainties and Challenges

Despite increasing attention to STEM education worldwide, there is considerable uncertainty as to what constitutes STEM education and what it means in terms of curriculum and student outcomes (Holmlund et al., 2018).

Compared with the highest performing nations on the international TIMSS exam, U.S. state STEM curriculum standards have problems in all three areas: they are less focused, with too many topics covered in each grade; less rigorous, with students studying more basic topics; and less coherent, with an often illogical progression from topic to topic (STEM Smart, 2021).

As a summary, U.S. STEM education has experienced tremendous enthusiasm and significant development, yet there is still a long way to go to accomplish a highly achieving education for the nation's present and future need.

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SUB-THEME: STEM and TVET for Economic Diversification and Human Resource Development

Effects of Low Income on the Standard and Quality of Residential Buildings in Kaduna State, Nigeria

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Abstract
This study examined low income and its effect on the standard and quality of residential building in Kaduna State, Nigeria. Two research questions were developed and answered while two null hypotheses were formulated and tested at 0.05 level of significance and 100 degrees of freedom. Descriptive survey research design was adopted for the study. The entire population of 2,019 respondents consisting of 1,435 registered residential buildings and 584 builders in Kaduna State were used for the study. A 24 item structured questionnaire developed from the literature reviewed for the study was used to collect data from the respondents. Each questionnaire was divided into two categories of; reasons for acquiring low quality materials and curtailing the difference between low income and the standard and quality of residential buildings in Kaduna State. The "reasons for acquiring low income materials" had a four (4) response options of Highly Often (HO), Often (O), Moderately Often (MO) and Not Often (NO). The "curtailing the difference between low income and the standard and quality of residential buildings" category also had 4 response options of High Agree (HA), Agree (A), Moderately Agree (MA) and Not Agree (NA). The questionnaire items were face validated by three experts. The 2,019 copies of the questionnaire were administered on the respondents with the help of two research assistants. 694 copies of the questionnaire administered were retrieved and analysed. Weighted mean, standard deviation and Improvement Need Index (INI) were used to answer the research questions while t-test statistic was used to test the null hypotheses 1 and 2 respectively. The findings of the study revealed that low income has effect on the standard and quality of residential buildings in Kaduna State, Nigeria. The findings on hypotheses1 and 2 revealed that there was no significance difference in the mean ratings of the respondents (Residential Building Clients and Builders) on all the items on reasons for acquiring low quality materials and ways of curtailing the difference between low in come and it's effects on the standard and quality of residential buildings in Kaduna State, Nigeria. It was therefore recommended that theministry of urban and town planning should organised orientation/seminar from time to time to brainwash the residential building client on what is required at each stage of the housing value chain, from foundation footing to roofing and finishing, and from engaging locals from the communities, to building and improving the standard and quality of their residential buildings so that it will to be safe, resilient and sustainable. There should be a provision for an effective loan scheme, partial upgrading, effective urban development policy, and improvement of sanitary conditions and enforcement of housing and building codes.

Keywords: Low Income, Quality and Standard, Residential Buildings

Introduction

Housing is basic to human life. It is a fundamental yardstick for estimating the quality of life of a nation's citizens. Almost every measure of human well-being is connected to housing, be it a measure of health, social, religious or economic factors (Ogbu, 2017). The indispensability of residential building to humankind makes housing problems a global challenge. The most pathetic feature of Nigeria society today is that a majority of its members are living in a state of destitution while the remaining relatively insignificant minority, are living in affluence, which result to many going on low quality buildings. The end users of low-income housing seldom make inputs at the pre-construction and construction stages of the project (Ogbu, 2017). They often have to live with whatever quality of housing is provided by the housing designers and contractors. In the attempts to reduce the cost of construction, the quality of low-income buildings may be compromised between the design and construction stages of procurement. The designers of the projects attempt to specify cheaper materials ostensibly to make for affordability, while the contractors carry out workmanship to increase their profit margin. Similarly, due to the excess demand for housing, these housing providers often give minimal attention to building quality with the notion that whatever is provided for the low-income group will be accepted. This concept has not held true in many cases, partly because residents' satisfaction with their housing is strongly correlated with the buildings' features. Low-income buildings are frequently defective as a result (Nyameka, *et al.* 2012). Consequently, unregulated building modifications, and sometimes, significant structural alterations have been carried out to improve the quality of low-income housing buildings in Nigeria (Kaduna State inclusive). This compounds the affordability problem by increasing the cost of maintenance of the buildings. These issues lower the public's perception of low-income housing (Ogbu, 2017). Despite this, the effects of building standard and quality on maintenance cost remain inadequately addressed.

Quality is a fundamental term in the construction industry (Nyameka, *et al.* 2012). The non-achievement of such a crucial aspect of construction can result in the failure of a construction project and in the dissatisfaction of clients and/or building occupants. Furthermore, the non-achievement of quality can result in delays in building projects and the need for rework, which can result in a significant financial loss. Quality focuses on eliminating defects and variations and seeks to avoid waste of time, materials, and financial resources due to rework. The physical condition of a building refers to the state of its fabric. A building is a composite of different elements and materials. The deterioration or damage of an element of a building will diminish its standard – regarding aesthetics, functionality, and value. Building maintenance, therefore, is an act directed at restoring the standard of a building, its component or element. Every maintenance activity will entail one form of impact or the other on the physical condition of the building. It is assumed that residents judge the adequacy or habitability of their buildings based on predefined standards of physical condition (Abdulkadir*et al.* 2018). Some studies evaluated cognitive responses to the physical conditions of buildings focusing on issues such as the perceived quality of the buildings and environmental quality (Nyameka, *et al.* 2012). Similarly, Mario (2010), described quality as the extent to which a product fulfils the requirements set for it, and 'architectonic quality' as an umbrella term, covering various aspects of quality such as aesthetic, functionality (building efficiency), symbolic and cultural value. In the low-income housing sense, a resident's perception of the quality of his/her building will be related to how 'fine' it is. Low-

income earners are perceivably used to low standards and will ascribe a higher quality to inferior materials that can serve their purposes.

The purchase of poor-quality construction materials as a result of low income possibly affects the standard and quality of residential buildings. This is because the use of such materials causes building inadequacy and unexpected accidents. According to Alabi, *et al.* (2021), observed that building collapse is caused either by a natural factor or a man-made factor. The researcher further stated that developing nations suffer frequent collapse of buildings. For example, a country like Nigeria suffers periodic collapse of buildings predominantly caused by man-made factors. To buttress the above example, some studies were conducted few years ago by Kaduna State urban planning and development authority (Kasupda) to determine the key causes of building failure and collapse in Kaduna State. The findings attained showed that sub-standard building materials remained a major issue to building collapse/failure. The author added that low quality building materials intensify the cost of construction above the actual projected cost due to the loss of material during the implementation phase Alabi, *et al.* 2021. However, due to poor quality of residential building material purchase as a result of low income this call for improvement.

Improvement simply means a change for better, that is, progress in development. Alabi, *et al.* (2021) viewed improvement as an activity undertaken based on meeting the target objectives and satisfaction from lower achievement. With reference to this study, improvement connotes the performance gap to be filled by low income house owners in order to improve the standard and quality of their residential buildings. That is, this study collected information from the respondents through the use of questionnaire to determine the present low income residential building and the effects on the standard and quality of such buildings for improvement thereby, generating gaps that are to be filled by the findings of this study of low income and it's effect on the standard and quality of residential building in Kaduna State, Nigeria.

Statement of the Research Problem

Quality is the extent to which a residential building fulfils the requirements set for it, and 'architectonic quality' as an umbrella term, covering various aspects of quality such as aesthetic, functionality (building efficiency), symbolic and cultural value. Negligence of such a crucial aspect of construction can result in the failure of a construction project and in the dissatisfaction of clients and/or residential building occupants. In the low-income housing sense, a resident's perception of the quality of his/her building will be related to how 'fine' it is. Low-income earners are perceivably used to low standards and will ascribe a higher quality to inferior materials that can serve their purposes.

Despite the considerable modifications and revisions to the housing policy over the years, concerns related to quality, efficiency, effectiveness and sustainability of housing programmes still define and frame discussions (Nyameka et al. 2012). The challenges usually dominating the low-income residential housing sector include poor design of houses; houses that are environmentally unsound; houses that are not suitable to the local climate, and high maintenance costs. The residential building client therefore, required improvement because any improvement on the low income building will help improve the standard and quality of these structures in future. This study is therefore design to examine low income and it's effect on the standard and quality of residential buildings in Kaduna State, Nigeria.

Aim and Objectives of the Study

The main purpose of the study is to examine the effect of low income on the standard and quality of residential buildings in Kaduna State, Nigeria. Specifically, the study will sought to determine:

1. The effect of low income in acquiring materials for standard and quality residential building in Kaduna State, Nigeria.
2. The ways of curtailing the difference between and the low income and the standard and quality of residential buildings in Kaduna State, Nigeria.
3.

Research Questions

The following research questions are raised to guide the study:

1. What are the reasons for acquiring low quality materials in residential buildings in Kaduna State, Nigeria?
2. What are the ways of curtailing the difference between low income and the standard and quality of residential buildings in Kaduna State, Nigeria?

Research Hypotheses

The following null hypotheses are formulated and will be tested at 0.05 level of significant:

HO_1: There is no significance difference between the mean response of builders and clients regarding the reason for acquiring low quality materials during residential building constructions in Kaduna State, Nigeria.

HO_2: There is no significant difference between the mean response of builders and clients as regard ways of curtailing the difference between low income and the standard and the quality of residential building in Kaduna State, Nigeria.

Methodology

A descriptive survey research design was adopted for this study. The study was conducted in Kaduna State, Nigeria. The geographical coordinates of Kaduna State are Latitude 10.609319; Longitude 7.429504 and is located in the Cities place category with the gps coordinates of 10° 36' 33.5484" N and 7° 25' 46.2144" E; sharing boundaries with Zamfara, Kastina and Kano to the North, Bauchi and Pateau to the east, Nassarawa to the south, and Niger and FCT to the west. The targeted population for this study was 22,523 respondents consisting of 21, 340 registered residential buidings and 1,183 builders in all the three senatorial district in Kaduna State, Nigeria. Therefore, the sampled population for the study was 2,019 respondent comprising of 1,435 registered residential buildings and 584 buiders, drawn through the adoption of a multi-stage sampling technique (purposive sampling technique and Yaro Yamane formula for finite population respectively). Purposive sampling technique was used to select three local governments each from the three senatorial district in Kaduna State, Nigeria. The three local government in each of the three senatorial district include: Zaria, SabonGari and Makarfi local government from Kaduna North Senatorial district; similarly, Kaduna north, Kaduna south and Chikun local government from Kaduna Central Senatorial district; Kaura, Sanga and Kagarko from Kaduan South Senatorial district. High numbers of newly constructed residential buildings with total negligence to standard and quality necessitate the choice of Kaduna State for the study. While, registered residential

building in each of the three senatorial district were sampled out with the used of Yaro Yamane Formula for a finite population given as $n = N/1 + N(e)^2$ in Abdulkadir, et al. (2018) and because of the small number of registered residential buildings and builders, the entire population was used for the study; hence the were not sampled.

A structured questionaire titled: Low Income, Standard and Quality of Residential Buildings (LISQRB) was developed by the researchers and validated by three experts was used for the data collected for the study. All sections of research questions were structured so that respondents expresssed their opinion on a four-point rating scale of: Highly Often (HO) = 3.50 – 4.00; Often (O) = 2.50 – 3.49; Moderately Often (MO) = 1.50 – 2.49 and Not Often (NO) = 0.05 – 1.49 respectively for research question one (1). Whereas the rating scale for research question two (2) was: Highly Agree (HA) = 3.50 – 4.00; Agree (A) = 2.50 – 3.49; Moderately Agree (MA) = 1.50 – 2.49 and Not Agree (NA) = 0.05 – 1.49. Mean and standard deviation were the statistical tools used to analyze the data for answering research question; while t-test and was used to test the null hypotheses and 1 and 2 respectively at 0.05 level of significant.

Result

What are the reasons for acquiring low quality materials in low income residential building in Kaduna State, Nigeria.

Table 1: Mean and standard deviation of respondents on the reasons for acquiring low quality materials for residential buildings in Kaduna State, Nigeria N= 2,019

S/N	Items	Mean	Sd	Decision
1	Lack of sufficient finance.	3.62	0.49	Highly Often
2	Use of unskilled labour.	3.62	0.49	Highly Often
3	Increase in Final Cost of Building Products.	3.65	0.48	Highly Often
4	Lack of client commitment toward quality achievement.	3.64	0.50	Highly Often
5	The allocation of projects to unqualified and unmotivated contractors.	1.65	2.04	Moderately Often
6	Purchase of poor-quality construction materials.	3.62	0.50	Highly Often
7	Relatively small sizes of houses.	2.55	1.84	Often
8	Poor building standards in terms of inadequate sound attenuation/heat insulation.	3.63	0.48	Highly Often
9	Lack of basic urban design amenities.	3.67	0.48	Highly Often
10	Inadequate supply of services.	1.61	1.98	Moderately Often
11	Fluctuation in Cost of Construction.	3.71	0.46	Highly Often
12	Substandard quality of workmanship**.**	1.64	1.99	Moderately Often
		3.05	**0.97**	**Often**

Note: N= Number of Respondent, SD= Standard Deviation

Table 1 present the mean responses of the respondents on the 12 items on the reasons for acquiring low quality materials for residential buildings with grand mean of 3.05 which implies that the reasons for acquiring inferior materials for residential buildings are often in Kaduna State. Ten (10) out of the 12 standard deviation of the items ranges from 0.46 – 1.84 this shows that the respondents were not too far from the mean and were close to one another in their responses. However, two standard deviation items ranges from 1.98 – 1.99 this shows that the respondent

were too far from the mean and were not close to one another in their responses. This closeness of the responses adds value to the reliability of the mean.

Result 2

What are the ways of curtailing the difference between low income and the standard and quality of residential building in Kaduna State, Nigeria.

Table 2

Mean and standard deviation of respondents on the ways of curtailing the difference between low income and the standard and quality of residential building in Kaduna state, Nigeria. N= 2,019

S/N	Items	Mean	Sd	Decision
1	Ability to Purchase quality construction materials.	3.62	0.49	Highly Agree
2	Inspections to residential building during the construction phase.	1.62	2.09	Moderately Agree
3	Ensure project monitoring by ministry of housing.	1.65	2.08	Moderately Agree
4	Ensure registration with a quality assurance body by the Constractors.	3.64	0.50	Highly Agree
5	Need to engender a culture of excellence related to quality on residential building.	1.65	2.08	Moderately Agree
6	External/Internal ceiling finishes/decoration internally.	3.62	0.50	Highly Agree
7	External/internal wall finishes/decoration.	2.50	0.94	Agree
8	allocation of projects to qualified contractors	3.63	0.48	Highly Agree
9	Ability to set up qaulity control on building material by the government.	3.67	0.48	Highly Agree
10	Training and education on low-income house building standards.	3.61	0.48	Highly Agree
11	Reduction in land acquisition and titling.	3.71	0.46	Highly Agree
12	Adquate security of building material during construction phase.	3.64	0.49	Highly Agree
		3.04	**0.92**	Agree

Note: N= Number of Respondent, SD= Standard Deviation

Table 2 shows the mean responses of the respondents on the 12 items on the ways of curtailing the difference between low income and the standard and quality of residential building in Kaduna State with a grand mean of 3.04 which implies that the ways of curtailing the difference between low income and the standard and quality of residential building in Kaduna State, Nigeria, agree. Nine (9) items out of 12 standard deviation of the items ranges from 0.46 – 0.94 this signified that the nine (9) respondents were not too far from the mean and were close to one another in their responses. However, three (3) standard deviation items ranges from 2.08 – 2.09 this shows that the respondent were too far from the mean and were not close to one another in their responses. This uncloseness of the responses adds value to the reliability of the mean.

Hypothesis

HO_1: There is no significant difference between the mean response of builders and clients regarding the reasons for acquiring low quality materials during residential building construction in Kaduna State, Nigeria

The result of independent sample t-test mean ratings of the respondents on builders and clients as regarding the reason for acquiring inferior materials during residential building construction is presented in table 3. Levene test of homogeneity of variances for the data was .138 (and since the

value is greater than the significant level of (P< 0.05) the assumption of homogeneity of variance was met. Therefore, t-test could be employed for the analysis.

Table 3

t-test of mean rating of respondents on response of builders and clients as regarding the reasons for acquiring low quality materials during residential building construction in Kaduna State, Nigeria.

Groups	N	df	Mean	Sd		p	Remark
Builders	584	2,017	69.12	14.46			Kaduna State, Nigeria
Clients	1,435		74.59	11.83	-1.298	0.644	Often

Significant at P>0.05

Table 3 shows the analysis of independent sample t-test of mean achievement scores of Builders and Clients on causes of low income in standard and quality residential building. It revealed that the calculated t-value = -1.298, df = 2,017, p=0.644 indicating p> 0.05. Hence, hypothesis two was retained. This means, there was no significant difference in the mean achievement scores of Builders and clients on the reasons for acquiring low quality materials during residential building construction in Kaduna State.

HO_2: There is no significant difference between the mean response of builders and clients as regard ways of curtailing the difference between low income and the standard and quality of residential building in Kaduna State, Nigeria (P<.05).

The result of the t-test mean ratings of the respondents of builders and clients as regard ways of curtailing the difference between low income and the standard and quality of residential buildings in Kaduna State is presented in table 4. Levene test of homogeneity of variances for the data was .138 (and since the value is greater than the significant level of (P< 0.05) the assumption of homogeneity of variance was met. Therefore, t-test could be employed for the analysis.

Table 4

t-test of mean rating of respondents on response of builders and clients as regard ways of curtailing the difference between low income and the standard and quality of residential building in Kaduna State, Nigeria

Groups	N	df	Mean	Sd	t-value	P	Remark
Builders	584	2,017	79.12	14.46			
Clients	1,435		75.69	12.83	-1.398	0.864	Agree

Significant at P>0.05

Table 4 shows the analysis of independent sample t-test of mean achievement scores of Builders and Clients on ways of curtailing the difference between low income and the standard and quality of residential buildings. It revealed that the calculated t-value = -1.392, df = 2,017, p=0.864 indicating p> 0.05. Hence, hypothesis two was retained. This mean, there was no significant

difference in the mean achievement scores of Builders and clients on ways of curtailing the difference between low income and the standard and quality of residential buildings in Kaduna State, Nigeria.

Discussion of Findings

The findings in table 1 relating to research question 1 showed that respondents agree with all the items on the reasons for acquiring low quality materials during residential building construction in Kaduna State, Nigeria, (10) out of the 12 standard deviation of the items ranges from 0.46 – 1.84 this showed that the respondents were not too far from the mean and were close to one another in their responses. However, two standard deviation items (no. 10 and 12) ranges from 1.98 – 1.99 this showed that the respondent were too far from the mean and were not close to one another in their responses. The finding showed that the reason for acquiring low quality material during residential building construction are often**.** This is in conformity with the views of Mario (2010) who asserted that the allocation of projects to unqualified and unmotivated contractors, poor building standards in terms of inadequate sound attenuation/heat insulation, increase in final cost of building products and lack of basic urban design amenities are they possible causes of low quality residential building. Corroborating this finding Abdulkadir, (2018) pointed out that through this lack of clients' commitment toward quality achievement purchase of poor-quality construction materials, Substandard quality of workmanship and use of unskilled labour chosen among others. The finding in Table 2 related to research question 2 revealed that respondents agree that with all the items on the ways of curtailing the difference between low income and the standard and quality of residential building in Kaduna State, Nigeria, 10 items out of 12 standard deviation of the items ranges from 0.46 – 0.94 this signified that the nine (9) respondents were not too far from the mean and were close to one another in their responses. However, three (3) standard deviation items (no. 2,3 and 5) ranges from 2.08 – 2.09 this showed that the respondents were too far from the mean and were not close to one another in their responses. The findings showed that low income residential buildings need to have a high quality control on building materials by the government, Inspections on residential building during the construction phase, ensure project monitoring by ministry of housing and Ability to Purchase quality construction materials. This finding corroborate with the views of Abdukaldir, (2018) who stated that there should be registration with a quality assurance body by the constractors, allocation of projects to qualified contractors at all times among others.

The findings also revealed the Need to engender a culture of excellence related to quality on residential building. It also agreed on the ways of curtailing the difference between low income and the standard and quality of residential building in Kaduna State, Nigeria.Therefore, for standard and quality on residential building residential building, the client must ensure Adequate acquisition and security of building material during construction phase.

Conclusion

The study is determined to examine low income and it's effect on the standard and quality of residential buildings in Kaduna State, Nigeria. The finding of the study serves as the basis for making the following conclusion: that the above mentioned ways of curtailing the difference between low income and the standard and quality of residential building in Kaduna State highly agree by both builders and residential owners (clients) for a good standard and high quality of residential buildings in Kaduna State.

Recommendations

Bases on the findings and implication of the study, the following recommendation were made:

1. Kaduna State Government, through ministry of urban and town planning should organised orientation/seminar from time to time to brainwash the residential building client on what is required at each stage of the housing value chain, from foundation footing, (substructure), through the main building (super structure) and to the covering (superimposed structure) and to the finishing.
2. The Kaduna state government should setup a provision for an effective loan scheme, partial upgrading, effective urban development policy, and improvement of sanitary conditions and enforcement of housing and building codes. Above all, building materials should be subsidies by the government to encourage standard, quality and afforble residential buildings.

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Efficiency of Ternary Blended Cements on Concrete Samples

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Abstract

Ternary blend materials the innovative combination of cement with two different supplementary cementations materials (SCMs) rich in oxides of alumina, silica and iron in their content produced from wastesby-products to replace cement as binders. The ternary blended materials used as SCMs are rice husk ash (RHA) from agricultural waste and ground granulated blast furnace slag (GGBS) an industrial waste by-product from molten iron oremixed with aggregates to produce concrete. This are proportioned at 30, 40, 50, 60, and 70% by weight of cement combined with aggregates to cast concrete cubes and flexure for beams. This paper presented the performance and efficiency of the ternary blended concrete samples cured in water and hydrochloric acid (HCL) for 14, 28, and 160 days tested for compressive and flexural strength test. Results of M_B and M_C showed compressive strength of 44.6 and 38.34 N/mm^2 more than 33.9 N/mm^2 of M_A (the control) at 28 days and increased in strength as it ages in water for samples containing 70% cement, 25% RHA, 5% GGBFS and 60% cement, 30% RHA, 10% GGBS respectively. Similarly, the flexural strength results of M_B and M_C are 25.92 and 22.84 N/mm^2 as against 22.6 N/mm^2 of M_A at 28 days in water, while the samples cured in acid for the same period showed reduction in strength as the ternary blended samples resisted the acid better than the M_A control of 100% ordinary Portland cement. Therefore, ternary blended cement of RHA and GGBS properly proportioned with cement increase efficiency of concrete strength and durable.

Key words: Ternary cement, compressive strength, flexural strength, water, HCL acid

Introduction

Cement is one of the essential constituents for the production of concrete. HoweverHendricks, (2008) and Naik, (2008) reported that the main constituent (cement) is responsible for the emission of 7% carbon dioxide (CO_2), the total global CO_2 gas, the key green- house gas responsible for the global warming and climate change. Meena, (2007), further submitted that large amounts of carbon–dioxide gases are emitted during the calcinations of limestone to produce cement, for the production of one tonne of cement, the raw material of about two tonnes is required and it releases approximately one tonne of carbon – dioxide (CO_2).

To mitigate or reduce cement production due to hazardous gas released to the atmosphere, the new innovative combination of cement with supplementary cemetitious materials (SCM) rich in oxides of alumina, silica and iron in their content in the form of ternary could be used to partially replace or reduce the amount of cement in the concrete. The term ternary blended cement refers to a blend of portland cement with two supplementary cementitious materials (SCM). Kumar and Naik (2008), SCMs are waste, natural materials or artificial material that has cementitious properties

known as pozzolans or supplementary cementituous materials when combined. According to Peter (2014) reported that ternary mixtures contain portland cement and other two cementitious materials as binder, the materials may be industrial by-product or agricultural waste that contained supplementary cementitious materials such as fly ash, silica fume, ground granulated blast furnace slag, metakaolin, rice husk, corncob, snail shell and perm kernel shell etc. According to Hanson (2010) there are benefits in strength gain, reduction of shrinkage, and environmental benefits from using ternary blends since these mixtures reduce the amount of expensive raw materials used to manufacture cement and recycled industrial by-products. St. Clair (2007) conducted a study and reported that the potential of using ternary blends was to improve the strength of concrete if proportioned accurately. Amos et al (2018) tested the strength of concrete for 7 and 28 days using ground granulated blast furnace (GGBFS) and fly ash, compressive strength test results obtained for 100% cement (control) was 65.3 N/mm^2 and 74.5 N/mm^2 respectively, at 80% cement, 10% GGBFS and 10% fly ash, results are 70.5 N/mm^2 and 80.6 N/mm^2. Results at 60% cement, 30% GGBFS and 10% Fly ash are 56.7 N/mm^2 and 65.5 N/mm^2 respectively. At 70% cement, 10% GGBFS and 20% fly ash results are 65.67 N/mm^2 and 74.89 N/mm^2 respectively. Sarika et al (2013) conducted compressive strength of ordinary portland cement and ternary blended concrete at 28 and 90days at w/c ratio of 0.55. The following results were obtained, 100% cement 35.20 N/mm^2 and 37.52 N/mm^2 respectively, 80% cement, fly ash at 15%, 5% silica fume results are 40.64 N/mm^2 and 44.87 N/mm^2, when 75% cement, fly ash at 20%, silica fume at 5% results are 35.47 N/mm^2 and 42.35 N/mm^2. When cement is at 70%, fly ash at 20%, silica fume at 10% results are 38.21 N/mm^2 and 38.60 N/mm^2. This showed that ternary blended concrete has more strength that ordinary Portland cement. Jones et al., (2000) examined the chloride performance of concrete containing ternary blends using metakaolin, ground granulated blast furnace slag (GGBFS) and cement, the following results at 7, 14, and 28 days, 24 N/mm^2, 29 N/mm^2 and 38 N/mm^2 were obtained. This shows that ternary concrete has high resistance to chloride attack. Murthy and Shirakumar, (2008) investigated acid resistance of ternary blended concrete immersed up to 32 weeks in sulphuric acid and Hydrochloric solution using fly ash and silica fume showed that the ternary blended prepared by 20% fly ash and 8% silica fume did better, had acid resistance than the Portland cement. Amos et al., (2018) did a flexural strength test on ternary concrete, at 28 days. When cement is at 100%: 6.0 N/mm^2 was obtained, at 80%, RHA 5%, silica fume 15%: 8.6 N/mm^2 was obtained, cement at 85%, RHA at 10%, silica fume at 5%: 8.4 N/mm^2 was obtained and cement at 75%, RHA at 15% and silica fume at 10%: 7.2 N/mm^2 was obtained.

This research investigated the performance and efficiency of ternary blended cement materials, such as ground granulated blast slag (GGBS) and rice husk ash (RHA) which is industrial and agricultural by-product combined to partially replace cement to produce and determine concrete strength. The study proportioned ternary blended SCMs mixed with cement added to aggregates to form concrete. The work is to test the efficiency of ternary blend concrete, evaluate compressive and flexural strength of cast samples cured in water and hydrochloric acid to study the performances at 14, 28 and 160 days.

Materials and Method

Rice husk ash (RHA)

The rice husk shaft used for this research work was obtained from the rice mill factory at Lafenwa, Abeokuta, Ogun State, Nigeria. The rice husk shaft was calcined and produced at Moshood Abiola polytechnic laboratory Abeokuta, Ogun state at a temperature of 400^0C. Afterwards, sieved with a 0.063 mm sieve size to remove burnt particles and obtained a finely rice husk ash.

Granulated ground blast furnace slag (GGBFS)

Granulated blast furnace slag was gotten from Ogijo, Ogun State. It is a waste by product of smelting molten pig iron and when cooled becomes granulated. It is then grinded at a milling shop at Kuto, Abeokuta, Ogun State into a fine powder. It was thereafter sieved with 0.063mm sieve size to achieve a finely ash powder for the research work.

Plate 2: Samples of ground granulated blast furnace slag

Water

Water used for this project work was gotten from the public tap, pure and clean fit for human consumption.

Cement

Portland cement of the Elephant brand was obtained from reputable sales outlets in the city of Abeokuta.

Aggregates

The fine aggregate used was washed river sand, with particle size ranging from 5 mm down while coarse aggregate used was granite of 10 mm size, sourced from quarry in the city of Abeokuta.

Hydrochloric acid (HCL)

The test for durability of the blended concrete was done by curing the samples in hydrochloric acid solution a colorless inorganic chemical purchased from a sale outlet shop at Panseke, Abeokuta, Ogun state. 10% of acid solute by weight of water that submerged 3samples is used to test the durability of the specimens while other samples were cured in water for 14, 28, and 160 days respectively for determination of strengths.

Mix proportions

The mix proportions for the concrete was 1: 1: 2, water cement ratio of 0.5 mixed at 0, 30, 40, 50, 60 and 70% of proportioned RHA and GGBS by weight of cement as shown in Table 1. One hundred and eight numbers of samples were produced for the test which consisted of the cubes and beams cured in water and acid for 14, 28 and 160 days. The cubes size was 70 x 70 x 70 mm, while the size of the beam was 120 x 120 x 360 mm cast and cured in water and HCL.

Table 1: Proportioned percentage SCMs by weight of cement

Ternary blended SCMs %	Sample no.	CEM (%)	RHA (%)	GGBS (%)	Total SCMs %
100% OPC (control)	M_A	100	0	0	0
0.7C+ 0.25RHA +0.05GGBS	M_B	70	25	5	30
0.6C+0.3RHA+ 0.1GGBS	M_C	60	30	10	40
0.5C + 0.35RHA + 0.15GGBS	M_D	50	35	15	50
0.4C + 0.4RHA + 0.2GGBS	M_E	40	40	20	60
0.3C +0.45RHA +0.25GGBS	M_F	30	45	25	70

Mechanical strength test of samples

Compressive and flexural strength test were performed on the samples at the ages of 14, 28, and 160 days. Samples removed from the curing tank, dried in the air, test conducted on the universal tensile machine as shown in Plate 3-4.

Plate 3: Compressive strength test

Plate 4: Flexural strength test

Results and Discussion

Consider Table 2 and fig. 1 respectively, M_A, M_B, M_C, M_D, M_E and M_F showed increase in compressive strength throughout all the ages cured in water but at a decreasing rate in acid fig. 2. The tested ternary supplementary cementitious blended concrete samples M_B, M_C and M_D cured in water, showed improved increment of compressive strength from 14 to 160 days more than M_A which contains ordinary Portland cement. At 28 days compressive strength the M_B and M_C are 44.6 and 38.34 N/mm^2 respectively more than 33.9 N/mm^2 of M_A of the control. Likewise the samples cured in acid, the ternary blended concrete samples M_B, M_C resisted the hydrochloric acid more than the ordinary Portland cement M_A though at a decreasing strength as the samples ages. This is as a result of chloride attack on the siliceous aggregate and the alkaline present in the blended concrete which formed a gel that create void in the concrete which the SCMs resisted.

The flexural strength, Table 3 and fig.3 conducted on samples M_A, M_B, M_C, M_D, M_E and M_F showed increase in flexure from 14, 28 and 160 days. Samples M_B and M_C at 28 days flexural strength was 25.92 and 22.84 N/mm^2 as against 22.6 N/mm^2 M_A in performance, showed improved strength more than the control. The performance of samples cured in HCLacid fig. 4 follow similar trend but at a reducing strength due to the acid attack. The ternary sample with more alkaline present resisted the acid attack more than the 100% ordinary Portland cement.

Table 2: Compressive strength of ternary blended concrete cubes

TERNARY BLENDED SCMs %	COMPRESSIVE STRENGTH (N/mm^2) CURING DAYS					
	14		28		160	
	WATER	ACID	WATER	ACID	WATER	ACID
M_A	21.5	10.95	33.9	6.55	42.65	2.45
M_B	24.96	18.95	44.6	13.27	48.74	3.21
M_C	22.67	13.16	38.34	12.68	43.98	2.72
M_D	10.71	8.44	20.32	9.76	31.98	2.21
M_E	7.45	5.75	18.01	6.99	22.32	2.11
M_F	6.69	5.13	15.83	3.55	20.14	1.43

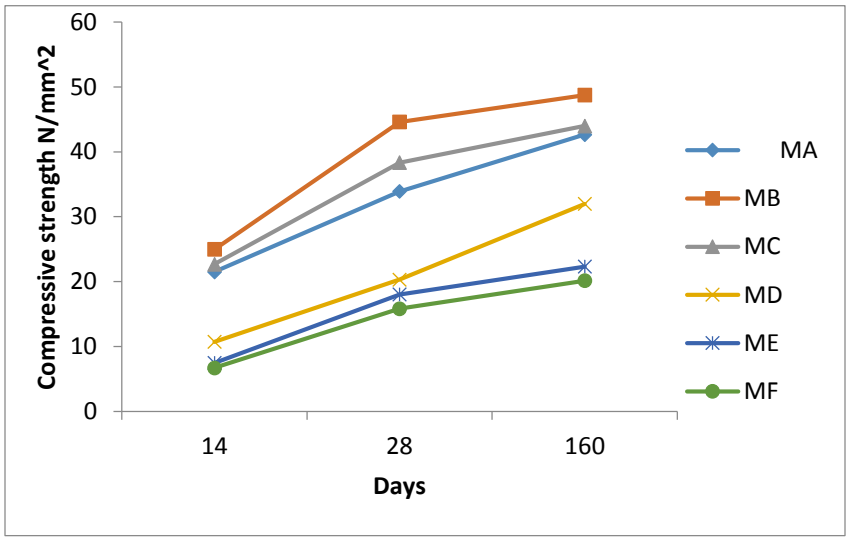

Fig. 1: Compressive strength of ternary blended concrete cubes in water

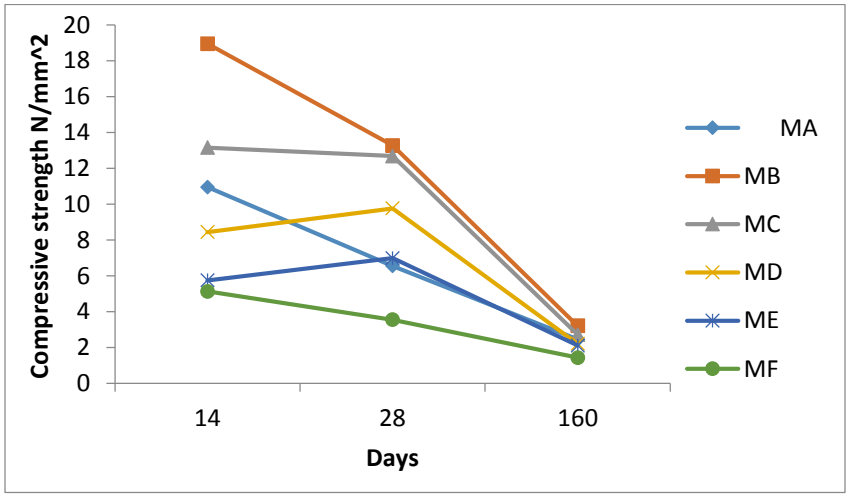

Fig. 2: Compressive strength of ternary blended cubes in acid

Table 3: Flexural strength of ternary blended concrete beams

TERNARY BLENDED SCMs %	FLEXURAL STRENGTH (N/mm²) CURING DAYS					
	14		28		160	
.	WATER	ACID	WATER	ACID	WATER	ACID
M_A	10.03	7.38	22.6	4.82	38.54	2.86
M_B	14.51	11.2	25.92	9.36	45.75	5.73
M_C	12.39	9.38	22.84	7.49	39.64	4.21
M_D	9.2	7.64	18.34	4.62	27.41	2.86
M_E	8.22	6.59	15.12	4.01	22.65	2.23
M_F	7.18	5.58	12.44	3.97	19.74	2.08

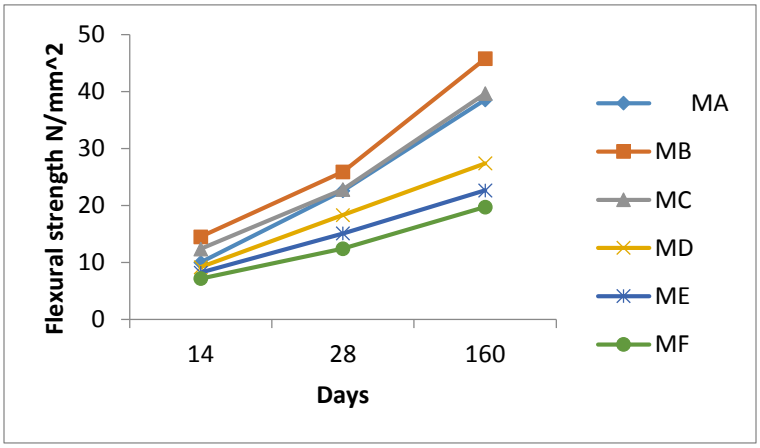

Fig. 3: Flexural strength of ternary blended beams cured in water

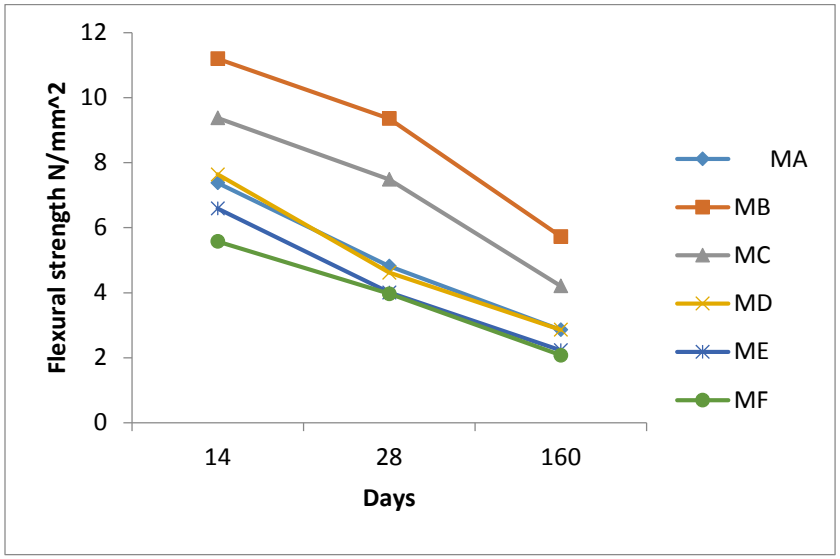

Fig. 4: Flexural strength of ternary blended beams cured in acid

Conclusion

M_B and M_C samples contained 70% cement, 25% RHA,5% GGBS and 60% cement, 30% RHA, 10% GGBS performed creditablyin strength well above $M_A$which contained 100% ordinary Portland cement at 28 days both in compressive and flexural strength. Therefore the efficiency of ternary blended materials in form of RHA and GGBS proportioned appropriately with cement improved concrete structural strength and durable.

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The Role of Vocational Training in Bridging Skills Gap in The Building Industry of Nigeria

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Abstract

The level of skills possessed by vocational education graduates for employment has been a worrisome issue in Nigeria. In fact, the representatives of labour markets tagged graduates from Nigerian universities as half-baked perceiving these graduates as lacking in employable skills, making them unemployable. The purpose of this study is to ascertain how partnerships between industries and vocational institutions can be a tool to bridge the skills gap and unemployment of vocational education graduates in Nigeria. The study revealed that industries and institutions partnerships will help to bridge the skills gap and reduce unemployment of vocational education graduates in Nigeria through workplace partnership like resource sharing, staff exchange and the establishment of vocational skills, exhibition centres amongst others. Based on the findings of the study, it was recommended that industries, government and institutions should establish partnership that will help to enhance the skills and chances of employment of vocational education graduates in Nigeria.

Key words: Vocational Training, Skills, and Building Industry.

Introduction

Skills are what an individual possesses which may be learnt informally and/or on-the-job. Skills Gap is the difference in the skills required on the job and the actual skills possessed by the staff. Skills Gap arises when a worker does not have all the skills necessary to do the job effectively. Therefore, skills gap refers to the situation where an industry has workers but they are not skilled enough to meet the organizations' objectives (Jean, 2003). The building industry is growing but it seems the stock of competent skilled construction workers has dwindled (Odusami & Ene, 2011). A skill gap is the shortage in performance. It is the difference between what is required or expected and what we actually get. Put in another way a skill gap is the required performance minus the present performance. Hence, it is also called the performance gap. Basically, a skills gap or performance gap is the difference between the actual or present performance and the optimal or future performance.

Vocational training is an educational training which encompasses knowledge, skills, competencies, structural activities, abilities, capabilities, and all other structural experiences acquired through formal, on-the-job or off-the job which is capable of enhancing recipients' opportunity for securing jobs in various sector of the economy or even enabling the person to be self-dependent by being a job creator. Federal Republic of Nigeria (2004), opined that vocational training is an aspect of the educational process involving in addition to general education, the study of technologies and related sciences and the acquisition of practical skills, attitudes, understanding and knowledge relative to occupations in the building sector. Manfred and Jennifer (2004),

advocated that vocational training comprises all more or less organized or structured activities that aimed at providing people with the knowledge, skills and competencies necessary to perform a job or a set of jobs whether or not they lead to a formal qualification. These definitions show the relationships between vocational training and skill development towards a sustainable building industry in Nigeria. Common indicators of Skills issues are poor workmanship and building failure. Nigerian cities with the exception of the enclave of the rich and powerful are characterized by poor quality structures, poor layout and streets access, lack of essential utility services, inadequate security, and social services (Alemika, 2010). Apparently, deficiencies exist between the skills of vocational workers and those required to meet the needs and expectations of employers in the building sector which prompt the researcher to examine the role of vocational training in bridging the skills gap that exist in building industry in Nigeria. The skills gap in the Nigeria building industry can be attributed to the dwindling stock of competent skilled construction workers and the influx of unskilled, inefficient and dissatisfied workers who see the building sector as a last resort. Adequate and effective vocational training in Nigeria can meet the highly skilled human resource need in the Nigerian building industry. Skill needs in building sector includes building drawing skills, surveying, landscaping and site preparation skills, foundation skills, ability to use machines for construction, ability to use hand tools for practical work, brick and block laying skills, roofing skills, masonry skills in building, concreting and reinforcement skills, carpentry and joinery skills, final finishes skills and plumbing skills. In recent times, the government of Nigeria through the Federal Ministry of Lands, Housing and Urban Development has shown concern about the present dearth of skilled artisans and craftsmen in the building construction industry. They asserted that artisans and craftsmen constitute an important component of the value chain in housing delivery and essential for the production of well-built, good quality and durable housing on a greater scale across the country. The ministry is using two vocational training centres located in Lagos state to upgrade the skills of this category of tradesmen. The ministry recently completed the renovation and upgrading of its facilities at the Harvey Road, Yaba Lagos training centre and a school of Architectural and Building Technicians is being constructed in Kuje, in the FCT. Efforts are being made by the Nigeria Federal government 10 establish six more skills acquisition/ vocational training centres in different parts of the country, as well as undertake a review of the curricula for artisan and vocational training in conjunction with relevant institutions.

Apart from skill obsolescence that occurs over time in the Nigerian building industry, there are other factors that cause skill gaps which an effective vocational training would have curtailed. A major factor is the changing pattern of working in building industry. The current trends in the world of work such as globalization, commercialization, flexi-hour, deregulation, outsourcing, contract work, homework and freelancing have led to marked changes in industry structure. New definition, new meaning, and new application of knowledge drive all these changes. New forms of work structures which are flexible, adaptable, less hierarchical, and multi-skilled and which encourage continuous learning are becoming sources of competitive advantage in the building industry. International competition for jobs and workers has also intensified, leading to the global talent hunt for innovation-driven knowledge workers. However, the researcher is examining the role of vocational training in bridging these skill gaps that exists in the Nigerian building industry.

Concept of Workplace Training in Technical Vocational Education and Training

Workplace training has been widely recognized as the most efficient method for skills development. According to the Australians, workplace training and learning is the training or learning undertaken in the workplace, usually on the job, under normal operational conditions. Similarly, the European Centre for Development of Vocation, defined workplace training as a form of training that takes place in a workplace based on the principle of learning by doing and includes demonstrations by a more experienced employee, performance under supervision, and coaching, job rotation and participation in specific projects. CEDEFOP further asserted that workplace training can be associated with formal training programmes as well as informal or incidental learning that may or may not result in some form of credential.

The works and training, emphasized the need for learning and practice to be in context, for learning to be effective and meaningful. To these authors, knowledge is situated of which is a product of the activity, context and culture in which it is developed and utilized. This implies that enabling learners to work and learn in stimulating environment can enhance learning. Workplace training can take various forms such as formal apprenticeships which typically involve a contract, lasting for a period of two to four years and leading to a formal qualification or other shorter and often less formal training and work experience programmes for youths as well as training for employees. CEDEFOP stated that workplace training generally involves the use of experts (trainers) who play a leading role in transferring the needed knowledge and skills to the learners or workers. Through workplace training, people are motivated to learn. Uwameiye added that the workplace is the primary location in which the pedagogic values can be appreciated by relating what is learnt to the application and development of identities. Here, learning becomes a natural process that occurs as people participate in the work situation. A key advantage of workplace training is that it provides opportunity for immediate application of the acquired knowledge and skills to the workplace (CEDEFOP, 2011).

In recent years, due to the globalized markets, improved technology increasedcompetition, and as a result transformed demand, the construction industry is suffering from low performance. The project-based nature of the construction industry led us to consider construction companies and the projects as the main components of the industry. Therefore, with an inductive approach, it can be assumed that the performance of a construction company depends on the cumulative success in its construction projects; the performance of the construction industry depends on the cumulative success of construction companies, and the performance of a country's economy depends on the success of its constituent industries, including the construction industry. Therefore, all these components should perform superior performance in order to increase the performance of the countries. Especially, it should be noted that the performance of construction projects and hence of construction companies and the construction industry depend on a great deal on competent project team. However, the construction industry suffers from a shortage of skilled labor. Human resource development is important to gain competitive advantage in the construction industry. In this context, training and development of labour force takes an important place. In addition, dynamic structure of construction industry necessitates various new methods and project types. Also, changeable labour force profile for every project alleviate demand for trained labour force in the construction industry. In this context, the companies can apply two different methods: "on the job training" and "off the job training". "On the job training method workers take pre-prepared courses and they are sent to different workplace to learn their vocation. However, they are not as

much effective as "off the job training" because training expenditure, contracting and lack of worker incentive can be problems for construction companies. One of the important providers of "off the job training is Vocational Education and Training TVE(T) institutions. TVE(T) provides adequately trained labour which in turn may lead to increase productivity that will directly enhance construction company competitiveness.

In addition, equipping the workforce with the skills required for the jobs of today and those of tomorrow is a strategic concern in the national growth and development outlooks of all advanced countries. The need to upgrade skills applies to the current generation of workers. Therefore, building a skill development strategy requires good-quality education and training systems, and reliable performance measurement to sustain efficiency. In this context, considering that delivering knowledge is no longer restricted, traditional higher education institutions, TVE(T) has become an inevitable and necessary asset in the knowledge-based economy era. Consequently, TVE(T) institutions are important in achieving company and industry targets. TVE(T) institutions create competitive advantage for a construction company by improving project performance in terms of reduced cost, better quality, and shorter duration, as VE(T) institutions train construction workers to learn their vocation (Bilginsoy 2003, Tabassi and Bakar 2009). One of the important management tasks in the construction industry is performance evaluation to improve the performance of the industry. Reports emphasized the need for performance evaluation in the UK (Bassioni et al. 2004). As stated above, increase in the performance of TVE(T) in construction industry will cause a direct increase in the performance of construction projects and companies respectively. Therefore, setting a clear set of indicators to measure the performance of education and training systems is important (EC 2010). Therefore, in addition to setting up TVE(T), it is necessary to put in place performance measurement systems. Measuring the performance of TVE(T) is conducive to better education and training programs. Performance evaluation systems provide a mechanism that enables organizations to improve their business (Robinson et al. 2005). Therefore, one of the important steps in the development of a performance evaluation system is the identification of the Key Performance Indicators (KPIs). KPIs represent a set of measures focusing on those aspects of organizational performance that are the most critical for the current and future success of the organization. In designing a conceptual performance measurement system of TVE(T), the determination of KPIs is very important as these KPIs can improve the outcomes of TVE(T) and may encourage TVE(T) providers to engage in long-term and goal-oriented development work, hence facilitating the achievement of the goals set for TVE(T) by the industry.

The relationships between the Performance of TVE(T) Institutions and Construction Industry shows that the construction industry depends heavily on manpower (Awe et al., 2010). In contrast to this requirement, there is a problem to find skilled labour force in the construction industry, labour shortage plays a drastic role in achieving sustainability in construction projects. Because the labour force not only have vital importance on time, quality and cost, but also have an effect on sustainable development characteristics (economic, environment, and social) depending on time, quality and cost. Awe et al. (2010), also performed survey to identify the root causes of Nigerian construction industry's labour shortage. According to respondents, insufficient training methods, non-applicability of apprenticeship according to lack of facilities and lack of incentives are the highest scored causes of labour shortage. Thus, comprehensive vocational education and training is a remedy to the shortage of skilled labour force. Bilau et al. (2015) also summarized the importance of skilled labor force for projects of small and medium construction firms. According

to the authors, skilled labour force increase quality, productivity and reduce time and cost overruns. Therefore, the authors stated that there is a direct relationship between TVE(T) and construction industry. In Abdul-Aziz et al.'s study (2008), the authors performed a survey to investigate perceptions of TVE(T) trainees. The results showed that industry needs TVE(T) graduates to eliminate worker related problems because the trainees have required ability that meets industry needs. Also, interesting findings from the survey, ex-trainees do not spend too much effort to find work when graduating from TVE(T) centres. In brief, TVE(T) performance depending on nation policies, finding opportunities e.t.c; prevent effective skilled labour force in construction industry according to literature review. So that construction industry that depends heavily on manpower have problem with project constraints for TVE(T) Institutions. Most studies about performance evaluation were conducted by considering only one perspective, namely; finance which causes misleading consequences. Especially for VE(T), which has not only economic benefits, but also social benefits, a peTrformance evaluation based on only financial criteria does not provide a comprehensive understanding. Therefore, in this study, a framework based on Balanced Scorecard (BSC) was developed to reveal all aspects of performance evaluation of TVE(T) by conducting a comprehensive literature survey. The BSC is a strategic planning and management system that connects the dots between big picture strategy elements such as mission (organization's purpose), vision (what organization aspires for), core values (what organization believes in), strategic focus areas (themes, results and/or goals) and the more operational elements such as objectives (continuous improvement activities), measures (key performance indicators which track strategic performance). targets (organization's desired level of performance), and initiatives (projects that help organization reach its targets). BSCs are used extensively in business and industry, government, and nonprofit organizations worldwide. The concept of BSC was to replace traditional performance systems focusing on only one single financial indicator. The financial perspective is still the core performance criterion in BSC, but three more perspectives are considered, namely customer, industrial process, learning and growth. This model constitutes a balanced performance evaluation and provides comprehensive insights into the effectiveness of organizations. The BSC is commonly used to measure performance. For example, to measure the performance of non-profit small and medium sized enterprise, BSC was used to measure the performance of Enterprise Resource Planning (ERP) operations. The general representation of balanced scorecard (BSC) method is presented in the Framework based on BSC which were widely used in studies about the performance evaluation of educational institutions. For instance, BSC was used to assess the performance of extension education centers in Taiwanese universities, and to evaluate private universities in Iran, and by Al-Hosaini and Sofian (2015) to rate higher education institutions in Malasia.

Benefits of Building Industry in Career Development

Endless Opportunity

With seven out of every 10 jobs available in the United States requiring less than a four-year degree, the current job market is oversaturated with college graduates. By pursuing a craft career, you will be opening yourself up to more possibilities and opportunities. When you complete a technical degree, apprenticeship or craft training certificate, you are highly marketable in the job market. Additionally, with a skills gap and upcoming wave of retirees, there will be a demand for 1 million craft professionals by 2023. This is a staggering deficit, but it makes room for a lot of opportunities for new crafts people, want to know what the job demand is in your state? Take a

look at BYF's Craft Demand Map and check out the demand for skilled crafts by state and by specific crafts.

Variety of Careers

There are so many specialties within the construction industry. With a seemingly endless list of craft careers, there is something out there for everyone, whether you are creative, mathematically inclined or a natural problem solver, there is a craft career for you. In addition to different interests, there are different education requirements for different professions. Have your mind set on a college degree, associate degree or technical education program.

Freedom to Travel

With a high demand for craft professionals in every state, there is no limit to where a craft career can take you. Whether you move around on your own or work for a national or global construction company, there are endless ways to travel around. A career in construction presents the unique opportunity to travel throughout the country and get paid while doing so. Construction happens all around us. It happens in every country, every state and nearly every city. If you are interested in traveling, a craft career is perfect for you. With the opportunity to travel and work across the country or even the world, you can go anywhere you please with a construction skillset. Additionally, when working in construction or building industry, your office is always changing and in a variety of exciting places. Whether you are building a home, baseball park or theme park - you get to enjoy the added benefit of a constant change of scenery.

Room for Career Growth

It is estimated that 29% of the construction workforce will retire by 2026. By 2031, this number worsens as 41% of the current workforce is expected to retire. Essentially, almost half of the workforce will need to be replaced in just over a decade, though this is a frightening number, it puts newcomers to the industry in a good position. As boomers leave open opportunities in the skilled crafts, specifically in high up positions like journeyman, superintendent and project manager, there will be a lot of room for career growth. With the opportunity to continue to move up in the industry, there is no limit to how high a craft professional can go. With experience, expertise and passion - a craftsperson could become an executive, CEO or owner of their own company. In construction, the only thing limiting your career growth is your desire to move up.

High Wages

With such a high demand for craft professionals, companies are willing to spend more to get the skills they need. For those in the construction industry, this means they are getting paid higher salaries than ever before. When you factor in these high salaries, less debt and the ability to start earning a wage as an apprentice, craft professionals are getting an early start on making enough money to live comfortably. Each of these benefits alone is enough to make a career in construction worth exploring. But when you look at them together, it is hard to believe they can all come with a single career choice.

The Importance of Vocational Training for Career Development in building Industry

Skill development and employability

Vocational learning opportunities play a critical role in skill development and employability. The importance of vocational development can largely be summed up as the difference between theoretical knowledge and practical skills. Vocational students often spend hours of their time exploring a variety of different subjects. Their class time tends to be only a few hours per week, as they will spend many hours in the library and on computers conducting research and writing papers that help them continue to build their theoretical knowledge in a variety of fields. Even within their chosen discipline, they often spend a significant amount of time exploring theory, ideas, and procedures used by other professionals in the industry. They have significantly fewer opportunities to actually put these ideas to work compared to students going through a vocational education situation. The skills for work and vocational pathways are significantly limited for these students, as their theoretical knowledge does not have the work experience that helps them transition from a classroom study topic into their actual profession. This can sometimes cause challenges when the students graduate and transition into the working world.

However, for students in a vocational education and training setting, this situation gets corrected. Students spend hours in the practical workshops each week learning hands-on practical skills related to their chosen field. Class time tends to increase in these schools, compared to their outside research time, because students spend more time exploring actual work opportunities that prepare them for their future jobs. They do not focus as much time on researching the theoretical as learning the practical.

Students also have courses that will walk them through chances to use the highly specialized equipment and spaces that they need to do their jobs well. Rather than simply learning about this type of equipment or how it might be useful in the job, they actually have the chance to try out their own skills while still in school. When the time comes for them to transition to an actual job, they have the experience they need to begin the job right away. They will not have to spend time learning how to physically operate the equipment on the job, allowing them to become a valuable employee and build a career faster.

The value of graduating with work skills

When employers look for new employees to join their institution, they know that they want to find someone who has the skills to do the job well and can adapt quickly to the work environment. Businesses spend a significant amount of money trying to onboard new employees, as they must go through a training process and anticipate that there will be a learning curve for the employee on a new job.

Students do not enter the work field with little practical experience regarding the tools and environments in which they will work. Instead, they have specifically worked in these situations throughout their education under the supervision of their trainers. This creates a more favorable employability skills assessment. Potential employers can look at the academic record of these students and know the type of skills they will already have when they first enter the building. This effect can be leveraged even more, when a training institution is applying a competency-based training approach that is mapped with the industry's needs.

For those interested in learning how to enhance employability skills, therefore, the first solution should lie in vocational learning opportunities. These skills can help students learn the techniques and strategies that they specifically need for this area of work and ensure that they are prepared to succeed. Employers can feel confident that the candidates they receive from a quality school already have the experience and training they need to begin work right away.

Finding a Job Following Graduation

Many graduates struggle to find employment immediately following graduation. It can be a stressful time for many students, trying to balance their last few months of studies as they begin to submit applications and search for positions in their chosen field of work. For students who have graduated from a vocational training school, however, this situation can go a bit differently. They have the experience to list on their resume and employers know they have a significant portion of the training they need, often they even have started building a professional network through their job placements and internships they could potentially leverage. This helps to open doors to new possibilities.

Graduates often want to know how they can enhance their employability opportunities. The answer lies in gaining the work experience that employers want to see. Bringing this experience can make it significantly easier to find a job. Experience gives employers more insight into how a candidate will perform on the job and how many resources will need to be dedicated to training a new person for the job. For vocational students, these work experiences become part of the curriculum. Throughout the studies, students gain hands-on opportunities through internships and practical learning opportunities. Completing real work projects, as they do in a variety of classes, helps students build employable resume before they even graduate.

Building Strong Networks for Students before Graduating

In nearly any industry, the importance of a strong network can play a direct role in finding a job and building a successful career. Connections and relationships can help people find new jobs, learn about new opportunities, and have chances to continue their education and build more career-based skills.

Through a vocation-based education, students have an excellent opportunity to build a strong network that will enhance their learning experience and the rest of their professional careers. With a vocation-based training program, students work more closely with their fellow students and their trainers on their coursework. Since less time is spent independently researching and writing papers and more time is spent in class working on projects and learning practical skills, students naturally develop better and closer relationships with their classmates. Their fellow students transition from being people they simply sit next to in the lecture hall into partners with whom they work during projects and internships.

Similarly, students have more opportunities to get to know their professors. With skills-based training, students work more directly with their trainers. The hands-on opportunities they have to work during their coursework let them complete projects, engage with work tasks, and learn specialized techniques under the direct supervision of the trainer. Trainers are there to provide support and students have opportunities to speak with them and engage with more one-to-one time. This builds relationships and can help students find professional mentors for the transition to the

business world. Through internship opportunities, students expand this relationship horizon into the work world, even before graduation.

Altogether, this type of practical classroom experience helps those learning in a vocational training program develop a strong professional network that will benefit them throughout their entire professional career. They will have people who can provide them with insight and guidance as they build a career and find the jobs they want.

Students Experience Economic Benefits

Students who go through vocation-based schooling also have the chance to receive a variety of different economic benefits from their education. Most importantly, they often do not have to spend as much on their schooling while still receiving an education that prepares them exceptionally well for their field. Vocational schools often have fewer years required to earn the degree of certification and often cost less in tuition each year as well.

Additionally, students who graduate from specialized programs like this can enter their career path faster. Employers know that they already have work experience and training related to their field, which makes it easier to transition into the desired role and takes less of a toll on the business working to onboard them. Students can accept more specialized jobs and earn the applicable salary as well. This combines to create a strong economic opportunity for graduates from vocational programs. Vocational graduates also tend to have a good toolset to raise through the ranks rapidly as they know the trade inside out. Another financial aspect is "earn as you learn" that many vocational training paths offer. Here students have the ability to earn some money and hence reduce the financial impact of their studies through paid internships as part of some curricula.

When it comes to educating students, the importance of building skills-based education cannot be underestimated. Students who attend schools that specialize in teaching them skills that they need to excel in a particular field will find that they finish school well

prepared to enter their chosen field. They gain on-site work experience throughout their education so the transition to the working world is minimal, helping them professionally and financially. The businesses who hire them know that they can count on their new employees to get started immediately in the field and work with a high level of independence and competency, creating a favorable experience for everyone involved.

Those interested in pursuing a vocational pathway for their education and a career in one of the many exciting trade areas these types of schools' service should carefully be considered if the benefits described here will help them in their chosen field.

Conclusions

Non-acquisition of saleable skills has been a major factor in the countries underdevelopment and high rate of poverty and other social vices, for many citizens of the country, these problems are their daily challenges, when they cannot feed, clothe or shelter themselves or their immediate family. They surely cannot realize their full potentials, since the need for survival is so overwhelming and a good number of people have fallen victims to the pressures of survival and have ended up as arm robbers, prostitutes' scammers, or militants fighting for whatever that gives them hope for survival. The failure of the government to reposition the vocational and technical skills

Recommendations

1. The Nigerian government at all levels and TVE(T) policy makers should make a mandatory provision for TVE(T) institutions to establish effective and sustainable linkages with the 21st century workplace. This collaboration could be very useful for practical training of students and therefore facilitating effective skill acquisition.
2. TVET institutions curriculum should emphasize more on work environment habit, inculcating into students in order to make them abreast with the emerging trends in the occupation of work.
3. Adequate monitoring and supervision of SIWES programme should be intensified as well as developing a synergy of information between the TVE(T) institutions and the 21st century workplaces.
4. All stakeholders in the TVE(T) sub-sector should employ the school-workplace collaboration for enhancing workplace training. This will improve the quality of TVE(T) programmes in Nigeria.
5. TVE(T) institutions should encourage and give credit points for students who do long semester holiday placement training in relevant industries in their field of endeavour in order to improve and boost the student working experience for a smooth transition from school-to-work.

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Analysis of Technical Skills Improvement Needs of MVM Craftsmen in Autotronics Servicing in Benue State, Nigeria

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Abstract

This study determined the technical skills improvement needs of MVM craftsmen in autotronics servicing in Benue State, Nigeria. Three research questions were developed, while two null hypotheses were formulated and tested at 0.05 level of significance. Descriptive survey research design was adopted for the study. The entire population of 203 respondents consisting of 11 automobile technology lecturers in Benue State univeristy Makurdi, College of Education Kastina-ala and Oju, and 30 autotronics experts in the industries as well as 160 MVM craftsmen in Benue State, were used for the study. A 32 – items structured questionnaire, developed from the study was used to collect data from the respondents. Each questionnaire item was divided into two categories of skills required and possessed. The questionnaire items were face validated by three experts. 201 copies of the questionnaire administered were retrieved and analysed. Weighted mean, standard deviation and Improvement Need Index (INI) were used to answer the research questions while t-test and ANOVA statistic were used to test the null hypotheses 1 and 2, at 0.05 level of significance. The findings of the study revealed that 26 out of 32 technical skills required/ possessed items in autotronics servicing were required/possessed respectively. It was therefore recommended among others that, There should be in-service training on autotronics servicing to train the MVM craftsmen, curriculum contents should be directly related to what industries and society need of MVM craftsmen so as to make them (MVM Craftsmen) work easily in industries and take care of societal demand.

Key Words: Technical Skills, MVM Craftsmen, Autotronics

Introduction

Technical colleges are secondary institutions where individuals are trained to acquire skills knowledge and attitudes required for either self or paid employment. The aim of technical colleges according to Ogunmilade (2017), is to give training and impart the necessary skills leading to the production of craftsmen, technicians and other skilled personnel who will be enterprising and self-reliant. Technical colleges offer varieties of technical and vocational trades to include; carpentry and joinery, blocks, bricks laying and concreting, fitting and machinery technology, electrical installation and maintenance work, welding and fabrication and motor vehicle mechanics (MVM).

Motor Vehicle Mechanic (MVM) trade is one of the vocational training skill programmes operated basically through the informal setting with apprenticeship mode of instruction. It is designed to produce competent motor vehicle artisans for the technological and industrial development of the society. In Nigeria, Motor Vehicle Mechanic Works trade as a vocational training programme is offered in Technical Colleges, companies and designated skills acquisition centre of Motor Vehicle Workshops across the Nigeria (Okwelle, *et al.,* 2017). It is expected that those who acquired MVM

skills will be gainfully employed or self-employed after their training. In essence, according to National Board for Technical Education (NBTE) (2009),Motor Vehicle Mechanic work students are expected to upon completion of their training be able to test, diagnose, service and repair any fault relating to conventional motor vehicle assembly main units and systems to manufacturer's specifications.

The programme of motor vehicle mechanic work at technical college level consists of three components/subject grouping as; service station mechanic work and system layout, engine maintenance and refurbishing as well as auto electrical work (Ogunmilade, 2017). According to Deebom, *et al.*(2018) the major challenges of motor vehicle mechanic graduates who eventually turned out to be craftsmen upon graduation is lack of basic understanding of electronic system and sub-systems incorporated in modern autotropic. These might be as a result of the fact that the present motor vehicle mechanic curriculum has not been reviewed to take care of assemblage of a groups of sophisticated technologies in modern vehicles called autotronics.

Autotronics referred to the blend of "AUTOmobile and elecTRONICS", the advanced development of vehicles in the last few years was based mainly on electrical and electronic components and modules. Autotronics as the combination of automobile and electronics or the use of electronics science in automobile vehicles. It has many applications in motor vehicles technology. Autotronics as an aspect of automobile technology presents basics advantages, layout, components and functional operation of various computer controlled motor vehicle systems. It also clarifies how to use recent diagnostic tools and equipment for analysis and fault finding. Dem, (2014) further explained that autotronics involve computer controlled motor vehicle systems like; engine management, Ignition system, Fuel System, Transmission System, Traction Control system (TCS), Anti Brake Skid (ABS)and Stability Control (SCS).Thus, an individual charged with the responsibilities of maintaining and repairing all forms of these components in modern vehicles are of course the MVM craftsmen.

The graduates of motor vehicle mechanic work are also known as "Auto-mechanic Craftsmen" and are expected to acquire these skills to enable them create or secure sustainable jobs and use their knowledge, ability, initiative and creativity for self-reliance. Motor Vehicle Mechanic craftsmen according to Abd-el-aziz (2013), refers to the particular person who upon graduation have acquire formal training in motor vehicle mechanic work (MVMW) from technical college and be able to test, diagnose, service and completely repair any fault relating to the conventional automobile assembly main units and systems to the manufacturers' specifications. Therefore, from the foregoing it becomes an imperative that for the MVM craftsmen to be able to diagnose and troubleshoot these modern vehicles, knowledge of technical skills is essential.

Technical skill refers to the knowledge and expertise needed to accomplish complex actions, tasks and processes relating to computational and physical technology as well as a diverse group of other enterprises. Technical skills in the context of this study refer to the ability to repair service and maintain engine components expertly and well in accordance to set standard or manufacturer instructions. Okwelle *et al.*, (2017) further explained that, technical skills expected in maintenance and repairs of autotronics include: servicing, repair and maintenance of Traction Control system (TCS), engine management, Anti-lock Brake Skid (ABS), transmission system, fuel system, ignition system, Stability Control (SCS) and other self- diagnosis and fault codes. Even though

these skills are paramount, most MVM craftsmen are yet to meet up with the standard required by motor vehicle mechanics employers.

For MVM craftsmen to remain competent and relevant to the industrial workforce, technical skills in autotronics servicing must be given proper attention to achieve the needed productivity, deliberate and conscious effort toward improving the skills that must be given prominence towards effectiveness and efficiency (Bobai, 2018).This can be achieved by undertaking needs analysis aimed at identifying the gaps; that is the discrepancies existing on skills required and the skills possess towards meeting the technical skills needs of MVM craftsmen in autotronics servicing in technical colleges. Furthermore, Audu, *et al.*,(2014)explain that skills improvement is meant to impact knowledge, sharpen skills and change the attitudes of MVM craftsmen so that they can perform better in their places of work. Hence, to impact knowledge, sharpen skills and change attitudes, improvement of the skills required must be given paramount attention.

Required simply means, having something especially because it is necessary according to a particular law or set of rules. Required is an activity undertaken based on meeting the target objectives and satisfaction from lower achievement. Skills required by MVM craftsmen in autotronics servicing are meant to enable the craftsmen to work effectively at that level of skill development. With reference to this study, require connotes the performance gap to be filled by MVM craftsmen in order to service and maintain autotronics effectively. Therefore, this study is design to collect information from the respondents through the use of questionnaire to determine what they possess and what they are supposed to required thereby, creating gaps that are to be filled by the findings of this study in autotronics servicing in Benue State, Nigeria.

Statement of the Research Problem

MVM is a skill oriented programme that is taught to students in technical colleges. The Federal Government of Nigeria (2014), stated that the overall aim of technical college education in Nigeria is to give training and impart the necessary skills that will lead to the production of craftsmen and other skilled personnel that will be enterprising and self-reliant. In addition, Ifeanyieze (2012), stated that MVM as a trade in technical college should involve the application of scientific knowledgein the design, selection of materials, operation and maintenance in subjects grouping such as; service station mechanics work, engine maintenance, refurbishing, and auto electricity. The most of the vehicles manufacture these days are75% electronic based, hence most technical college graduates seems to found it difficult to undertake the repairs in them because they were not taught when they are in schools this might be due to lack of perquisite skills on the part of their craftsmen. They end-up complicating the repair of these vehicles or damage them.

Presently, MVM employers are not really satisfied with the quality of MVM craftsmen in terms of technical skills in autotronics servicing due to the fact that these craftsmen were not exposed to autotronics aspect of these modern vehicles. Hence, they lack requisite specialised knowledge, adequate analytical ability within a specialty and faculty in the use of tools and techniques of carrying out the job (Audu, *et al*., 2014). The MVM craftsmen therefore, required skills improvement because any improvement on the competence of these MVM craftsmen will help improve the quality of autotronics servicing in future. This study is therefore design to analyse the technical skills improvement needs of motor vehicle mechanic craftsmen in autotronics servicing in Benue State.

Aim and Objectives of the Study

The main aim of the study is to determine the technical skills improvement needs of MVM craftsmen in autotronics servicing in Technical Colleges in Benue State. Specifically, the study seek to identify:

1. The technical skills require by MVM craftsmen in autotronics servicing in Benue State, Nigeria
2. The technical skills possessed by MVM craftsmen in autotronics servicing in Benue State, Nigeria

Research Questions

The following are the research questions formulated for the study:

1. What are the technical skills required by MVM craftsmen in autotronics servicing in Benue State, Nigeria?
2. What are technical skills possessed by MVM craftsmen in autotronics servicing in Benue State, Nigeria?

Hypotheses

The following null hypotheses were formulated for this study and will be tested at 0.05 level of significance.

HO_1: There is no significance difference in the mean responses of autotronics expert in the industries, and automobile lecturers as regards technical skills required by MVM craftsmen in autotronics servicing in Benue State, Nigeria($P \leq .05$).

HO_2: There is no significant difference in the mean responses of very highly, highly, moderately and slightly years of experienced of MVM craftsmen as regard technical skills possessed by MVM Craftsmen in autotronics servicing in Benue State, Nigeria ($P \leq .05$).

Methodology

A Descriptive research design was adopted for the study. The study was conducted in the entire standard automobile workshop in Benue State. It lies within the lower river Benue trough in the middle belt region of Nigeria. The geographical coordinates of Benue State are longitude 7^0 47^1and10^0 0^1 East. Latitude $6^0 25^1$ and $3^0 3^1$ North; sharing boundaries with Nasarawa state to the North, Taraba state to the East, Cross Rivers State to the South, Enugu State to the South-West and Kogi State to the west with a total land mass area of 34,059 square kilometers. Indiscriminate abandoning of faulty modern vehicles equipped with autotronics by the owners in almost every standard automotive workshops in Benue State as a result of lack of competent craftsmen and women that could affectively undertake the maintenance and repair of these autotronics automotive necessitate the choice of Benue State as an area of the study. The targeted population for this study was 203 respondents comprising of 11 Automobile Technology Lecturers from all the tertiary institutions offering technical education in Benue State, 30 autotronics experts in

standard automobile workshops and 162MVM craftsmen. The entire populations were study, hence no sampling was employed.

A structure questionnaire titled: Technical Skills Improvement Needs (TSIN) developed by the researchers and validated by three experts was used for the data collected for the study. All sections of research questions were structured so that respondents expressed their opinion on a four-point rating scale of: Very Highly Required (VHR) 4.50 – 5.00; Highly Required (HR) = 3.50 – 4.49; Required (R) = 2.50 – 3.49; Moderately Adequate (MR) = 1.50 – 2.49 and Not Adequate (NR) = 0.05 – 1.49 respectively for research question one (1). Similarly, the rating scale for research question two (2) was: Very Highly Possess (VHP) 4.50 – 5.00; Highly Possess (HP) = 3.50 – 4.00; Possess (P) = 2.50 – 3.49; Moderately Possess (MP) = 1.50 – 2.49 and Not Possess (NP) = 0.05 – 1.49.Mean and standard deviation were the statistical tools used to analyze the data for answering research question; while t-test and Analysis of Variance (ANOVA) were used to test the null hypotheses 1 and 2 respectively at 0.05 level of significant.

Research Question 1

What are the technical skills required by MVM craftsmen in Autotronics Servicing in Benue State, Nigeria?

Table 1

Mean and Standard Deviation of Respondents Responses on theTechnical Skills Required by MVM Craftsmen in Autotronics Servicing in Benue State.N = 41

S/N	Description/Item Statement	$\overline{x}_R$	SD	Remark
	Braking System			
1	Checking anti-lock brake system for efficient performance.	4.70	0.90	VHR
2	Dismantly anti-lock brake system for efficent maintenance.	3.16	1.13	R
3	Ability to assemble the dismentled anti-lock brake system.	3.27	1.05	R
4	Removing the brake drum.	1.34	1.01	NR
		3.12	**1.02**	
	Transmission System			
5	Reinstall transmission/transaxle for effective performance.	3.43	1.90	R
6	Disassembling the transmission system for efficient maintenance.	2.75	1.85	R
7	Cleaning of transmission/transaxle components.	3.70	0.98	HR
8	Checking of fluid leakage to determine necessary action	3.33	1.06	R
		3.30	**1.44**	
	Ignition system			
9	Ability to diagnose ignition system related problems for efficient performance.	3.69	1.05	HR
10	Inspecting of ignition system primary circuit wiring.	2.67	1.08	R
11	Ability to dictate the causes of enging misfiring.	3.13	1.14	R
12	Inspecting distribution performance.	4.06	0.87	HR
		3.38	**1.03**	
	Fuel system			
13	Carefully removing of fuel filter using correct tools.	1.40	1.17	NR
14	Inspecting electrical fuel pumps.	2.94	1.12	R

15	Testing pump control system.	3.33	1.10	R
16	Inspecting of pressure regulation guage.	3.71	2.03	HR
		2.84	**1.35**	

Key: *N = Number of respondents, $\bar{x}p$ = mean, SD = Standard Deviation; HR = Highly Required; R = Required; MR = Moderately Required; NR= Not Required*

Data in Table1 revealed that the four clusters (A, B, C and D) had mean ($\bar{x}_R$) values of 3.12, 3.30, 3.38 and 2.84. The mean value of each cluster was within the real limit of 2.50 – 3.49, indicating that all the technical skills from the four clusters were moderately required by MVM craftsmen in autotronics servicing in Benue State, Nigeria. The standard deviations (SD) of the four clusters were 1.02, 1.44, 1.03 and 1.35. These values were less than 1.96, indicating that the respondents were not too far from the mean or from one another in their responses on the technical skill required by MVM craftsmen in autotronics servicing in Benue State, Nigeria.

One (1) out of the 16 skill items was within the real limit of 4.50 – 5.00, indicating that the one technical skill item was very highly required. Similarly, the data further revealed that four (4) technical skill required items were within the real limit of 3.50 – 4.49, indicating that four technical skill items were highly required by MVM craftsmen. Furthermore, nine (9) skills required items were within the real limit of 2.50 – 3.49 indicated that 9 technical skills are required by MVM craftsmen. Similarly, two (2) items were within the real limit of 0.05 – 1.49 indicated that 2 technical skills were not required by MVM craftsmen in autotronics servicing. The standard deviations of the 15 items out of 16 corresponding technical skills required items ranged from 0.87 to 1.90, indicating that the respondents were not too far from the mean or from one another in their responses. However, the remaining the 1technical skills required items have a value of 2.03 indicating that the respondents were too far from the mean or from one another in their responses.

Research Question 2

What are the Technical Skills Possessed by MVM Craftsmen in Autotronics Servicing in Benue State, Nigeria?

Table 2

Mean and Standard Deviation of Respondents Responses on the Technical Skills Possess by MVM Craftsmen in Autotronics Servicing in Benue State. N = 160

S/N	Description/Item Statement	$\bar{x}_R$	SD	Remark
	Braking System			
1	Checking anti-lock brake system for efficient performance.	3.70	0.90	HP
2	Dismantly anti-lock brake system for efficent maintenance.	2.16	1.13	MP
3	Ability to assemble the dismentled anti-lock brake system.	3.03	1.05	P
4	Removing the brake drum.	2.34	1.01	MP
		2.80	**1.02**	
	Transmission System			
5	Reinstall transmission/transaxle for effective performance.	1.43	0.90	NP
6	Disassembling the transmission system for efficient maintenance.	2.75	0.85	P
7	Cleaning of transmission/transaxle components.	4.40	0.98	HP
8	Checking of fluid leakage to determine necessary action	4.33	0.06	HP

		3.32	**0.69**	
	Ignition system			
9	Ability to diagnose ignition system related problems for efficient performance.	1.39	1.05	NP
10	Inspecting of ignition system primary circuit wiring.	3.67	0.08	HP
11	Ability to dictate the causes of enging misfiring.	1.13	0.14	NP
12	Inspecting distribution performance.	3.06	0.87	P
		2.31	**0.53**	
	Fuel system			
13	Carefully removing of fuel filter using correct tools.	4.40	1.17	HP
14	Inspecting electrical fuel pumps.	1.04	1.12	NP
15	Testing pump control system.	4.33	1.10	HP
16	Inspecting of pressure regulation guage.	3.71	1.83	HP
		3.37	**1.31**	

Key: *N = Number of respondents,* $\bar{x}p$ *= mean, SD = Standard Deviation; HR = Highly Possess; R = possess; MR = Moderately possess; NR = Not possess*

Data in Table 2 revealed that the four clusters (A, B, C and D) had mean ($\bar{x}_R$) values of 2.80, 3.32, 2.31and 3.37. The mean value of cluster A and B was within the real limit of 2.50 – 3.49, indicating that the technical skills from the two clusters were possessed. Cluster C was within the real limit of 1.50 – 2.49 indicating that the technical skills was moderately possessed. In addition, cluster D was within the real limit of 3.50 – 4.49 indicating that the technical skills from cluster D was highly possess by MVM craftsmen. The standard deviations (SD) of the four clusters were 1.02, 0.69, 0.53and 1.31. These values were less than 1.96, indicating that there respondents were not too far from the mean or from one another in their responses on the technical skill required by MVM craftsmen in autotronics servicing in Benue State, Nigeria.

Seven (7) out of the 16 skill items was within the real limit of 3.50 – 4.49, indicating that the seven technical skill items was highly possessed. Similarly, the data further revealed that three (3) technical skill possessed items were within the real limit of 2.50 – 3.49, indicating that three technical skill items were possessed. Furthermore, two (2) skills possess items were within the real limit of 1.50 – 2.49 indicated that 2 technical skills were moderately possessed. In addition, four (4) items were within the real limit of 0.05 – 1.49 indicated that 4 technical skills items were not possessed by MVM craftsmen in autotronics servicing. The standard deviations of the of all the 16 technical skills possessed items ranged from 0.06 to 1.83, indicating that the respondents were not too far from the mean or from one another in their responses.

Hypothesis 1

HO_1: There is no significance difference in the mean responses of Autotronics Expert in the Industries, and Automobile Lecturers as Regards Technical Skills Required by MVM Craftsmen in Autotronics Servicing in Benue State, Nigeria.

Table 3: Two independent simplest-test results (Responses of Autotronics Experts in the Industries and Automobile Technology Lecturers on Technical Skills Required by MVM craftsmen in autotronics servicing)

Groups	N	Df	Mean	SD	Sig. (2-tailed)	Remark
Lecturers	11	39	3.43	0.63		
Autotronics Professionals	30		4.40	0.87	.398	No significant

Significant at P>0.05

Table 3 revealed that there was no significant difference (P<0.05) in the mean ratings of the respondents. These data supported the hypothesis, df = 39; 2-tail =0.398. The mean and standard deviation for automobile technology lecturers were 3.43 and 0.63 respectively. The mean and standard deviation for autotronics professional in the industries were 4.40 and 0.87 respectively. Hence, hypothesis one was retained. This mean, there was no significant difference in the mean achievement scores of Automobile Technology Lecturers and autotronics experts in the industries as regard technical skills required by MVM craftsmen in Autotronics servicing in Benue State.

HO_2: There is no significant difference in the mean responses of very highly, highly, moderately and slightly years of experienced of MVM craftsmen as regard technical skills possessed by MVM Craftsmen in autotronics servicing in Benue State, Nigeria.

Table 4: Oneway analysis of variance summary table showing the difference in the years of experience as regard technical skills possessed by MVM craftsmen in autotronics serving in Benue State Nigeria.

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	2134.713	3	711.571	.945	.420
Within Groups	117434.381	156	752.784		
Total	119569.094	159			

Table 4 revealed that there was no significant difference (P<0.05) in the mean ratings of the respondents. These data supported the hypothesis, $F(3, 156) = 0.945$, p= .420. The mean and standard deviation for (1-5) years working experience of MVM craftsmen were 3.12 and 0.93 respectively. Similarly, the mean and standard deviation for 6-10 years working experience of MVM craftsmen were 2.99 and 0.35. Furthermore, the mean and standard deviation for 11-20 years working experience of MVM craftsmen were 2.99 and 0.35, and the mean and standard deviation for 21-30 years working experience were 4.97 and 0.32 respectively. Hence, hypothesis two was retained. This mean, there was no significant difference in the mean achievement scores of 1-5years (slightly experience); 6-10year (Moderately experience); 11-20years (highly experience) and 20 -30years (Very highly experience) MVM craftsmen as regard technical skills possess by MVM craftsmen in Autotronics servicing in Benue State.

Discussion of Findings

The findings in table 1 relating to research question 1 showed that respondents agreed with 14 out of the 16 items on the technical skills required by MVM craftsmen in autotronics servicing. The finding showed that checking anti-lock brake system for efficient performance is very highly

required. This is in conformity with the views of Dem, (2014) who asserted that cleaning of transmission/transaxle components, inspecting of pressure regulation guage chosen among others. Removing the brake drum and carefully removing of fuel filter using correct tools are not required by MVM craftsmen in autrotronics in Benue State, Nigeria.

The findings in table 2 relating to research question 2 showed that respondents agreed with 12 out of the 16 items on the technical skills possessed by MVM craftsmen in autotronics servicing. The finding showed that Inspecting of ignition system primary circuit wiring, checking of fluid leakage to determine necessary action are highly required. This is in conformity with the views of Deebom *et al.*, (2018) who asserted that ability to assemble the dismantled anti-lock brake system, inspecting distribution performance chosen among others. Through this, reinstall transmission/transaxle for effective performance, ability to dictate the causes of enging misfiring among others are not possessed by MVM craftsmen in autotronics servicing.

Conclusion

The study is determined to analysis of technical skills improvement needs of MVM craftsmen in autotronics servicing in Benue State Nigeria. The finding of the study serve as the basis for making the following conclusion: Those technical skills improvements are highly required by MVM craftsmen in autotronics servicing in Benue State, Nigeria.

Recommendations

The following recommendations were made based on the findings of this study;

1. The workshop administrators should organize workshops and seminars where MVM craftsmen could be trained by experts on technical skills required in autotronics servicing.
2. New technological development having implications for automobile such as Autotronics should be integrated into the skills and learning contents of the curriculum of technical college programme.
3. Curriculum contents should be directly related to what industries and society need of MVM craftsmen so as to make them (MVM Craftsmen) work easily in industries.
4. There should be an advocacy on the importance of technical skills training of MVM craftsmen which translates into skills improvement of MVM craftsmen in autotronics.

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Cheap and Durable Method of Retaining Wall Construction Using Sand Crete Block

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Abstract

TVET is a characteristics' of "intellectual" work, it is often in contrast with 'manual' work. Thus White collar (office) professional, traders, technicians etc, on one hand no long pose discernable distinctions nowadays, even though society continue to undervalue and minimize technical education. To that extent TVET found themselves-unable to provide the skill required by business, which contributes to increasing graduate unemployment. Facing increasing costs with the context of structural adjustment program which culminated to drastic budgetary reductions and inadequate investment in TVET causing deterioration and reduction in its effectiveness. The principal objective of TVET is to train youths and adult alike, reading them for the labor market, with technical revolution and innovations in science and technology, labor market needs has significantly evolved. New challenges must be met in order to match the education proposed with vocational demands in that regard, several countries are in the process of reforming their educational system with a view to training youths to meet national, regional or international market needs.

Introduction

Concrete is one of the most versatile material used in modern structures and will produce a material of great strength and durability provided good control is maintained through all the stages of production. Concrete is composed of cement, fine and coarse aggregates, and water and of course a wide variety of ratios of mixes may be obtained from these ingredients. Concrete are particularly affected by: The wide variety of aggregate that may be used including gravels, non-porous stones, slags, manufactured types, the surface texture of those stones and the particular shapes. Each mix of concrete has its own characteristics and should be designed to suite the requirement for which it is indented. Once a particular concrete has been selected, it is important to maintain it throughout the series of operations, otherwise a weakness may be created in a structural member by the introduction of an inferior concrete, constant check are required, therefore, on the quality of the concrete mixes throughout the progress of the structure. Concrete design and production has been the longest known method through which great strength can be achieved in building constructions world-wide, though, but it is almost becoming unaffordable to the common man, due to the economic situation of the country, financial set-back, from the effect of kidnapping, heads men-ship attack etc. peoples no longer move about to strange places for greener pastures, construction companies are constraint from acquiring quarry sites at will for the production of aggregates, unemployment problems, poor management of human and material resources has brought about high cost of building materials.

It is on these premise that the drive for this study was developed. The study aims at providing an alternative method of shoring earth pressure to protect structures in our environs for advancement on the topographical challenges of construction sites in Nigeria. Greater percentages of the lands

in various states of Nigeria are faced with ecological challenges, especially in erection of buildings. It involves the effects of hills, valleys and rocks which consequently increases flood potential that mars the stability of our buildings.

Sand Crete block is produced from a mixture of sand or stone dust in the category (dust2) which is a combination of stone quartered into dust and pebbles passing through a sieve of 5mm, mixed with the cement in proportion of 1-part cement to 6- part aggregate etc. Depending on the expected final strength of the product water is applied at a sufficient quantity to dampen the mixture in other to facilitate handling of the materials. The material compacted into a box measuring 225mm x 225mm x450mm in volume. The molded product will be allowed to set and slightly harden into a solid block before the curing process which includes: Watering the blocks regularly, or cover with a wetted sack, in other to achieved final strength of the block.

Statement of Problems

I find it incumbent on me to say that one common problems of building shelters for residencies is in the nature of our topography. it is characterized with hills, valleys and huge rocks. Building on such soils required costly engineering designs, which is not affordable to most individuals, considering the case of random ancestral land ownership methods of the communities. To that extent most families that erected houses on such challenged soils have been faced with ecological problems like flood, erosion, landslides etc. the high cost of building materials coupled with financial setbacks has made it extremely difficult for these land owners to employ the services of professionals to take into account the surrounding ecological challenges. Most houses that are well designed are not left out of the challenges, due to the in ability of the owners to afford concrete walls to retain the earth from movements around the buildings. Some buildings have cracks all over with very high broken steps for accessing it, others have been dilapidated and abandoned for a rented accommodation, while most families have accepted the risk of staying in houses with signs of imminent collapse, because there is nowhere else to go. This study is targeted towards providing an affordable method of combating these challenges in order to restore and sustain our homes. The use of sand Crete blocks wall to retain large volumes of earth from collapse has been found to be cheap and affordable to almost all buildings owners.

Purpose of Study

TVET: High cost of building material has serious effect on buildings and its maintenances, since building new houses are almost impossible for the common man, it is a known fact that education is projected majorly towards the ideals of society. Demands of the community determined to a large extent the areas of educational planning processes and decisions. TVET has been associated with series of planned formulations and modifications of methods for awareness to the acquisition of knowledge of vocational skill from inception to proffer answers through informal and formal training and innovative processes for posterity. These processes stem from teachers and parents, to educate or train the young ones through the school system or apprenticeship methods

Governments' interests to establish school for the provision of TVET to the society, did not receive a robust funding sufficient enough to embrace the challenges in totality. Consequently, our technology has not been a match for those of the western community that receives adequate funding and trainings. It has been a consortium of the efforts of the teachers and parents, counseling and guiding the students to work hard in order to overcome problem areas in TVET. One of such

problems are in the area of alternative solutions to high cost of building materials to protect our houses since it is no longer easy for individuals to build a house of their own.

Aggregates are generally divided into two groups**:**

1. Fine aggregates or sand which passes through a 5mm sieve and is used as a filler in concrete and mortar
2. Coarse aggregate or shingle which is coarse that 5mm and is used as a filler in concrete.

The aggregate may be dug from pits and river beds or sucked up with huge suction pumps or dredge from sand and shingle banks under the sea.

They should be free from too much clay or loam as these consist of very fine particles which increase the surface area of the aggregate. This can be explained by comparing different spherical shapes having similar volumes, such as a football, a number of cricket balls, a greater number of golf balls and a still greater number of marbles. It can be seen that the smaller the particles, then greater is the surface area for the same volume of material. If the particles areas are very small, then the surface area of these can be enormous in relation to their total volume. Since the strength of the concrete or mortar relies to a large extent on there being sufficient cement past to cover each particle of aggregate. If the surface area Is increased, there are likely to be parts which are not covered and can cause a weakness in the concrete or mortar. Any excess clay impurities will also cause weakness, as they may be present as a coating on the aggregate, and this will breakdown the bond between the cement and the surface of the stone, thus creating soft and unreliable patches in mortar and concrete.

The aggregate should be free from organic impurities, such as decayed plant life, which may have a harmful effect on the setting action of cement and may also cause discoloration. Aggregate in general should also be hard, durable, contain no soluble particles (that is anything that dissolves in water) and be well graded and free from clay or silt.

Every mortar should:

1. Have sufficient strength for the purpose for which it is required. In no case need it be stronger than the brick or block which will bedded in the mortar.
2. Be workable so that the block layer can handle it easily.
3. Have a good bond with the bricks or blocks which are bedded in it.
4. Be durable and resistant to frost and chemical attack.

For general block work, sand or a mixture of cement and sand will satisfy all the above requirement but good general mixes would be as follows:

1. One part cement to six parts fine aggregate
2. One part cement to nine parts fine aggregate

Findings

The technological motivation for the study was emanated from the inter relationship between an individual sitting on a chair and the chair on which he/she seats.When a person seats on a chair, the chair comes under an active force that stabilizes it in position and supports the individual that is subjecting it. Both tends to reinforce each other in harmony.

- Force "1" (individual) holds down the chair in position while
- Force "2" from the chair sustain the individual (reaction force)
- Force "3" provides a back rest for the user of the chair.
- But Force "3" is not under severe force since it is not under gravity as Force "1"
  But Force "3" assumes the position of a retaining wall sustaining the pressure of earth.
  Force "3" is not affected by direct gravitational force as in Force 1 and 2. Force "3" will collapse the retaining wall if the effect of force 1 and force 2 are ignored

From this assumption, retaining walls are not expected to support pressure or force, from the earth, but to interact in harmony with the forces on it.

According to WG NASH (1983) one of the characteristics of a soil which can never be taken for granted is it angle of repose? That is the angle that the soil will make with the horizontal plain if left to adopt its own shape. Figure1, illustrates the angle of repose of a soil. This angle of repose will vary according to the types of soil, its moisture content and its density.

This is one of the reasons why a trench which is being excavated into what appears to be a stable type of soil and for which no trench sheeting has been used, suddenly collapse without any warming because its angle of repose has changed perhaps due to drying out or becoming wet.

Far too many accidents of this kind occur each year causing serious injuries, and in many cases, death to workmen who have been buried or killed due to the impact of falling earth.

Method

The natural ground has the characteristics of movements, when it loses or absorb water due to shrinkage or weight of water absorbed.

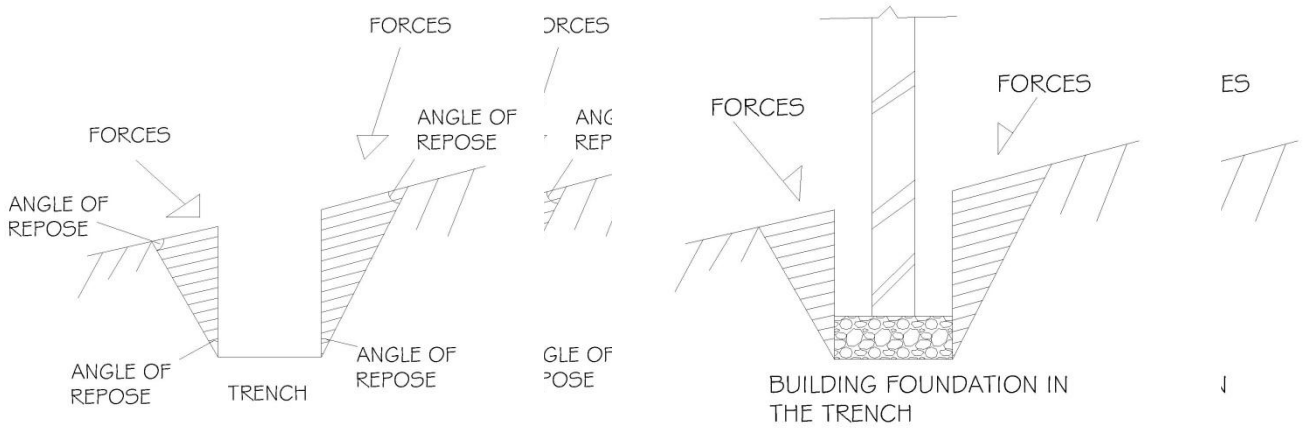


Fig 3, illustrates a trench under the effect of movement

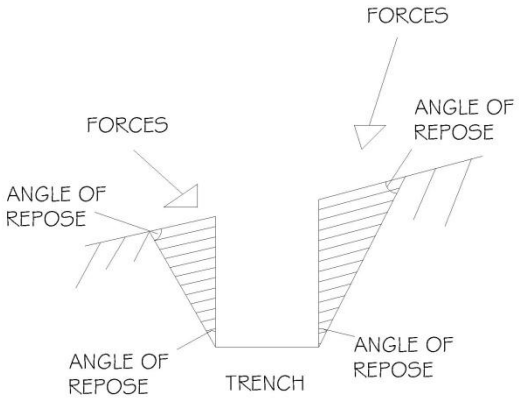
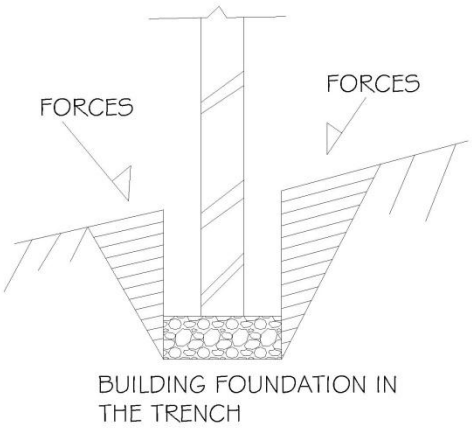


Fig 4

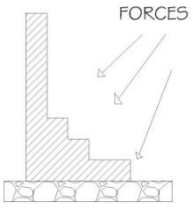


Fig

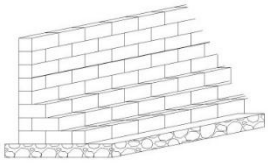
By sliding towards the foot of the foundation of the wall The earth will collapse towards the foot of the trench from the shaded area which means that the earth pressure bears on the foundation of the walls. Greatcare must be taken to design the foundation. It is therefore the major component of the wall that is subjected to almost all the pressure exerted by the earth. The design should take into account the movement of the earth.

FIG 6 **FIG 7** **FIG 8**

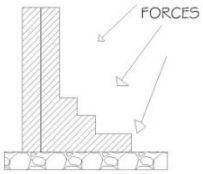
FIG 6 **FIG 8**



SECTIONAL VIEW OF A RETAINING WALL



LONGITUDINAL VIEW OF A RETAINING WALL



SECTIONAL VIEW OF CAVITY WALL RETAINING EARTH

In the cases of larger span of area of earth filling, the design may involve cavity or composite wall. Fig 6and 7 represents the design of a retaining wall built with blocks.

The footing courses are laid on the side to be loaded by earth, in series of extend steps on which the volume of earth will settle on, in the form of an individual seating on a chair as illustrated in fig1 above. Holding the walls to itself without any impact of force effect on it and the wall will safely sustain the earth without any uneven settlement, or undue movement. The entire system will harmonize with each other without undue settlement of the earth with careful compaction.

Conclusion

The engineering principles adopted in these techniques are calculated to ensure that retaining walls are not on any account subjected to forces or pressures from the loading of the earth. Rather, the loaded volume of earth attracts the wall to itself, reinforces it and stabilizes it to its firm position. Both the retaining wall and the retained volume of earth Co-exist in simple in durable harmony.

The nature of soil and our topography, demand an affordable method of shoring the earth. That could be done with a retaining wall built with sand Crete block. It is affordable to the common man and the vast challenge on our soils for buildings could be controlled.

Recommendations

I recommend that this practice of building retaining wall with block is suitable and durable to control soil challenges at our domestic environments.

- It could be applied when intending to raise the level of a site.
- When there is need to control the soil from sliding or giving away due to the absorption of excess water or shrinkage.
- it should be used as fencing wall at a slope sites.
- it can be applied as a retaining wall to sustain a large volume of earth in preference to concrete walls.

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Capacity Building Needs of Automotive Mechatronics Instructors in Maintenance of Braking and Ignition system in Vocational Enterprise Institutions in Abuja and Kogi State, Nigeria

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Abstract

The study was designed to identify the Capacity Building Needs of Automotive Mechatronics Instructors in Vocational Enterprise Institution in Abuja and Kogi State, Nigeria, two research questions and two null hypotheses guided the study. A descriptive research design was used for the study. The study was carried out in FCT, Abuja and Kogi state, Nigeria. A proportional stratified random sampling technique was used to drawn 10% of automotive industrial technicians for the study. Therefore, the sample population for the study was115 respondents comprises of 77 automotive industrial technicians and 38 automotive mechatronics instructors was used as a total population for the study. Automotive Mechatronics Instructors Capacity Building Needs Questionnaire (AMICBNQ) developed by the researcher and validated by three experts was used for the data collected for the study. The reliability coefficient of the instrument was 0.88 through Cronbach Alpha statistics. Statistical Package for Social Science (SPSS Version 23) was used for the data analysis, weighted mean, standard deviation and improvement needed index (INI) were the statistical instrument for answering research questions. While z-test statistics was used to analyzed the null hypotheses formulated for the study at .05 level of significant. The findings of the study revealed among others that automotive mechatronics instructors need capacity building in all the identified area of competencies. Based on the findings it was recommended that: Workshop and seminars should be organized for of automotive mechatronics instructors inorder to build their capacityinbraking and ignition systems.National Directorate of Employment (NDE) as one of the government agency charge with the responsibility of training motor vehicle mechanics should organize capacity building training from time to time and regular seminars and conferences for automotive mechatronics instructors in Vocational Enterprise Institution in Abuja and Kogi State and indeed automotive mechatronics instructors in other parts of Nigeria. Automotive mechatronics instructors should also be sent for further training in automotive mechatronics coursesinordertoacquiremoreknowledge/competencies. Modern automotive industrial employers should from time to time visit Vocational Enterprise Institution to inform them about the new development and the required skill development that goes with it in order to keep these schools abreast with the on-going developments.

Introduction

Vocational Enterprise Institutions (VEIs) are institutions approved as part of the ongoing reform of the technical and vocational education sector. They are institutions which offer competency based-skills in vocational, technical or professional education and training at post-basic and post-secondary levels to equip the youths as well as working adults with vocational skills and

knowledge to meet the increasing demand for skilled man-power in the various sectors of the nation's economy (NBTE 2007). Specially, the objective of VEIs according to National Board for Technical Education (NBTE 2009) is to equip the youth as well as working adults with vocational skills and knowledge to meet the increasing demand for skilled manpower in the various sectors of the nation's economy and to widen access to vocational education and offer credible alternative to higher education. Federal Republic of Nigeria FRN (2014) stated that, VEIs is aimed at providing appropriate skills and certification to pursue a chosen trade or career, such as fashion design, agriculture, office secretarial, carpentry and joinery, computer studies, fabrication and welding, block laying and concreting, printing technology, electrical installation and wire repair works, motor vehicle mechanics and automotive mechatronics.

Automotive mechatronics is one of the vocational trades offered in vocational enterprise institution in Nigeria which is aimed at producing competent vehicle mechanics with sound practical skills, knowledge and ability to diagnose and carryout repairs and/or maintenance on all types of modern vehicles equipped with electronics and computer systems. According to Abubakar*et al.*,(2015) Automotive mechatronics is the synergic application of physics, namely, mechanics, fluidics (hydraulics or pneumatics), electrics, electronics, overall control theory, computer science, and sensor and actuator technology to design improved automotive products and manufacturing. However, the process of developing competencies and capabilities in individuals, groups, organization is refered to as capacity building.

Capacity building is the process of developing competencies and capabilities in individuals, groups, organization sectors or countries which leads to sustainable and self-generating performance improvement in specific area or aspect of human development. Akbar (2013) defines capacity building as a process of developing and strengthening the skills, instincts, abilities, processes and resources that individuals, organizations and communities need to survive, adapt and thrive in the fast changing world. It focuses on understanding the obstacles that inhibit people, institution, government, international organizations and non-governmental organization from realizing their developmental goals while enhancing the abilities that will allow them to achieve measurable and sustainable results. In automotive mechatronics the fundamental goal of capacity building is to enhance the ability of instructors based on perceived needs.

Capacity building needs are set of activities that expand the scale, reach, efficiency or effectiveness of an individual, organization or programme. These activities may expand services, enhance delivery of services, or generate additional resources for the individual or organization. The Canadian International Development Agency (CIDA) (2013), viewed capacity building needs as the activities, approaches, strategies, and methodologies which help organizations, groups and individuals to improve their performance, generate development benefits and achieve their objectives. Therefore, capacity building needs in the context of this study refers to strengthening the skills, competences and abilities that automotive mechatronic instructors should possessed so that they can produce competent automotive mechatronics craftsmen. Since automobile industries advance every day, automotive mechatronics instructors need consistent capacity building so as to

kept in pace with the technological advancement in the industry. Moreover, adequate knowledge and skills cannot be transfer to the trainee without an instructor.

An instructor is one who influences another to change his attitude and behavior on the basis of new skill, knowledge, values, habit and practical skills. On the other hand, an automotive mechatronic instructor is one who role extends from the development of intellectual activities and cognition to the development of practical skills in modern vehicles, (psychomotor), emotions, attitudes and morals (affective) (Adamu, 2015). The foregoing clearly revealed that an automotive mechatronic instructor should be familiar with the current technological changes in automotive industry, be computer literate, and plan the learning activities and experiences with the view of current global changes and practices in the technological world. However, one of the major challenges of automotive mechatronics instructors is the changes in the present day modern vehicle systems; these changes according to Jimoh (2017) have affected automotive instructors in the areas of understanding, interpreting and maintenance of modern vehicles.

Maintenance involves taking specific approved steps and precautions to care for a piece of equipment, machinery or facility and ensure it attains its maximum shelf life. Maintenance is defined as actions necessary for retaining or restoring a piece of equipment, machine, or system to the specified operable condition to achieve its maximum useful life (Olaitan*et al.*, 2009). This signifies that the automotive mechatronic instructors need to know how to carry out maintenance on modern vehicle. Maintenance in the context of this study is a set of organized activities that should be carried out in order to prolong the service life of a vehicle and keep its best operational condition with minimum cost acquired. Parts of these modern vehicle system and sub systems equipped with mechatronics in the words of Malone (2016) include: Braking system and Ignition system. However, vehicle system which serves to either reduces the speed of the vehicle or brought it to rest when the need arises is the braking system.

The braking system converts the mechanical energy possessed by the vehicle into heat energy by the means of friction in other to slow down the vehicle or completely stop the vehicle safely when the need arises. Giri (2013) revealed that the operation performed in braking system is the reverse of that carried out in accelerating. In the latter the heat energy of the fuel is converted into the kinetic energy of the vehicle, is converted into heat. Accordingly, the vehicle system responsible for providing spark necessary to ignite the mixture of air/fuel inside the engine cylinder is the ignition system.

The ignition system supplies a suitable spark inside the engine cylinder under all varying condition of engine operation. The spark ignites the compressed air/fuel mixture in the combustion chamber; each spark is timed to appear at the plug gap just as the piston approaches top dead centre on the compression stroke (Giri, 2013). The main component of the conventional ignition system includes; ignition coil, distribution, centrifugal advance mechanism, spark plug, switch and condenser. Gscheidle (2016) argued that most engines produced today are distributor less and rely on sensor and electronic component to perform this task.

Automobile industrial technicians in the context of this study refers to the highly skilled individual or group of individual whose major works are to maintain vehicle functional condition by listening to operator complains, conditioning inspection, repairing engine failures, repairing mechanical and electrical system malfunctions, replacing parts and components as well as body damage. Even though automotive instructors are involves directly in imparting practical skills aspects of modern vehicle to the trainees. They can only do so in the aspect that they can perform through the skills they possessed. Hence, this will enable them to identify those aspects of modern vehicle performance skills they possessed in term of maintenance and repairs.

The foregoing clearly revealed that modern automobiles are blend of 20th century and 21st century technology. The designs of modern vehicles have advanced to a very sophisticated level. Unlike the old mechanical operated vehicle systems, the modern vehicles are being operated and controlled by computerized electrical sensors. Indeed almost every other function within the engine is controlled by an onboard computer. However, Michika (2019) pointed out that the use of electronic circuit and advents of computers have changed the operating systems in modern vehicles. Many stakeholders involvedin ensuring effectiveintegration ofmodern technologiesin theeducation system, instructorshavea particular important role to play and Carlson andGadio(2012)opinedthatinstructorsarethekeytowhethertechnologyisusedappropriatelyand effectively. Appropriate use of modern technologies can catalyze the paradigm shift frominstructors-centeredpedagogytoamoreeffectivelearner-centeredpedagogy;Capacitybuildingof instructors can play a major role in enabling this shift.This study is therefore design to identify the capacity building needs of automotive mechatronics instructor in vocational enterprise institutions in Abuja and Kogi state.

Statement of the Research Problem

The responsibility of Automotive Mechatronics Instructors in Vocational Enterprise Institutions Vocational Enterprise Institutions (VEIs) in Nigeria is to facilitate learning in theoretical, practical aspect of automotive mechatronics courses and evaluate the trainees for effectiveness of training and individual growth. In addition he should be able to conduct practical demonstration of automotive mechatronics in the workshop through the capacity building possessed by them. These will enable graduates of VEIs to function effectively as a craftsmen and women in automotive establishments, carryout necessary general tests procedures, standard diagnosis and faults rectification in modern vehicles (FRN, 2014). Automotive mechatronics instructors are expected to be able to demonstrate the use of different sophisticated diagnostic equipment for fault detection and rectification in various modern vehicles brands, observe relevant safety in automotive Mechatronics Engineering practice, interpret wiring diagrams, fault codes, as well as technical reference materials (NBTE, 2009).

However, it has been observed that graduates of automotive mechatronic from VEIs who are expected to, upon completion of their training programme have acquired practical skills that will enable them to secure paid employment or set up their own workshop and become self-employed and employ others could not do so because of the limited competencies possessed by them

(Michika, 2019). Although literatures attributed these low competencies possessed by these trainees upon graduation to low capacity building of automotive mechatronic instructors. Jimoh (2017) attributed the low capacity building in those instructors to recent advancement in automotive industry. Although these might not be unconnected with the fact that these instructors do not have up to date the technical know-how and seems to lack capacity building in automotive mechatronic systems such as braking system, ignition system, transmission system, fuel supply system and suspension system. The problem of this study therefore is to determine the capacity building needs of automotive mechatronics instructors in Vocational Enterprise Institutions in Abuja and Kogi state.

Aim and Objectives of the Study

The aim of this study was to identify the capacity building needs of automotive mechatronics instructor in vocational enterprise institutions in Abuja and Kogi state; specifically, the study sought to achieve the following objectives:

1. Determine the capacity building need of automotive mechatronics instructors in the maintenance of braking system
2. Identify the capacity building needs of automotive mechatronics instructors in maintenance of ignition system

Research Questions

The following research questions were guided the study

1. What are the capacity building needs of automotive mechatronics instructors in maintenance of braking system?
2. What are the capacity building needs of automotive mechatronics instructors in maintenance of ignition system?

Hypotheses

The following null hypotheses guided the study and were tested at 0.05 level of significant

HO_1: There is no significant difference in the responses of the automotive industrial technicians and automotive mechatronics instructors as regard the capacity building needs of automotive mechatronics instructors in maintenance of braking system.

HO_2: There is no significant difference in the responses of the automotive industrial technicians and automotive mechatronics instructors as regard the capacity building needs of automotive mechatronics instructors in maintenance of instructors in maintenance of ignition system.

Methodology

A descriptive research design was employed for the study. The study was carried out in FCT,

Abuja and Kogi State, Nigeria. A proportional stratified random sampling technique was used to drawn 10% of automotive industrial technicians for the study. Therefore the sample population for the study was 115repondents comprises of 77 automotive industrial technicians and 38 automotive mechatronics instructors was used as the total population for the study. A structured questionnaire titled: Automotive Mechatronics Instructors Capacity Building Needs in Braking and Ignition System Questionnaire (AMICBNBIQ) developed by the researchers and validated by three experts was used for the data collected for the study. The questionnaire items were assigned four points rating scale of:Highly Needed(HN)/ Highly Performed (HP) (4), Needed (ND)/ Performed (PD) (3), Moderately Needed(MN) Moderately Performed (MP) (2), and NotNeeded (NN) / Not Performed (NP)(1) The reliability coefficient of the instrument was 0.88 through Cronbach Apha statistics: Statistical Package for Social Science (SPSS Version 23) was used for the data analysis. 115 copies of questionnaire were distributed to respondents; 106 copies were duly filled by the respondents and retuned representing 91.2%.Weighted Mean and standard deviation improvement needed index were the statistical tools for answering research questions while z-test statistics was used to analyze the null hypotheses formulated for the study at .05 level of significant.

Therefore, decisions for research questions were based on the resulting mean scores interpreted relative to the concept of real lower and upper limits of numbers;accordingly, the decisions on the null hypotheses formulated for the study were based on comparing the significant value with (P< .05) level of significant; that is where the significant value is less than (P < .05) it was rejected, while equal or greater than (P < .05) level of significant the hypothesis was upheld and accepted.

Result

ResearchQuestion1
Capacity building needs of automotive mechatronics instructors in the maintenance of braking system?

Table1. PerformanceGapAnalysisoftheMeanResponsesofRespondentsontheCapacity Building Needs of Automotive Mechatronics Instructors in Maintenance of Braking System N= 115

S/N	Items	Mean (X_n)	Mean(X_P)	PG = (X_n-X_p)	Rmks
1.	Perform visual inspection of wheel speed sensor and cables	3.87	3.32	0.55	CBN
2	Identify defective wheel speed sensor	3.51	3.02	0.49	CBN
3	Check wheel speed sensor and the pulse ring	3.88	3.37	0.51	CBN
4.	Carry out speed sensor signal testing	3.91	3.27	0.64	CBN
5.	Check power supply of the wheel speed sensor	3.79	3.07	0.72	CBN

6.	Service the wheel speed sensor	3.80	3.65	0.15	CBN
7.	Visually inspect the wheel speed sensor pulsers for chipped or damaged teeth	3.88	3.37	0.51	CBN
8.	Remove wheel speed sensors	3.91	3.71	0.20	CBN
9	Replace electrical wiring to the wheel speed sensor	3.78	3.01	0.77	CBN
10.	Perform a test drive to check the wheel speed sensor after replacement	4.31	2.89	1.42	CBN
11.	Carryout visual inspection of the wiring and the mechanical components	4.04	2.45	1.59	CBN
12.	Recognize a defective Anti-lock Braking System (ABS) warning light	4.04	2.85	1.19	CBN
13.	Repair braking system for functionality	3.83	2.81	1.02	CBN
14	Test braking system after repair	3.75	2.89	0.86	CBN
15.	Carry out all kinds of mechanical tests on the braking system	4.14	2.92	1.22	CBN
16.	Check the operation of the braking system, adjust and repair according to the manufactures specification	3.55	3.45	0.10	CBN
17.	Replace faulty or bad braking system with new one	3.65	3.15	0.50	CBN
18.	Select appropriate tools and equipment for the maintenance of automotive braking system	3.90	3.65	0.25	CBN
19.	Service automatic braking system correctly	2.97	2.47	0.50	CBN
20.	Recalibrate the speed sensors	4.50	3.80	0.70	CBN
21.	Use oscilloscope to verify the voltage and signal supply to the braking system	3.65	2.50	1.15	CBN
	GRAND MEAN/PG	**4.04**	**3.23**	**0.74**	**CBN**

Keys: Xn = weighted mean for needed category, Xp = weighted mean for performance category, performance gap (PG) = Xn - Xp, CBN = CapacityBuilding Needed, CBNN =Capacity BuildingNotNeeded

Table 1shows the mean responses of the respondents on the twenty one (21) items posed to determine the capacity building needs of automotive mechatronics instructors in the maintenance of braking system with the grand performance gap value of 0.74. This implies that automotive mechatronics instructor's needs capacity building in all the areas of competences in the maintenance of braking system.

ResearchQuestion2

Capacity building needs of automotive mechatronics instructors in maintenance of Ignition system?

Table 2
PerformanceGapAnalysisoftheMeanResponsesofRespondentsonthe Capacity Building Needs of Automotive Mechatronics Instructors in Maintenance of Ignition System N= 115

S/N	Items	Mean(X_n)	Mean(X_p)	PG (X_n-X_p)	Rmk
1.	Conduct engine performance test using engine analyzer and determine needed repair	3.61	3.20	0.41	CBN
2.	Test run the ignition system using the multimeter	4.31	3.15	1.16	CBN
3.	Check the crankshaft (CKP) and camshaft (CMP) sensors and their wiring for damage	4.15	2.66	1.49	CBN
4.	Record ignition timing using digital multimeter	3.51	2.91	0.60	CBN
5.	Carry out throttle cable inspection and adjustment	4.18	2.50	1.68	CBN
6.	Check the crank sensor using diagnostic tool	3.97	2.85	1.12	CBN
7.	Perform magnetic sensor testing	4.00	3.82	0.18	CBN
8.	Inspect faulty crank position sensor	3.83	3.23	0.60	CBN
9.	Test and diagnose defective reluctor sensor	3.65	3.80	0.15	CBN
10.	Use plug wire to check for spark of the plug	3.75	3.60	0.15	CBN
11.	Conduct a careful visual inspection of the wiring and the mechanical components	3.45	3.27	0.17	CBN
12.	Check the battery to make sure there is ample voltage to start the engine	3.32	3.00	0.32	CBN
13.	Inspect, repair and replace faulty electronic ignition components	3.57	2.60	0.97	CBN
14	Use engine analyzer to conduct engine performance test	3.42	2.52	0.90	CBN
15	Use diagnostic tool to check ignition problem	3.56	3.35	0.21	CBN
16	Interpret ignition diagnostics trouble codes	3.78	2.49	1.29	CBN
17	Inspect faulty electronic ignition components	4.06	3.27	0.79	CBN
18	Repair faulty electronic ignition components	3.87	3.07	0.80	CBN
19	Replace faulty electronic ignition components	4.30	2.85	1.45	CBN
20	Inspect, faulty computerized ignition components	4.18	2.50	1.68	CBN
21	Repair faulty computerized ignition components	3.76	3.27	0.49	CBN
22	Replace faulty computerized ignition components	3.74	2.49	1.25	CBN
23	Inspect faulty transistorized ignition components	3.84	3.27	0.57	CBN
24	Repair faulty transistorized ignition components	4.30	3.07	1.23	CBN
25	Replace faulty transistorized ignition components	3.75	2.85	0.90	CBN
	GRAND MEAN/PG	**3.83**	**3.02**	**0.82**	**CBN**

Keys: Xn = weighted mean for needed category, Xp = weighted mean for performance category, performance gap (PG) = Xn - Xp, CBN = CapacityBuilding Needed, CBNN =Capacity BuildingNotNeeded

Table 2 shows the mean responses of the respondents on the twenty five (25) items posed to determine the capacity building needs of automotive mechatronics instructors in the maintenance of ignition system with the grand performance gap value of 0.82. This implies that automotive mechatronics instructors in Vocational Enterprise Institutions in Abuja and Kogi state, needs capacity building in all the areas of competences in the maintenance of ignition system.

Testing of Hypotheses

Hypothesis1
There is no significant difference in the mean responses of the automotive industrial technicians and automotive mechatronics instructors on the capacity building needs of automotive mechatronics instructors in maintenance of braking system.

Datafortestinghypothesisonearepresentedintable4.6.

Table3: The z-test Analysis of the Mean Responses of automotive industrial technicians and automotive mechatronics instructors onthecapacity building needs of automotive mechatronics instructors in maintenance of braking system

Motor vehicle mechanics	N	Mean	S.D	df	P – value	Alpha level	Decision
Automotive industrial technicians	77	4.04	0.77	114	0.60	0.05	Accepted
Automotive mechatronics instructors	38	3.23	0.65				

Key:df = degree of freedom**,** p- value = probability value calculated by the computer, S.D=Standarddeviation

The analysis of the results presented in table 3 revealed that since p-value 0.60 is greater than 0.05 this implies that there is no significant difference in the mean responses of both groups of respondents. Therefore, the null hypothesisof nosignificantdifference between the mean responses ofautomotive industrial technicians and automotive mechatronics instructors on the capacity building needs of automotive mechatronics instructors in maintenance of braking system wasupheld.

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Hypothesis2
There is no significant difference in the responses of the automotive industrial technicians and automotive mechatronics instructors on the capacity building needs of automotive mechatronics instructors in maintenance of ignition system.

Datafortestinghypothesistwoarepresentedintable4.

Table 4
Thez-testAnalysisoftheMeanResponsesofautomotive industrial technicians and automotive mechatronics instructors onthecapacity building needs of automotive mechatronics instructors in maintenance of ignition system

Motor vehicle mechanics	N	Mean	S.D	df	P – value	Alpha level	Decision
Automotive industrial technicians	77	3.82	0.77	114	0.96	0.05	Accepted
Automotive mechatronics instructors	38	3.02	0.65				

Key:df = degree of freedom**,** p- value = probability value calculated by the computer, S.D=Standarddeviation

The analysis of the results presented in table 4 revealed that since p-value 0.96 is greater than 0.05 this implies that there is no significant difference in the mean responses of both groups of respondents. Therefore, the null hypothesisof nosignificantdifference between the mean responses ofautomotive industrial technicians and automotive mechatronics instructors on the capacity building needs of automotive mechatronics instructors in maintenance of ignition system wasupheld.

Findings/Discussion of the Findings
The findings in Table 4.1 relating to research question 1 showed that automotive mechatronics instructors in Vocational Enterprise Institutions in Abuja and Kogi State, Nigeria needs capacity building in all twenty-one areas of competencies in the maintenance of braking system. The findings revealed thatautomotive mechatronics instructor's needs capacity building in recognizing a defective Anti-lock Braking System (ABS) warning light.This isline with the view of Erjavec (2010) who pointed out that ABS scan tools and testers can often be used to monitor and trigger input and output signals in the ABS. This will allow technicians to confirm the presence of a suspected problem with an input, switch, or output solenoid in the system. Buttressing this finding, Bosch (2013) opined that 76 percent of all new vehicles were equipped with Anti-locking Braking System and it has become standard equipment for passenger vehicle in the European Union (EU), United States of America (USA) and Japan. Affirming this assertion Ofria, (2015) reported that anti-lock braking system originally developed for aircraft braking system is now been applied in modern motor vehicles.

The finding also revealed thatautomotive mechatronics instructors needs capacity building inrepairing braking system for functionality. This is in agreement with the findings of Kerr (2014)

who maintained that electronic brake force distribution (EBFD) is a computer controlled solenoid that is part of the anti-lock brake system that varies brake pressure to the rear wheel based on the vehicle deceleration rates, steering angle and possibly even lateral acceleration of the vehicle. This is also in conformity with the views of Erjavec (2010), who asserted that braking system converts the momentum of the vehicle into heat by slowing and stopping the vehicle wheel, this is done by causing friction at the wheel. The finding also revealed thatautomotive mechatronics instructors needs capacity building in carrying out preventive maintenance in the braking system. This finding conform to the findings of Li (2010) who asserted that, the ABS control computer is incorporated into the ABS modulator and, with the aid of sensor inputs, provides the controlling actions that are designed to allow safe braking in emergency stops. Bonnick (2016) argued that ABS control computer that was incorporated into the ABS modulator and, with the aid of sensor inputs required high maintenance to keep the system working effectively.

The findings in Table 4.2 relating to research question 2 showed that automotive mechatronics instructors in Vocational Enterprise Institutions in Abuja and Kogi State, Nigeria needs capacity building in all twenty five areas of competencies in the maintenance of ignition system. The findings revealed thatautomotive mechatronics instructors needs capacity building in replace faulty electronic ignition components,The finding is in line with the assertion of Melior (2015) who held that the designs of vehicles have advanced to a very sophisticated level, and unlike the old mechanically operated vehicle systems, the modern vehicles are being operated and controlled by computerised electronic sensors. For example, latest vehicles' ignition systems are electronically controlled without employing the old use of manually reset contact breaker. This finding agreed with the findings of Julian (2015)which asserted that, an ignition system is needed on gasoline engines to ignite the air-fuel mixture. It produces an extremely high voltage surge, which operates the spark plugs. A very hot electric arc jumps across the tip of each spark plug at the correct time. This causes the air-fuel mixture to burn, expand, and produce power.

The findings further revealed thatautomotive mechatronics instructors needs capacity building in using wire to check for spark of the plug. This finding is in consonant with the views of Melior (2015) which pointed out that, ignition system have several ignition coils, one for each spark plug or pair spark plugs, when a coil is activated by the electronic control module, high voltage is sent through a spark plug unit. Buttressing this, Bonnick (2016) revealed that without a good quality spark, in the right place at the right time the engine performance will be affected as well as the operation of emission control system.

Conclusion

This study was designed mainly to determined capacity building needs of automotive mechatronics instructors in vocational enterprise institution Abuja and Kogi State, Nigeria. The findings of the study serve as the basis for making the following conclusion: that automotive mechatronics instructors needs capacity building in all the area competences in the maintenance of braking system such as perform visual inspection of wheel speed sensor and cable, check power supply of the wheel sensor, replace electrical wiring to the wheel speed sensor.It was also concluded that automotive mechatronics instructors needs capacity building in all the area

competences in the maintenance of ignition system such as inspect, adjust or replace faulty crank position sensor, test and diagnose defective reluctor sensor, use plug wire to check for spark of the plug, conduct a careful visual inspection of the wiring and the mechanical components, check the battery to make sure there is ample voltage to start the engine.Therefore, the trainees in vocational enterprise institution at all levels can only acquire skillsforemployments or self-reliant undercompetentinstructors. The inclusion of these identified areas of competences in the training manual of automotive mechatronic instructors will in no doubt help the instructors

Recommendations

1. Workshopandseminars should be organizedby National Automotive Council of Nigeria for automotive mechatronics instructors inordertobuildtheircapacityinbraking, ignition,transmission,fuel supply andsuspensionsystem.
2. National Directorate of Employment (NDE) as one of the government agency charge with the responsibility of training in Nigeria should organize capacity building training from time to time and regular seminars and conferences for automotive mechatronics instructors in Vocational Enterprise Institution in Abuja and Kogi State and indeed automotive mechatronics instructors in other parts of Nigeria
3. Automotive mechatronics instructors should be alsosent forfurthertraining in automotive mechatronics coursesinordertoacquiremoreknowledge/competencies.

SuggestionforFurtherResearch

Thefollowingaresuggestedforfurtherresearch

1. Capacity building needs of automotive mechatronics in vocational enterprise institution in other states of the federation
2. Competency improvement needs of lecturers of automobile technology in NCE programmes of Polytechnics and Colleges of Education in North central, Nigeria.
3. Capacity building needs of automotive mechatronics instructors in vocational enterprise institutions in the maintenance of compression ignition engine.

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Characteristics of Concrete Containing Iron Ore Tailings as Partial Replacement of Sand

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Abstract
Natural sand has been the conventional fine aggregate in concrete production for many decades. However, there has been extensive research into alternative materials suitable to replace sand in concrete. In this research Itakpe Iron Ore Tailings (IIOT) was used as partial replacement of fine aggregate in concrete production. The IIOT was obtained from different locations at the tailings dump sites of National Iron Ore Mining Company (NIOMCO) in Itakpe, Kogi State, Nigeria. Sieve analysis, Specific gravity, Bulk density, Moisture content, AIV and ACV tests were carried out on the aggregate. Three concrete specimens were prepared from a mix of designed strength 25N/mm^2. IIOT was used to replace fine aggregates from 0% to 20% in steps of 5%. Concrete cubes measuring 150 x 150 x 150mm were cast and theirdensities and compressive strengths evaluated at 3, 7, 14, 21 and 28 days. The result showed IIOT concrete had high densities than control due to the Iron (Fe) content while that of 5% IIOT has the highest compressive strength of concrete at 28days and 15% and 20% were very close to 5%. The findings of this research showed there is a potential towards utilization of IIOT in construction applications and can serve as a normal aggregate alternative for future use. Tailings promote the preparation of eco-friendly IIOT concrete and provide a new way to use waste resources.

Keywords: Concrete, Iron ore tailings, Itakpe, Compressive strength, Sand replacement

Introduction
Concrete is the basic material in all construction works. Concrete is a solid mass made by the use of a cementing medium, generally the ingredient consists of cement(binder), fine aggregate(sand), coarse aggregate (gravel) and water. Concrete is a construction and structural material consisting of hard, chemically inert particles substance known as aggregate such as sand and gravel, that is bonded together by cement and water (Abdullahi, 2006).

Natural sand has been the conventional fine aggregate in concrete production for many decades. However, there has been extensive research into alternative materials suitable to replace sand in concrete. The need to find replacement for sand stems from the fact that in most parts of the world, there is growing concern about the depletion of sand deposits, environmental and socio-economic threats associated with extraction of sand from river banks, coastal areas and farm lands (Aditya and Lakshmayya, 2016). Some alternative materials which have been studied for use as partial replacement for sand include fly ash, slag limestone, silica stone, furnace bottom ash and recycled fine aggregate (Siddique, 2003).

Ugama *et al.* (2014); Uchechukwu and Ezekiel (2014) examined the feasibility of reusing Iron Ore Tailings (IOT) after conducting, physical, compressive and tensile tests, as a substitute for fine aggregate (sand). The presence of heavy metals concentration in Iron rich soil for Iron ore in the

following order of trend Fe > Pd > Mn > Zn > Cr > Ni > Cu > Cd were found within the neighbouring farm lands of Itakpe Iron Ore mines, Kogi State(Itodo *et al.*, 2017).

Itakpe iron-ore deposit has an orereserve of about 200 million tonnes with an average of36% Fe content with a conservative mine life at 25 years under average productionrate of 8 million tonnes per year(Audu *et al.*, 2013; Oladeji *et al.*, 2015). The Itakpe iron ore deposit in Nigeria which has a total estimated reserve of about 182.5 million metric tonnes consists mainly of quartzite with magnetite and hematite (Soframines, 1987). The Itakpe project was designed to treat a minimum of 24,000 tons of ore per day and operate 300 days per year. For a plant of production capacity of 24,000 tons per day, an average ore grade of 36%, 64% gangue, 20% iron mineral content in waste and at an average concentrate price of ($1,200 per ton of concentrate)(Soframines, 1987; Ajaka, 2009).

The level of utilization stems from sustained research work carried out regarding increasing application of IOT fine aggregate.Studies into properties of hardened concrete have shown there is decrease in drying shrinkage with Itakpe IOT in concrete. The decrease in drying shrinkage is mostly attributed to high percentage of fines if the IIOT and also the rough texture of the tailing particles(S. F. Oritola *et al.*, 2017).Uchechukwu and Ezekiel (2014) evaluated the properties of IIOT which showed that it has pozzolanic properties, and can be used as a retarder for hot-weather concreting.

Adebimpe and Fatoye (2021) characterised IIOT as fine medium sand with low porosity, permeability, high specific gravity, having mainly crystalline phases of quartz (SiO2), Hornblende, Amphibole, Haematite, Magnetite, Calcite and Plagioclase. Similarly, Alabi *et al.* (2019) studied the chemical composition of IIOT consisting of C, Ti, Al, Mn, Cu, and O within the mineral matrix; such that iron, titanium, and silicon are the major elemental constituents.Radiological impacts of IIOTcannot constitute external radiological problems to its workers and the public in general(Audu *et al.*, 2013).

IOT used as fine aggregate replacement in cement concre was suitable for low grade concrete pavement in rural areas due to its high density, high axial compression and low deformation due to external loads(Costa and Adriana, 2010; Che *et al.*, 2019).Kankam *et al.* (2017) studied the characteristics of replacing fine aggregate with Quarry dust on the stress-strain curve (SSC). Similarly, Ilangovan and Nagamani (2007) investigated into the durability of quarry dust concrete showing it had improved both the strength and durability properties of the concrete.

Gonzalez *et al.*, (2020)studied the replacement of IOT as a substitute for natural aggregates for production in Ultra-High-Performance Fibre-Reinforced Concrete (UHPFRC) at 50%, 70% and 100% by volume of 0–0.5 mm natural silica sand. The results obtained indicated the variations in the properties of consistency, compressive strength, modulus of elasticity and tensile strength, were acceptable for substitutions of up to 70%. Similarly, (Jiang *et al.*, 2019) observed that the sand replacement in eco-friendly Ultra-High Performance Concrete (UHPC) containing aeolian sand improved the workability,strength and toughness of UHPC but the aeolian sand accessibility proved to be a challenge yet resolved.

experimental Work

Materials

Ordinary Portland limestone cement as the binding agent, river sand and ItakpeIron Ore Tailings (IIOT) both of 5 mm maximum size as fine aggregate, and 20 mm crushed rock coarse aggregate were used for the concrete. The iron ore tailings used for the experiment was obtained from Itakpe mines, located in Okehi LGA,Kogi State, Nigeria. Portable water, obtained within the structurallaboratory of Kaduna Polytechnic, Tudunwada, Kaduna State, was used for the concrete production. Both sand and granite used were also obtained from kabala junction, western by-pass, in Kaduna State. The physical properties of the fine and coarse aggregates are shown in Table 1. The fine and coarse aggregates satisfied the BS 882 (1992) specification.

Table 1: Physical Properties of Aggregates

Aggregates	Un-compacted Bulk Density (kg/m^3)	Compacted Bulk Density (kg/m^3)	Fineness Modulus	Moisture Content (%)	Specific Gravity	Crushing Value (%)	Impact Value (%)
River sand	1537.44	1688.68	3.29	2.41	2.65	-	-
Itakpe Iron Ore Tailings	1660.06	1924.53	4.43	5.74	3.12	-	-
Coarse Aggregate	1641.18	1783.02	-	6.97	2.74	7.10	7.97

Method

Based on the British Standard specifications, materials used for concrete production (sand, crushed granite, and iron ore tailings) were tested before using them. Sieve analysis test BS 812: part 103 (1985), determination of moisture content and specific gravity test were conducted in order to arrive at a viable concrete mix design

Concrete Design

The Building Research Establishment (BRE) design of normal concrete mixes was adopted in this study for the selection of the proportions of constituents for concrete, to make the most economical use of available materials and to produce concrete of the required properties for adequate mix. The mix proportion was designed for characteristics strength of $25N/mm^2$ maximum aggregate size of 20mm, slump 50mm, based on the procedure of the concrete mix design and using the appropriate design tables and figures. The normal weight concrete design for the production of one metre cube of concrete is presented in Table 2.

Plate I: Itakpe Iron Ore Tailings

Plate II: River sand

Proportioning of Concrete Materials

Five different types of concrete samples (C_0, C_1, C_2, C_3, and C_4) were considered, with the percentage of tailings used to replace sand as fine aggregate ranging from 0 to 20%. The reference sample is taken as C_0 with no tailings and the four others, containing tailings at 5% intervals. The reference mix adopted is that, which contain sand as the only fine aggregate. The quantities of cement, water and the coarse aggregate were kept constant for all the mix samples, the only variant are the materials used as fine aggregate (sand and iron ore tailings). The five different types of concrete samples produced and the details of the concrete mix proportioning of materials, based on water-cement ratio of 0.58, determined from Tables in BRE design of normal concrete mixes, is shown in Table 3.

Testing of Concrete

The concrete Samples produced for hardened concrete cubes were also tested for density and compressive strength using the average of three samples each and cured for 3, 7, 14, 21 and 28 days respectively based on British Standard (BS) guidelines BS 1881 Part 108 (1983) and BS 1881 Part 116 (1983) respectively

Table 2: Materials Requirements to Produce 1m^3 of normal weight concrete

Materials	Cement (kg/m^3)	Fine Aggregate (kg/m^3)	Coarse Aggregate (kg/m^3)	Water (kg/m^3)
Quantity (kg/m^3)	362.06	668.88	1189.12	210.0
Ratio	1.00	1.85	3.28	0.58
1 Bag of Cement (kg)	50.0	92.5	164.0	29.0

Table 3: Mix Proportions of Concrete Mixes.

Concrete Samples	Constituent Materials for 0.30375m^3				
	Water (kg)	Cement (kg)	Fine Aggregate mass (kg)	Itakpe Iron Ore Tailings (kg)	Coarse Aggregate (kg)
C_0	63.79	109.98	203.17	0.00	361.20
C_1	63.79	109.98	193.01	10.16	361.20
C_2	63.79	109.98	182.86	20.32	361.20
C_3	63.79	109.98	172.70	30.48	361.20
C_4	63.79	109.98	162.54	40.63	361.20
Total	318.94	549.88	914.28	101.59	1805.98

Results and Discussions

Particle Size Distribution

The Particle size distribution curve for sand, iron ore tailings and crushed granite are shown in Figure 1. The result indicates that the Iron ore tailings are very similar with the sand and the crushed granite are uniformly graded. Uniformly graded aggregate, indicates aggregate containing particles of almost the same size,with this type of grading, aggregates are not well packed, and resulting concrete will require lot of paste to make the workable concrete.

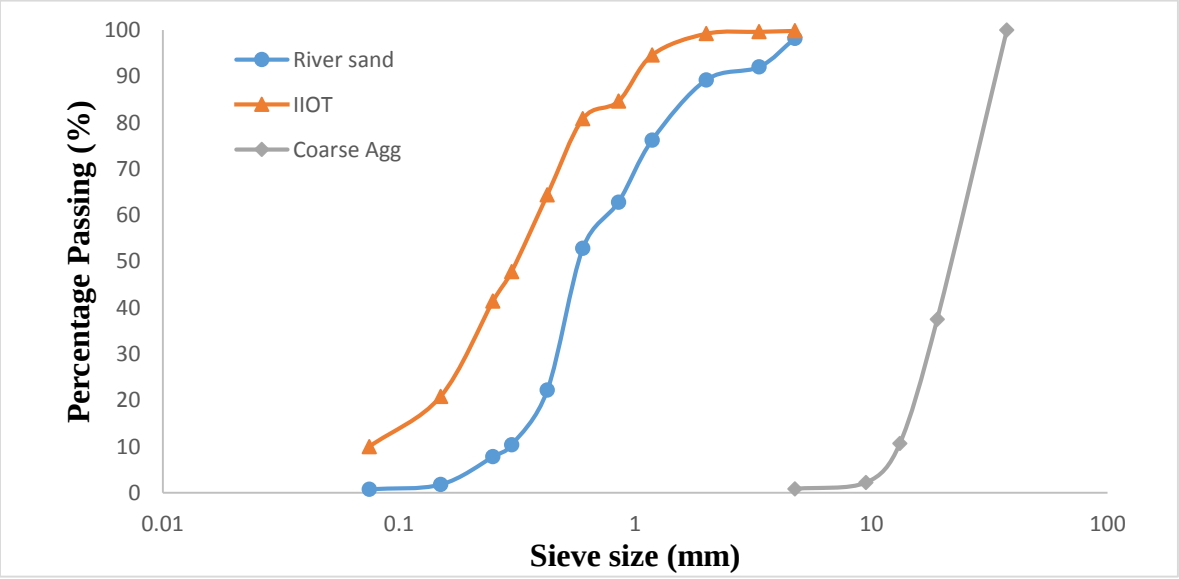

Figure 1: Sieve Analysis of Aggregates; Sand, IIOT and Coarse Aggregate

The Effect of Itakpe Iron Ore Tailings on Compressive Strength of Concrete

Variation of density and compressive strength withcuring age are presented in Figure 2 and Figure 3 respectively. The density of the produced concrete cubes samples falls within the range 2400kg/m^{3}to 2553.09kg/m^3 at 28 days which makes it a heavy aggregate. The densities followed a steady increase in similar pattern with C_0 having 2553.09kg/m^3 of C_2 as the highest. The increase in densities of IIOT concrete was due to the high Iron (Fe) content. The compressive strength values range from 25.96N/mm^2 to 30.20N/mm^2 at 28days. The compressive strength increases with the increase in tailings content up to 20% replacement level. The compressive strength of all sand replacement, C_0, C_1, C_2, C_3, and C_4 at 28 days hydration period all met the desired design strength of 25N/mm^2. These are comparable with the values obtained by other researchers (Oritola et al., 2015; Kuranchie et al., 2015; Krikar and Hawkar, 2018). The results indicated that replacing 5% of the fine aggregates with IIOT yielded the highest strength, 30.47N/mm^2; this value is approximately 17.4% higher than that of the control mixture C_0but the density decreases for 5% but was close to C_0 at 28 days, which had the lowest strength, approximately 25.96N/mm^2. The strength development for IIOT percentage mix is faster up to 28 days hydration period where as the control mix containing 0% IIOT is lower.

This is due to the angular and rough texture ofItakpe Iron ore Tailings which improves the bond between cement and aggregate interface, the presence of Iron, Fe in reasonable quantity resulting in higher compressive strength.

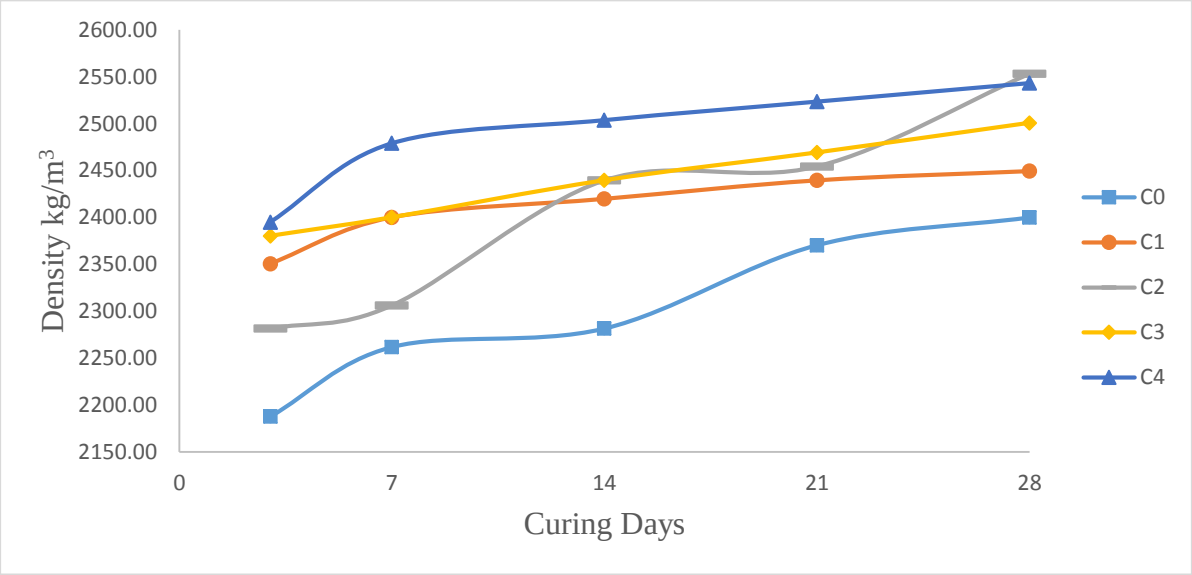

Figure 2: Variation of Density with Curing Age of Concrete

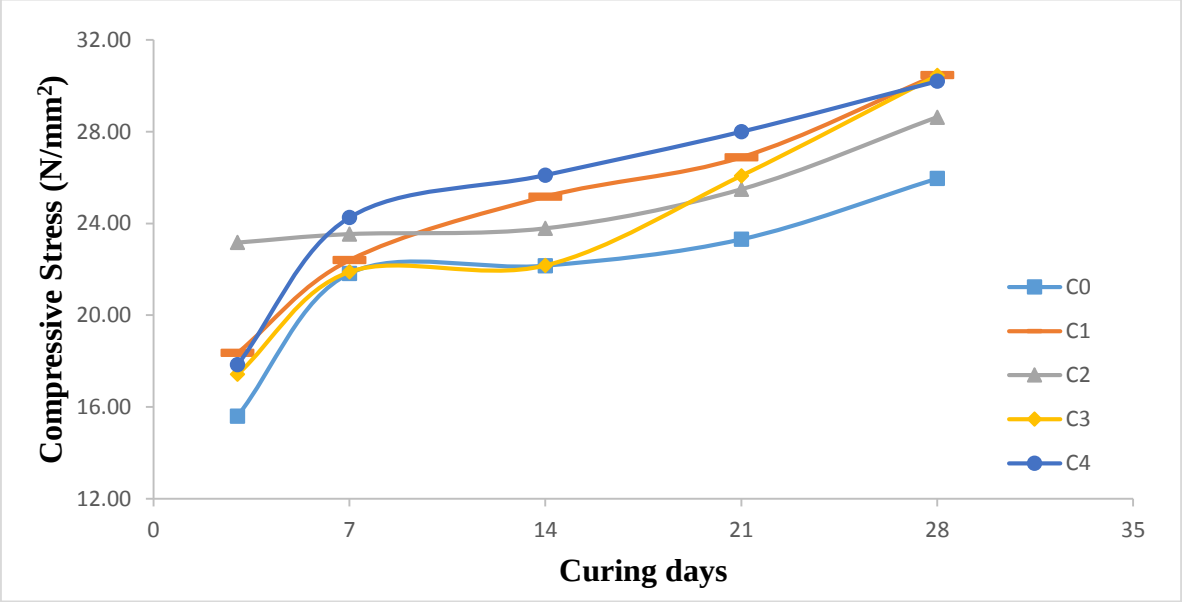

Figure 3: Variation of Compressive Strength with Curing Age of Concrete

Conclusion

From the outcome of this study, the following conclusions were drawn:

1. Properties of concrete containing iron ore tailings obtained fromItakpe, owned by Nigerian Iron Ore Mining Company(NIOMCO) Okehi LGA, Kogi Sate, Nigeria, have been determined. The hardened properties of concrete evaluated are density and compressive strengthin accordance to British Standards.
2. The fine aggregates samples were characterised to be medium grading. The IIOT was very similar to the fine aggregate but had coarse but finely graded particles than the river sand, making it compatible for replacement of fine aggregate.
3. The IIOT concrete had high densities aggregate due to the high Iron (Fe) content. The densities of C_1, C_2, C_3 and C_4 all increased 2449.38, 2553.09, 2543.21 and 2553.09kg/m^3 respectivelyat a similar pattern with C_0 at 28 days.
4. The compressive strength of IIOT concrete is much higher than the control and there is a continuous strength development comparable with that of the control. The optimum level of IIOT replacement is 5% having attained 121.88% of the design strength at 28 days but both 15% and 20% were close at 121.80% and 120.80% respectively.

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Automotive Air Conditioning System Maintenance Practices Adopted by Service Technicians in Niger State, Nigeria

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Abstract

This research work examined the "Automotive Air Conditioning System Maintenance Practices adopted by service technician in Niger State, Nigeria". The study sought out safety and collection practices required by automotive air conditioning services technicians in Niger State. Two research questions and two hypotheses guided the study. A descriptive survey research designed was utilized for this study. The population of the study consisted of 155 respondents made up of 97 highly experienced registered air conditioning service technicians and 58 moderately experienced registered air conditioning service technicians in Niger State. A structured questionnaire title "Automotive Air Conditioning System Maintenance Practices Questionnaire" was faced validated by three experts (one lecturer from Department of Industrial and Technology Education, Federal University of Technology Minna, one expertfrom Ministry of Environment Niger State andone expertfrom Ministry of Health Niger State). The questionnaire was pilot tested using 30 automotive air conditioning service technicians from Abuja. The data collected were analyzed using Cronbach AlphaStatistics and it yielded 0.71 reliability coefficient. Mean and standard deviation were used to answer the two research questions and the two null hypotheses were tested at 0.05 level of significance using z-test statistics. The numerical values obtained from the responses of the respondents were tabulated and analyzed using statistical package for social science (SPSS) version 23. The findings among other revealed safety practices such as wearing of safety glasses, always put on insulated gloves should be adopted during maintenance practices. The finding on collection practices of automotive air conditioning system maintenance practices revealed that hazardous automotive waste are not usually stored in closed containers neither collected by licensed agencies. It is recommended amongst other that Federal Government should provide laws that will guide the handling and recycling of automotive air conditioning maintenance practices in order to free the society from hazardous effects of the collection and disposal practices.

Keywords: Automotive, Air Conditioning, Refrigeration, Refrigerant, Maintenance Practices, Service Technicians

Introduction

Automotive is a four wheeled vehicle designed for transporting passenger and goods from one place to another. Giri, (2013) postulated that a self-propelled vehicle used for transportation of goods and passengers on land is called an Automobile, Motor Vehicle or Automotive. The automotive has its limitations in regard to the load it can carry and the speed as well as the distance it can carry the load. The protection and comfort is provided by the body, the suspension system and the air conditioning system.

Automotive air conditioning is a system for maintaining comfort of occupants of automotive, trucks, limited to air cooling, air heating, ventilation and occasionally dehumidification. Nishant and Ekhlak (2018) explained that automotive air conditioning is the process by which the air is cooled and cleaned, the humidity lowered and the air circulated. The quantity and quality of the air is also controlled. Under ideal conditions the air-conditioning system can be expected to accomplish all these tasks at the same time. The automotive air conditioner in the context of this study functions as the mechanism to transfer heat from a vehicle to the surrounding. In automotive air conditioning system, thermal energy is taken away to keep the air at a cool temperature and the supplying of this thermal energy from a place at a cold temperature to a place of higher temperature is called refrigeration.

Refrigeration is the process of removing of unwanted heat from a selected object, substance, or space and its transfer to another object, substance or space. Mohan *et al.*, (2019) defined refrigeration as the process of removing heat from a substance under controlled conditions. It also includes the process of reducing and maintaining the temperature of a body below the general temperature of its surroundings. Nishant and Ekhlak (2018) explained that in the refrigeration cycle, heat is transported from the passenger compartment to the surrounding air. A refrigerator is an example of such a system, as it transports the heat out of the interior and into its environment (i.e. the room). Circulating refrigerant vapor enters the compressor (located in the engine bay) and is compressed to a higher pressure, resulting in a higher temperature as well. The hot, compressed refrigerant vapor is now at a temperature and pressure at which it can be condensed and is routed through a condenser, usually located in front of the car's radiator. Here the refrigerant is cooled by air flowing across the condenser coils and condensed into a liquid. Though, generally that which enables the refrigeration cycle to produce cold by removing heat is referring to as refrigerants.

Refrigerant is a fluid capable of changes of its state at low temperatures. Vandana& Gupta, (2015) explained that natural refrigerants such as hydrocarbons, ammonia, and carbon dioxide have good thermodynamic fluids for a vapor compression system because they have large latent heats of vaporization which yield lower refrigerant flow rates and have low pressure drops because of their properties.Vandana& Gupta (2015) argued that since tubes and components through which R-12 used in automotive air conditioning system passes through are made smaller, there is every tendency for capacity and COP to suffer due to a high pressure drop and this may results into a development of a technical problems of the entire system which may required the attention of a service technicians.

Service technicians are responsible for providing difference services, depending on their area of expertise, and diagnosing problems and making repairs. Hossain, *et,al.,* (2017) Automotive service technicians inspect, maintain, and repaired automotive s with their education &experiences.The service technicians in the context of this study are further classified as highly experienced service technicians and moderately experienced service technicians, their year of service in the job is a major factor considered for these classification. For instance, for those of them who have been in this job 1-15 years are termed moderately experienced and those with 15-25 years are termed highly experienced. Hence, they are in better position to respond to the issued raised for this study. Automotive Air Conditioning (AC) Service technicians have the potential of becoming sick, ill and disable for life because of their exposure to a variety of health hazards such as skin cancers,

cataracts, eyes problems, weakened immune systems. Thus, extra care must be taken during maintenance.

Maintenance is the upkeep of equipment. Adeyeri (2017) defined maintenance practices are practices of high quality aimed at increasing machines performance with improved/ enhanced functionality of parts using safe, secure technologies and methods utilizing optimal resources by reducing or eliminating machine downtime, Mean Time To Repair (MTTR) and products' wastes thereby providing maximum usability and reusability of parts/ components, enhanced production benefits, economic impact and making the enterprise to stand competitively. Maintenance practices is the action taken to prevent air conditioning system from failing, and to repair normal degradation experienced with the operation and to keep it fit for operation. Good maintenance practices in automotive air conditioning systems can cut production costs immensely, well beings of AC technicians and environment whereas poor maintenance procedures in air conditioning system leads to illness of technicians, affecting the environment and can also cost a company millions of naira to effect repairs and correct poor quality and production lost. In a bid to correct and reduce these menace, there is need to adopt effective safety practices.This implies that in order to be free from these hazardous and harmful effects in Niger State it requires efforts by National Environmental Standard and Regulation Enforcement Agency (NESREA) and Niger State Environmental Protection Agency (NISEPA) which are the main regulatory bodies on environmental pollution in the state to provide adequate educational information on how to safely and responsibly dispose the chemical during air conditioning and refrigeration maintenance practices. It is on this basis that the study is designed to identify the automotive air conditioning system maintenance practices in Niger State.

Statement of the Research Problem

The business of automotive air-conditioning technicians in the automotive industries is maintenance and repairs of cars air conditioning system. In essence, they operate as paid employees in automotive industry to install, inspect and repair automotive air conditioners. They ventilate equipment and controls making sure they operate efficiently and continuously. However, it has been observed that the rate at which air conditioning technicians handles and disposes refrigerants and other related wastes in Niger State are on the increase. Vandana and Gupta (2015) reported that many of these refrigerants are not only harmful and potentially life threatening but appears to be also flammable and should not be disposed indiscriminately. Evidences from the literature revealed that in Niger State, parts of the refrigerant wastes such as fluids and containers and other related wastes that required special handling were indiscriminately, dumped in the drainages, rivers, public major roads, around many automotive mechanic workshops any available space, there by contributing to ozone depletion climate. It is not quite certain weather the maintenance practices adopted by the automotive air conditioning technicians may be responsible for these. The question here is: What are the automotive air conditioning system maintenance practices in Niger State?

Aim and Objectives of the Study

The main aim of the study is to determine the automotive air conditioning system maintenance practices in Niger State. Specifically, the study sought to achieve the following objectives:

1. Identify safety practices adopted by service technicians in the maintenance of automotive air conditioning system.

2. Determine the collection practices adopted by service technicians in the maintenance of automotive air conditioning system.

Research Hypotheses

The following null hypotheses were formulated to guide the study and were tested at 0.05 level of significance.

Ho_1 There is no significant different in the mean responses of highly experienced automotive air conditioning service technicians and moderately experienced automotive air conditioning service technicians on safety practices adopted by service technicians in the maintenance of automotive air conditioning system.

Ho_2 There is no significant difference in the mean responses of highly experienced automotive air conditioning service technicians and moderately experienced automotive service technicians on collection practices adopted by service technicians in the maintenance of automotive air conditioning system.

Methodology

The research adopted a descriptive survey design to elicit information from automotive air conditioning service technicians in Niger State. Descriptive survey research design in the view of Nworgu, (2011) is a kind of research in which aims to collecting data on, and describing in a systematic manner the characteristic, feature of facts about a given population. The population of the study comprises highly experienced technicians and moderately experienced technician in Niger State, Nigeria. The target population was 155 automotive air conditioning registered services technicians by NATA in Niger State. Since the population is of manageable size, the entire population will be study; hence no sampling technique will be employed for the study. A structured questionnaire titled: Automotive Air Conditioning System Maintenance Practices Questionnaire (AACSMPQ) was used to collect data for the study. The instrument was validated by one expert in the Department of Industrial and Technology Education, Federal University of Technology Minna, one Medical Doctor in Ministry of Health (Public Health) Niger State, and one expert in Ministry of Environmental in Niger State. A trial test was conducted on Automotive Air Conditioning services Technicians in Abuja, to determine the reliability coefficient of the instrument using split half reliability method. The Overall reliability coefficient of the instrument was 0.71 indicating that the instrument had a high reliability. Mean and standard deviation were used to answer research questions and z-test was used to analyze research hypotheses.

Results and Presentation

Research Question 1

What are the safety practices adopted by service technicians in the maintenance of automotive air conditioning systems?

Table 1: Mean Responses and Standard Deviation as Regards the Safety Practices Adopted by Service Technicians in Maintenance of Automotive Air Conditioning Systems

N1 = 97, N2 =55 **N_T=152**

S/N	Items	X_1	X_2	X_T	SD_I	SD_2	SD_T	Remark
	Safety practices							
1	Technicians wearing safety glasses during handling and recycling of refrigerants	4.00	3.25	3.63	0.00	0.44	0.22	Adopted
2	Always put on insulated gloves	4.14	3.85	3.99	0.35	0.45	0.80	Adopted
3	Turn off power to the corresponding circuit in the beaker panel before feeling of refrigerants.	4.22	4.75	4.49	0.52	0.55	0.54	Adopted
4	Use proper lockout and tag procedures to ensure no one tries to turn on the ignition system while you are working.	3.72	4.25	3.99	1.21	0.95	1.08	Adopted
5	Before performing the task, test the circuit with a meter that is properly rated for the type of circuit you are testing	5.00	4.51	4.76	0.00	0.60	0.30	Highly Adopted
6	Never lift a cylinder by the top valves	5.00	4.36	4.68	0.00	0.59	0.29	Highly Adopted
7	check leakages by using gauge	4.24	4.84	4.54	0.43	0.50	0.47	Highly Adopted
8	Protective clothing should be worm if there is a possibility of direct contact or splashes	3.95	3.58	3.77	0.22	0.69	0.46	Adopted
9	Check using leak monitor to determine available oxygen during dispersion.	4.00	3.96	3.98	0.00	0.27	0.14	Adopted
10	The manufacturer instructions on changing oil and filters are usually followed by technicians	4.00	3.40	3.70	0.00	0.76	0.38	Highly Adopted
11	Evaporation process during recycling are used by the technicians.	4.00	3.67	3.84	0.00	0.69	0.60	Adopted
12	Adequate equipment inventory are usually kept in the workshop	4.59	3.75	4.17	0.49	0.79	0.64	Adopted
13	Wear safety boots when handling refrigerant cylinders	4.14	3.24	3.69	0.35	0.47	0.41	Adopted
14	Always assume that the cylinder contains gas	4.22	3.05	3.64	0.52	0.23	0.38	Adopted
15	When moving cylinders, keep their caps on	4.67	3.84	4.26	0.67	0.89	0.78	Adopted
16	Wear self-contained apparatus in high gas concentration	5.00	4.25	4.63	0.00	0.48	0.24	Highly Adopted
17	Provide good ventilation during working with refrigerant	5.00	3.91	4.46	0.00	0.29	0.15	Adopted
18	Clean tubing before cutting	4.24	3.91	4.08	0.43	0.29	0.34	Adopted
19	Conduct a standing pressure test with high pressure nitrogen	3.95	4.42	4.19	0.22	0.53	0.38	Adopted
20	Replace fitters and drier as needed	4.00	3.80	3.90	0.00	0.59	0.29	Adopted

21	Purge nitrogen before and after assembling tubing	4.00	4.05	4.03	0.00	0.76	0.38	Adopted
22	Make sure the fittings and refrigerant circuit components are clean and free of debris	4.00	3.49	3.75	0.00	0.50	0.25	Adopted
23	Keep open pipes work covered to prevent rainwater or condensation from entering	4.59	3.60	4.09	0.49	0.91	0.70	Adopted
24	Use clean oil for your pump and test it routinely	5.00	4.55	4.78	0.00	0.54	0.27	Highly Adopted
25	Adequate equipment inventory are usually kept in workshop	3.95	3.98	3.97	0.22	0.13	0.18	Adopted
26	Check using leak monitor to determine available oxygen during dispersion	4.00	4.71	4.36	0.00	0.46	0.23	Adopted
27	Inspect the refrigerant line before filling	4.00	4.55	4.28	0.00	0.50	0.25	Adopted
28	Turn off power to the corresponding circuit in the baker panel before feeling of refrigerant	4.00	3.27	3.64	0.00	0.45	0.23	Adopted
	Grand total			**4.12**			**0.41**	

Table1 shows the mean responses of the respondents on the 28 items posed to determine the safety practices in the maintenance of automotive air conditioning system with a grand mean of 4.12 which implies that the automotive service technicians agreed with the majority of items as safety practices adopted in the maintenance of automotive air conditioning system. The standard deviation of items ranges from 0.14 to 1.08. This standard deviation showed that the respondents were not too far from the mean and were closed in one another in their responses. This closeness of the responses adds values to the reliability of the item.

Research Question 2

What are the collection practices adopted by service technicians in the maintenance of automotive air conditioning systems?

Table 2

Mean Responses and Standard Deviation as Regards the Collection Practices Adopted by Service Technicians in Maintenance of Automotive Air Conditioning Systems

N1 = 97, N2 =55 **N_T=152**

S/N	Items	X_1	X_2	X_T	SD_1	SD_2	SD_T	Remark
	Collection practices							
1	Refrigerant containers are stored in separate drums for collection	2.87	3.00	2.93	0.36	0.00	0.18	Moderately Adopted
2	Registered private waste collectors are stored in separate drums for collection	3.05	2.95	3.00	0.27	0.23	0.25	Moderately Adopted
3	Hazardous air conditioning waste are usually stored in containers for collection by licensed agencies	3.07	3.11	3.09	0.26	0.45	0.36	Moderately Adopted
4	Informal waste pickers collect metallic scraps of automotive waste from the	4.95	4.78	4.87	0.27	0.46	0.37	Highly Adopted

	service technician workshops, vehicle users and dump sites.							
5	Used oil filters are crushed for collection by metal recycler	3.70	3.27	3.49	0.50	0.45	0.48	Moderately Adopted
6	There are modern waste collection facilities for automotive waste in all the local governments	3.03	2.95	2.99	0.64	0.68	0.66	Moderately Adopted
7	Oil rags are placed in a sealed container for ease of Collection	3.48	3.24	3.36	0.56	0.43	0.49	Moderately Adopted
8	There is curbside used oil collection programme for oil recycling incentives.	3.27	3.38	3.33	0.45	0.49	0.47	Moderately Adopted
9	Used solvent are kept in sealed drums for collection	3.36	4.20	3.78	0.48	0.59	0.54	Adopted
10	Waste antifreeze is stored in separate closed container for Collection	3.41	3.56	3.49	0.49	0.60	0.55	Moderately Adopted
11	Used refrigerants from vehicle are collected in approved recovery equipment for off-site reclamation	2.41	2.85	2.63	0.49	0.36	0.43	Moderately Adopted
12	Punctured and emptied aerosol cans are stored in a container for ease of collection by scrap merchants	2.77	2.80	2.79	0.42	0.65	0.54	Moderately Adopted
13	Metals such a lead, copper, aluminum and steel are stored in a secure container for collection by a metal recycler	2.80	2.82	2.81	0.39	0.39	0.39	Moderately Adopted
14	Catalytic converters are taken to a catalytic converter collection centres for profit	2.82	2.57	2.67	0.38	0.50	0.44	Moderately Adopted
15	There is curbside used oil collection programme for oil recycling incentives.	2.67	2.80	2.74	0.47	0.40	0.44	Moderately Adopted
	GRAND TOTAL			**3.20**			**0.44**	

Table 2 shows the mean responses of the respondents on the 15 items posed to determine the collection practices in the maintenance of automotive air conditioning system with a grand mean of 3.20 which implies that the automotive service technicians disagree with the majority of items as collection practices adopted in the maintenance of automotive air conditioning system. The standard deviation of items ranges from 0.18 to 0.66. This standard deviation showed that the respondents were not too far from the mean and were closed in one another in their responses. This closeness of the responses adds values to the reliability of the item.

Hypothesis One: There is no significant different in the mean responses of highly experienced automotive air conditioning service technicians and moderately experienced automotive air conditioning service technicians on safety practices of automotive air conditioning system maintenance practices adopted by service technicians in Niger State, Nigeria.

Table 3: z-test analysis of significant difference in the mean responses of the respondents as regards the safety practices of automotive air conditioning system maintenance practices adopted by service technicians in Niger State.

Automotive Air Conditioning Service Technicians	N	Mean	S.D	df	Z	P-value
Highly Experienced Service Technicians	97	4.27	0.13			
				150	9.35	0.01
Moderately Experienced Service Technicians	55	3.96	0.23			

Table 3 shows the z-test analysis of differences in the responses of Registered Highly Experienced Automotive Air Conditioning Service Technicians and Registered Moderately Experienced Automotive Air Conditioning Service Technicians in Niger State as regards the Safety Practices of automotive air conditioning system maintenance practices. The table revealed that the probability value obtained was found to be 0.01 which is less than the probability value of 0.05 in comparison. The null hypothesis was therefore rejected. Therefore, there is significant difference in the mean responses of highly experienced automotive air conditioning service technicians and moderately experienced automotive air conditioning service technicians as regards the safety practices of automotive air conditioning system maintenance practices adopted by service technicians in Niger State.

Hypothesis Two: There is no significant different in the mean responses of highly experienced automotive air conditioning service technicians and moderately experienced automotive air conditioning service technicians on collection practices of automotive air conditioning system maintenance practices adopted by service technicians in Niger State, Nigeria.

Table 4. z-test analysis of significant difference in the mean responses of the respondents as regards the collection practices of automotive air conditioning system maintenance practices adopted by service technicians in Niger State.

Automotive Air Conditioning Service Technicians	N	Mean	S.D	df	Z	P-value
Highly Experienced Service Technicians	97	3.18	0.12			
				150	-1.78	0.08
Moderately Experienced Service Technicians	55	3.25	0.28			

Table 4 shows the z-test analysis of differences in the responses of Registered Highly Experienced Automotive Air Conditioning Service Technicians and Registered Moderately Experienced Automotive Air Conditioning Service Technicians in Niger State as regards the collection

Practices of automotive air conditioning system maintenance practices. The table revealed that the probability value obtained was found to be 0.08 which is greater than the probability value of 0.05 in comparison. The null hypothesis was therefore accepted. Therefore, there is no significant difference in the mean responses of highly experienced automotive air conditioning service technicians and moderately experienced automotive air conditioning service technicians as regards the collection practices of automotive air conditioning system maintenance practices adopted by service technicians in Niger State.

Discussion of Findings

Findings on the safety practices of automotive air conditioning system maintenance practices adopted by services technicians revealed that automotive air conditioning system waste are needed such as, technicians denied wearing safety glasses during handling and recycling of refrigerants, putting insulated gloves and protective clothing should be worm if there is a possibility of direct contact or splashes that can cause problem to human body. Apart from the accidents resulting in fatalities, non-fatal accidents at the workplace, in some cases, leave victims with loss of body parts, skin diseases, musculoskeletal and reproductive disorders, cancer, mental and neurological illnesses, respiratory and cardiovascular diseases (Tadesse&Admassu, 2006; Punnett&Wegman, 2004; Adei, *et al.,* 2011). Studies have shown that employees in small and medium enterprises are more prone to work-related hazards and risks. This is partly attributed to inadequate resources, poor technical capacity and ignorance of occupational safety and health (OSH) standards (ILO, 2005).

Findings on the collection practices of automotive air conditioning system maintenance practices revealed that hazardous automotive air conditioning waste are not usually stored in closed containers neither collected by licensed agencies in the study area this might be as a result of lack of knowledge on their potential hazards on the part of automotive mechanics. This finding is in support of Abarca *et al*, 2013; Agarwal *etal*, 2015 who reported that the risk of exposure to automotive waste is influenced by poor management practice or neglect characterized by ineffective collection, unsafe disposal and absence of good polices.

Conclusion

Based on the findings of this study on automotive air conditioning system maintenance practices adopted by service technicians in Niger State, Nigeria, the desideratum to achieve air conditioning system maintenance practices required proper implementation of safety and collective practices. The study found out that air conditioning service technicians and officials of all the waste management regulatory agencies are not aware of the effects of indiscriminate disposal of automotive air conditioning system waste. It is in this regards that the automotive air conditioning service technicians and environmental protection agencies officials have to be enlightened on the consequences of improperly disposed automotive air conditioning waste especially the gases from refrigerants to the environment. It is necessary that any workshop housing service technicians alleged for environmental pollution be sanctioned in line with environmental laws.

Recommendations

Based on the findings of this research work, the following recommendations were made

1. Federal Government should provide laws that will guides the handling and recycling of automotive air conditioning maintenance practices in order to free the society from hazardous effects
2. Environmental agencies should introduce public enlightenment and education on the consequences of indiscriminate disposal of automobile refrigerants and other wastes.
3. Automotive air conditioning service workshops must always store liquid waste in according with manufacturer's requirement

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SUB-THEME: Curricular and Assessment Issues in STEM and TVET

Enhancing Critical Thinking Skills through Problem-Based Learning: The Mediating Role of Assessment Techniques

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Abstract
The assessment system enhances both teaching and learning effectiveness. The mediating role of assessment techniques on the relationship between PBL and critical thinking skills development among technical and vocational students was investigated. Recognizing the population's heterogeneous complexity, a stratified random selection process was used to choose 123 technical teachers out of a total of 184 for this study. Based on the small number of people that constitutes the population, Smart PLS version 3, Structural Equation Modeling was utilized to concurrently test the measurement model, structural model, and verify the convergent and discriminant validity of the calculation. Our findings on regression weights and probability values (P-values) were presented using the Sobel test technique. The findings indicate that the indirect effect > direct effect, the value of the independent variable to mediator and the mediator to the dependent variable is significant. It is established that the achievement of critical thinking skills will be improved if the problem-based learning method is utilized in collaboration with suitable evaluation methods.

Keywords: Problem-based learning; Assessment techniques; Critical thinking skills; Technical and vocational education and training (TVET).

Introduction

Graduates of technical and vocational education and training (TVET) institutions are also threatened by the problem of unemployment among the various graduates who roam the streets. Besides, it has been noted that graduates of TVET institutions in Nigeria are not adequately trained to acquire the appropriate employability skills required by the industry to enter the workforce (Akhuemonkhan & Raimi, 2014). The discrepancy between the skills acquired by graduates and the skills required in the complex 21st-century job environment has been reported to be the cause of the alarming rate of unemployment among TVET graduates (Ababa, 2007;Oviawe & Uwameiye, 2018) Current employers prefer candidates with concrete employability skills that have the potential to enhance the organizations' success (Kaur et al., 2008; Sunday, 2013). By the way, we are in an era of stiff competition such that graduates compete vigorously for the inadequate jobs available. Therefore, to cope with these obstacles, TVET institutions are challenged to incorporate the required skills such as critical thinking into their students to prepare them for effective and productive ventures in this competitive environment.

Critical thinking skills are valuable employability skills in the field of technical vocational education and training (TVET) (Kamin & Sukri, 2013). Critical thinking is the logically well-organized process of intentionally and skilfully conceiving, applying, analyzing, synthesizing, and evaluating knowledge obtained through observation, experience, reflection, reasoning, and communication to make an informed decisiontoward effective problem solving. Critical thinking is a skill that helps you to make the best rational and refined decisions. It relates to the capacity of cognitive and affective elements that involve active, productive, consistent, and detailed development of mental behaviour and processes.

Critical thinking skills have a direct positive association with both an employee's and the organization's success. Hence, a comprehensive body of research has identified agreement with students' necessity to develop their critical thinking skills (Saleem & Amin, 2013). It is responsible for gathering and choosing the right information, analyzing data and design suggestions, and solving problems(Molitor & George, 1976). Hence, critical thinking skills have been recognized as one of the main stakes of a new, knowledge-based economy (Changwong, 2018). Florea &Hurjui (2015) state that critical thinking is the capacity to distinguish differences, recognize causal relationships, gain ideas from examples, and evaluate information on the value of truth, positive or negative effects. Therefore, critical thinking is supposed to remain in students' everyday lives until it becomes an automatic common skill among them(Sinprakob & Songkram, 2015).

Preparing students to be able to think critically should be one of the main goals of TVET teachers as it is an important quality sought by most employers in the 21st century(Shahrazad et al., 2008). Therefore, teaching methods that require the involvement of students in the teaching-learning process should be encouraged for the successful development of their employability skills. Critical thinking is best developed through students' knowledge and experience, hence learning by using PBL strategies offers students the opportunity to improve their critical thinking skills since it involves real-life experiences (Martyn et al., 2014).

PBL is a pedagogical technique that uses real-world situations as the basis for information creation and problem-solving competencies. Problem-based learning is a method that creates a collaborative environment for learners to use the constructivist approach to learn how to solve daily issues(Savery & Duffy, 2001).Therefore, PBL helps to guide and encourage learners to perform constructive problem-solving tasks in real-world situations (Ram, 1999); encourages students to strive and find solutions to real-world problems by engaging cooperatively in communal work(Brundiers et al., 2010; Steinemann & Asce, 2004); encourages students to work together in groups, finding answers to real-world tasks, and developing skills to become independent learners (Akçay, 2009;Carder, Willingham, & Bibb, 2001).

PBL is a methodology for teaching and learning with a treasure of literature on its usefulness in several frameworks, as it is significantly student-centered, where learning requires collaboration, and thus livelier than passive. Various studies have proved that collaborative learning leads to diverse academic success, such as greater achievement, including knowledge attainment, precision, problem-solving skills, and a higher level of reasoning (Fawcett & Garton, 2005); yielding positive effects on the mindset, such as commitment towards objectives, inherent encouragement, transferal of learning to other situations, and remaining longer on tasks (Johnson

et al., 1998). This approach allows students to develop their critical thinking skills, evaluate and solve complex, real-world problems, function in community cooperation, and interact verbally and in written form (Akçay, 2009).

Assessment is said to be important in education as it plays a vital role in the teaching and learning process. This could promote the attitudes of students towards the development of skills as well as provide feedback on the development of competencies.Assessment is a process by which student learning data is gathered to create academic choices (Edwards, 2013). Assessment strategies have been recognized to have a positive influence on students' teaching and learning (Jimaa, 2017; Alkharusi, 2019). In recent times, assessment approaches have attracted teachers' interest in the fields of technical and vocational education and training for skills development (Wiliam et al., 2010). Through effective assessment, teachers ascertain and evaluate students, collect, study, and plan their lessons accordingly. Assessment techniques impact both teachers and students. Therefore, attention should be given to the assessment process for the effective integration of relevant skills into technical and vocational education programmes. Critical thinking skills, a significant element of soft skills, are acknowledged to be effectively evaluated when carried out in a real work context (Shafie et al., 2014).

Evaluation of soft skills has been categorized into three groups, namely; direct evaluation, indirect evaluation, and a combination of evaluation methods (Durowoju & Onuka, 2014). The methods of direct assessment involve, but are not restricted to, instructor-made-test; standardized tests; oral questions; projects; practical tests or tests; oral questionnaires. The indirect assessment method includes classroom observations; questionnaires; interviews; inventory; anecdotal records; attitudinal scale; interest scale; and checklist, among others. Four basic approaches to generic employability skills assessment were identified in a study conducted by (Matters & Curtis, 2008), namely; teacher's judgments; the use of portfolios; work experience assessment, and purpose-built instruments.

On the other hand, in their study, Aworanti et al., (2015) identified the following methods for assessing soft skills: practical tests, essay tests, observations, objective tests, questionnaires, rating scales, checklists, and assignments. Besides that, Curtis et al., (2004) classify the soft skills assessment methods into five: Standardized assessment; Common assessment tasks; Performance assessments; Teacher or holistic judgment, and Portfolio assessment.

Studies that investigated the development of skills using instructional approaches have produced conflicting findings. PBL promotes critical thinking skills among students more than conventional methods of teaching. Choi et al., (2014), and Ozturk (2008)find that PBL promotes critical thinking skills among students more than conventional methods of teaching. (Gholami et al. (2016) and Snyder & Snyder (2008), however, found that courses utilizing PBL approaches did not enhance analytical thinking compared to conventional methods. Meanwhile, Peter (2000) maintained that it is difficult to measure progress and determine if efforts to improve critical thinking skills have been successful without appropriate assessment techniques.

Generally, instructional methods which involve students in active learning can contribute to the attainment of soft skills such as critical thinking. Some of the instructional methods include problem-based learning, project-based learning, service-learning, and team-based learning, among

others. Unfortunately, even when these practices are used, there is often a missing link between the skills faculty want to develop using these activities and the techniques used for students' evaluation in those courses (Mouza, 2011;Graue, 1993). The reason for the disconnection between the skills teachers think are important and what seems to be reflected in their classes is the lack of implementing the appropriate assessment techniques (Haynes et al., 2016). Appropriate assessment techniques are essential elements for evaluating the effectiveness of technical and vocational education programmes and for assessing the potential benefits of new approaches aimed at improving students' learning outcomes.

The failure to appropriately assess students' learning outcomes that are deemed most important, such as critical thinking skills, has resulted in a lack of quality assurance in various institutions (Condon & Kelly-riley, 2004). It's much easier to develop a test to assess pupils' rote memory of factual material than it is to design an evaluation to assess critical thinking skills. When instructors utilize rote retention assessments to evaluate student performance, they are unknowingly pushing students to spend the majority of their time and effort memorizing knowledge. The effect of these appraisals across a school year can prompt unwanted results and disappointment with projects of study. Legitimate and proper appraisal apparatuses are a fundamental component in any work to assess the adequacy of TVET programs and to assess the expected advantages of new methodologies that intend to further develop student learning. Without suitable evaluation tools, checking progress and deciding whether endeavours to further develop critical thinking have been fruitful is not safe (Vogler et al., 2018). This study shall adopt the assessment techniques classified by Curtis as they appear to cover the areas of critical thinking such as interpreting, evaluating, analyzing, applying, understanding, and remembering.

Meanwhile, some researchers have been very critical of technical and vocational institutions in Nigeria for doing little to develop the critical thinking skills of graduates (Osemeke, 2012;Hauwa, 2016). By the way, there is a need to help TVET institutions effectively develop soft skills(critical thinking skills) among students through the application of efficient assessment techniques (Ali et al., 2013;Stronge et al., 2015). The literature review shows that there are no studies in Nigeria to assess technical teachers' perception of the mediating role of assessment techniques in enhancing critical thinking skills among students of technical and vocational education through PBL. Therefore, making faculty aware of the mediating role of assessment strategies in the partnership between PBL and critical thinking skills is ultimately an essential move to develop the critical thinking skills of TVET students. Hence, the study's objectives are i) to determine the elements of problem-based learning that are effective for the development of critical thinking skills; ii) to determine the mediating role of assessment techniques in the relationship between PBL and the enhancement of critical thinking skills among technical students.

Theoretical Framework

Experiential learning theory and sociocultural theory formed the theoretical framework of this study. Kolb introduced the principle of experiential learning in 1984. The theory describes learning as the machinery which generates knowledge through experiential adaptation. This results from the combination of the picking and spinning processes (Kolb, 1984). Kolb's theory was founded on the educational philosophy of John Dewey. The use of PBL has been explored in previous literature as a way of increasing student participation in the learning process(Han et al., 2014). PBL is an appropriate method of making students effectively participate in the teaching-learning process and

has therefore been widely used in experiential learning approaches (Omodan, 2019;Han et al. (2014). This, therefore, indicates that students in PBL should have a strong relationship with the concept of experiential learning theory. For example, PBL gives learners the ability to attain physical, social, academic, mental, moral, and political experiences in an environment where a learner can replicate and independently evaluate the success and failure of learning in accordance with the theories of the course (Alebaikan, 2010). Similarly, other researchers have noted that experiential learning theory encourages student learning outcomes that differ from the learner's specific characteristics, core subject skills, and common skills required to be effective in the workforce (Fry & Kolb, 1978).

Furthermore, its principle promotes educational interactions between teachers and students in an environment where pedagogical motivation is a necessary component for attaining knowledge. The philosophies found in this theory, however, suggest that PBL supports learners in terms of assessment and improvement as well as positive pedagogical strategies in trying to fulfill community needs. Both of these theoretical viewpoints stress the essential role of the communal engagement of learners in knowledge sharing and skills growth, and therefore, the theory of experiential learning has laid the theoretical foundations for this work.

Methodology of the Study

In this study, all teachers from public technical colleges in the north-western states of Nigeria constituted the population. Teachers are called students' future builders (Garrison et al., 2010). One of their primary responsibilities is producing well-trained, professional, and qualified graduates (employees) with solid values and the capacity to work and learn effectively (Meltzer, 1990;Darling-hammond, 2006). During the 2019 academic session (Dogara et al., 2020), the collection of data from the aforementioned technical colleges was held. Recognizing the mixed complexity of the population, a stratified random sampling methodology was employed to select 123 technical teachers, comprising 184 from the sample field for this analysis. Based on the sample size determination table (Krejcie & Morgan, 1970), an ideal sample size of 123 participants was selected.

For the main variables of the study, critical thinking skills (dependent variable) with 6 items of questions; assessment techniques (mediator variable) with 6 items of questions; and problem-based learning (independent variable) which has sub-constructs to include Small Group Learning, Active Learning, Tutorial, Reflection, and Technology with 5 items of questions each, except for Active Learning and Technology with 6 items of questions each. Before data collection from the respondents, both face and content validity of the 39 items of the standardized questionnaire were carried out by experts in technical and vocational education. The researchers, with the help of research assistants, distributed the questionnaires to the TVET teachers, who recovered them after two weeks. The study adopted a 5-point Likert-like scale of strongly agree (5), agree (4), not sure (3), disagree (2), and strongly disagree (1) for respondents to express their opinions (Ghulami et al., 2014). Before the administration of the final survey, the instrument was pilot tested to modify it appropriately. The questionnaire items' internal consistency was assessed through Cronbach's alpha-reliability method. To get a reliable test, the Cronbach Alpha of a component is recommended to be as much as 0.7 (Chan & Idris, 2017). From the pilot analysis, the findings indicate that the test models are consistent because their values were above 0.7 each. The survey exploration design is appropriate for this study because data was collected through a questionnaire

on the activities required for the effective integration of critical thinking skills among technical college students.

Structural Equation Modelling is a multivariate statistical analysis technique of the second generation that clusters the concept of factor analysis and multi-regression analysis (Ghulami et al., 2014). Hence, it has been utilized here to evaluate the related factors using an exploratory and confirmatory factor analysis approach. Since the sample size for this analysis was relatively small, the researchers were not sure that the data would be normally distributed. Therefore, SmartPLS is suitable for non-normally distributed results and has been adopted for this analysis. Initially, version 23 of the Statistical Program for Social Sciences (SPSS) was used for factor analysis, and later, Smart PLS version 3 was used to concurrently evaluate the measurement model and structural model, and, subsequently, validate the convergent and discriminating validity of the measure.

Data Analysis

In particular, determining the dimensions of the constructs is important for the unidimensionality of the scale before the SEM phase, to decide whether the objects fall together to form distinct constructs (Churchill, 1979). From the exploratory factor analysis (EFA) the outcomes of the factors for this study were extracted and utilized: small group learning, active learning, tutoring, reflection, and technology as independent variables; assessment techniques as mediating variable; and critical thinking skills as the dependent variable. Exploratory variable analysis (using the normalized rotation of varimax) was applied to the 39 items of the study. Each of the 39 items had a factor loading value above 0.5, which is considered statistically relevant and acceptable. According to Hair et al. (Joseph F. Hair et al., 2014), such loadings are graded as ±0.30=minimum, ±0.40=important, and ±.50=practically important using another thumb rule. Besides that, Kaiser-Meyer-Olkin (KMO) and Bartlett's employed to check the validity of the data and sampling accuracy for the study. The KMO value was 0.809, meeting the necessary KMO value of > 0.5 and the Bartlett test (Chi=6070.605, $p<0.05$).These tests established the minimum criterion for the continuation of factor analysis (Chan & Idris, 2017).

The outcomes of this study's mediation were evaluated using a reliable multivariate technique, structural equation modeling (SEM). The application of the SEM approach within the sense of mediation research has several benefits. SEM allows it to be possible to quantify and predict while there are latent variables in a model, such as problem-based learning, assessment methods, and critical thinking abilities. SEM simplifies work on the mediation hypothesis as more complex forms of mediation are evaluated in a single experiment (Awang, 2010)

Figure. 1 describes a route map of the specific relationships between the three main factors in this study: PBL, assessment techniques, and critical thinking abilities.

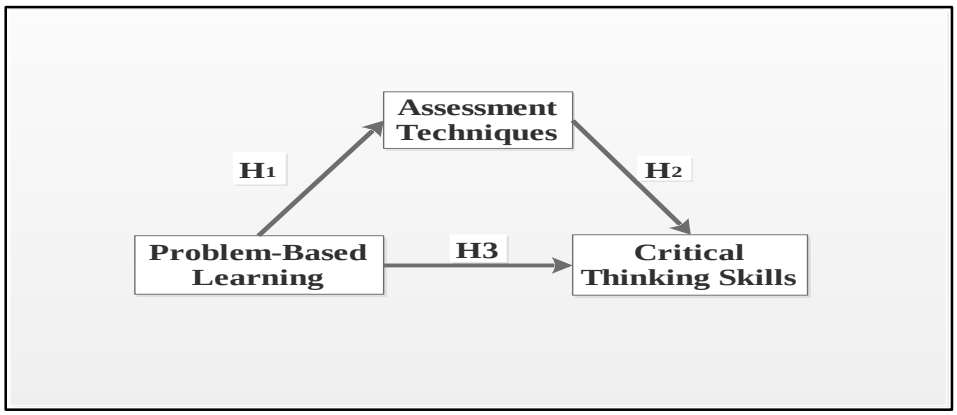

FIGURE 1.Path diagram of the causative relationships between the variables

Rungtusanatham et al. (2014) developed, outlined, and suggested two main strategies to explain the issue as to how formulated hypotheses are for the mediation effects, which are segmentation and transmittal methodologies. This study adopted the segmentation approach, which requires three hypotheses to be formulated.

The hypotheses to be tested in this analysis are, therefore, as defined in Figure 1: H_1) Problem-based learning has a direct and significant effect on assessment techniques; H_2) Assessment techniques have an indirect and significant effect on critical thinking skills development; and H3) Problem-based learning has a direct and significant effect on critical thinking skills development.

Assessment of Measurement Model (Outer Model)

The researchers used the PLS algorithm approach to examine the reliability and validity (convergent and discriminating validity) of the measurement models. This is done by determining the factor loading of all variables through their respective constructs. Firstly, the correlations between problem-based learning, assessment techniques, and the enhancement of critical thinking skills constructs. The impact of problem-based learning on the enhancement of critical thinking skills and the mediating role of assessment techniques were described by five individual factors: small group learning, active learning, tutoring, reflection, and technology (PBL) as the independent variables; assessment techniques as the mediating variable; and critical thinking skills as the dependent variable. Next, the PLS algorithm was applied and the resulting loading relationships, parameters, and values can be obtained in Figure 2.

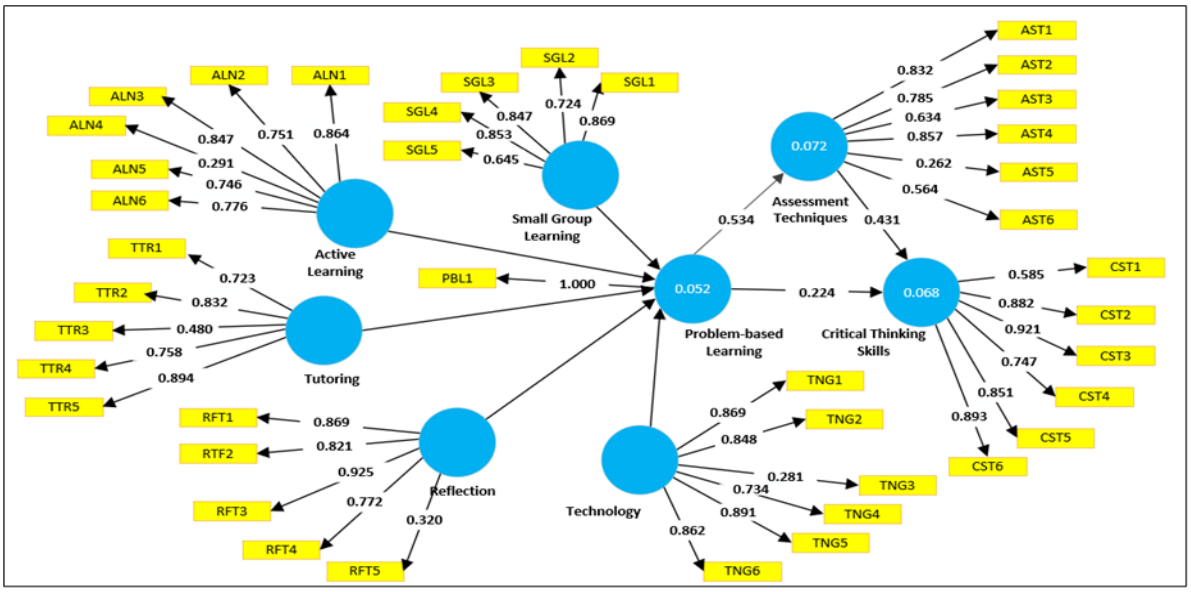

Figure 2: Initial Path Model of the Effect of PBL on Critical Thinking and the Mediating role of Assessment Techniques

Thirty-nine (39) items were used to assess the factors. Assessment of the reliability of each measured component was carried out by analyzing their cross-loadings and it was noticed that the factor loading of some items is below the satisfactory value of 0.50 (Akdeniz, 2012). In the course of authenticating the model, item AST5 with a factor loading of 0.262 was dropped from the Assessment Techniques factor. Subsequently, item ALN4 with a factor loading of 0.291 was dropped from the Active Learning factor. In the same vein, item TNG3 with a factor loading of 0.281 and item RTF5 with a factor loading of 0.320 were dropped one after the other from the Technology factor and Reflection factor respectively. Upon validation, the factor loading for each item was raised to be greater than the cut-off value of 0.50 (Figure 3).This means that the reliability of each construct was high, and there was a shared variance for strong convergent validity between the constructs and the items (Gefen, 2005; Ringle & Sarstedt, 2014).

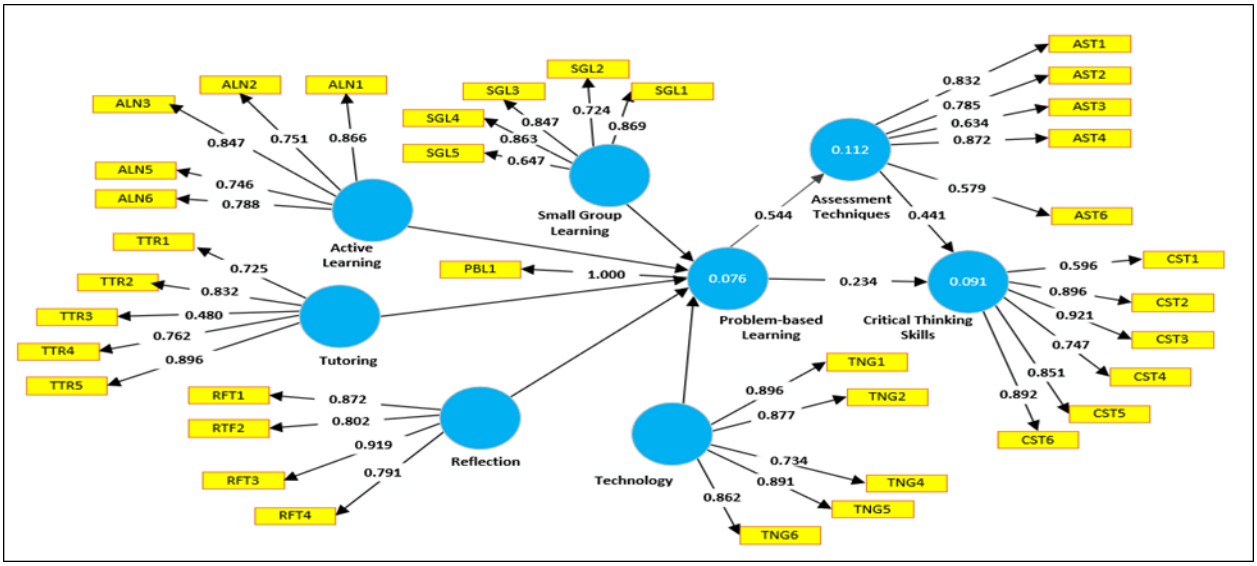

Figure 3: Modified Path Model of the Effect of Problem-Based Learning on Critical Thinking and the Mediating role of Assessment Techniques

Construct Reliability

Table 1 describes the comparative reliability (internal consistency) of the concept of the mediating function of assessment approaches on the partnership between PBL and the application of critical thinking skills. The appropriate range for such statistics is usually from 0 to 1, but in exploratory experiments, a value greater than 0.6 is deemed suitable (J. F. Hair et al., 2014). The model contained forty (39) items consisting of seven (7) factors: small group learning, active learning, tutoring, reflection, and technology as independent variables; assessment strategies as a mediating variable; and critical thinking skills as the dependent variable. Therefore, the measurement model has sufficient reliability and internal precision with values varying from 0.875 to 0.927, which crosses the 0.6 thresholds. This calculation is preferred to Cronbach's alpha as it demonstrates the higher estimate of the variance represented by the measurements and therefore uses the loadings of items found inside the homological structure (J. Hair et al., 2014). Consequently, the constructed items have sufficient reliability for internal accuracy as revealed by the findings (Table 1).

Convergent Validity

Convergent validity and discriminant validity are the two most commonly appropriate forms of construct validity which were assessed to determine the model's construct validity. Convergent validity is the evaluation to determine the degree of association between various indicators of a construct that agree. Converging validity is determined when two theoretical measures of the same form are positively associated (Agarwal, 2016). In line with Agarwal (2016), the convergent validity of the indicators for this analysis was determined using the Average Variance Extracted (AVE) and Composite Reliability. Convergent validity has been obtained for a construct that has an Average Variance Extracted value greater than or equal to 0.5 (Abdullah, 2015; Hair et al, 2016). The result of this study shows that each model has an Average Variance Extracted above 0.5. Going by these criteria, the existence of a latent variable must, therefore, explain the variance of at least 50% in each of the indicators (Henseler et al., 2014). Hair et al, (2016) maintained that

for a construct to be sustained, it must have composite reliability above 0.07. Based on the findings in Table 1, convergent validity for this study has been achieved.

Table 1: Reliability and Validity of Constructs of the Study

	Composite Reliability	Average Variance Extracted (AVE)
Active Learning	**0.899**	**0.599**
Assessment Techniques	**0.921**	**0.662**
Critical Thinking Skills	**0.927**	**0.680**
Reflection	**0.881**	**0.652**
Small-Group Learning	**0.936**	**0.637**
Technology	**0.918**	**0.655**
Tutorial	**0.875**	**0.639**

Discriminate Validity

Next is the assessment of the study model's discriminant validity. Discriminant validity is a valuable factor in any measurement model. It's the extent to which items are measured as distinct constructs in a model. Discriminant validity was performed to establish that both structures were distinct from each other, the degree to which the test is unique, and is not only a repetition of certain variables. This occurs by and wide when two metric scales explicitly quantify separate structures which share a low relationship. The discriminating validity assessment is carried out to ensure that a reflective construct has an optimal relationship with its items, for example, as compared to every other structure in the PLS path model(J. Hair et al., 2014). It is carried out by measuring the cross-factor loadings and the square root of Average Variance Derived (AVE), along with the inter-relationship of the whole constructs of the study (Anagnostopoulos & Yfantopoulos, 2013). Besides, discriminant validity is assessed by investigating the correlations between the constructs (Claes Fornell & David.F, 1981; Gefen, 2005). The discriminating validity of measurement models in this study was done following the standard by Fornell, C., & Larcker (2016), that for discriminant validity to be achieved, the AVE values in the diagonal axis should be greater than all of the correlation values of constructs. The discriminant validity of these constructs has, therefore, been achieved as presented in Table 2.

Table 2: Discriminate Validity of Constructs of the Study

	Active Learning	Assessment Techniques	Critical Thinking Skills	Reflection	Small-Group Learning	Technology	Tutorial
Active Learning	**0.774**						
Assessment Techniques	-0.039	**0.814**					
Critical Thinking Skills	-0.026	0.119	**0.825**				
Reflection	-0.083	0.209	0.215	**0.808**			
Small Group Learning	0.238	0.185	0.130	0.302	**0.87**		
Technology	0.125	-0.160	0.030	0.185	0.26	**0.809**	
Tutorial	0.026	-0.027	-0.033	-0.040	0.04	-0.116	**0.799**

Structural Model Assessment (Inner Model)

After evaluation of the outer model comes the assessment of the structural model.At this stage, we tested the structural model (inner model) to analyze the mediating function of assessment approaches in the partnership between PBL and the incorporation of critical thinking skills among

technical students. Bootstrapping has been conducted in Smart PLS 3.0 software to assess both the model's direct and mediating effects (Ringle & Sarstedt, 2014). Since PLS aims to maximize the variance explained rather than fit, prediction-oriented measurements such as R2 are thus used to test PLS models (Chin, 1997). The coefficient of determination (R2) indicate the percentage of the variance of dependent variable that are described by independent variables(Joseph F. Hair et al., 2014). It quantifies the model's predictive correctness. Joe F. Hair et al., (2011), recommended that R2 values of R2 < 0.25 - Very weak, 0.25 <= R2 < 0.50 – Weak, 0.50 <= R2 < 0.75 – Moderate, R2 >= 0.75 – Substantial. In this study, the R2 value for PBL toward the enhancement of critical thinking skills is 0.076, assessment techniques have 0.112, while critical thinking skills have 0.091 as indicated in the model (Figure 3). This indicated the model's predictive accuracy was reasonable.

The standard thumb rule for a relationship between structures to be relevant: (t-value ≥ 1.96 and p-value is ≤ 0.05) was applied in this study to determine the importance of the path coefficient between the research variables based on the data obtained (Byrne et al., 2004). The route study conclusion (Table 3) indicates that PBL has a significant direct positive association with assessment strategies to develop critical thinking skills. The relationship is positive with path coefficients (= 0.535, t ≥ ± 1.96). Assessment techniques have a positive significant relationship with the development of critical thinking skills among technical college students. The path coefficients are = 0.0.431, t ≥ ± 1.96, hence, the relationship is positive. In the same way, PBL has a significant positive relationship with the incorporation of critical thinking skills with technical college students. The path coefficients are = 0.267, t ≥ ± 1.96, hence, the relationship is positive.

Table 3: Structural Estimates (Hypothesis Testing)

	Beta (β)	T Statistics	P Values	Decision
Problem-Based Learning->Assessment Techniques	0.544	3.085	0.002	Significant
Assessment Techniques->Critical Thinking Skills	0.441	2.042	0.006	Significant
Problem-Based Learning-> Critical Thinking Skills	0.223	2.133	0.034	Significant

Testing Mediation in the Complex Model

Figure 1 demonstrates the path coefficient of standardized regression weights for the causal effect of exogenous variables on the endogenous variable and the role played by the mediator. Our findings of regression weights and probability values (P-values) are presented using the Sobel test technique. In the Sobel test, according to Koopman, Howe, & Hollenbeck, (2014), the indirect effect should be taking to account of independent variables → mediator variable → dependent variable of which value of standardized regression weight for both paths should be multiplied (value of independent to mediator x value mediator to dependent).

In structural modeling, full or complete mediation occurs once the indirect effect > direct effect, the value of independent to mediator and mediator to dependent are significant, and the direct effect is not significant after the mediator enters the model (Baron & Kenny, 1986). Baron and Kenny continued that partial mediation occurs when the indirect effect > direct effect, the value of independent to mediator and mediator to dependent are significant, and the direct effect is significant after the mediator enters the model. In this study, the value of indirect effect = 0.535 x

0.431 = 0.230. This indicates that the indirect effect > direct effect, the value of independent to mediator, and mediator to dependent are significant. Partial Mediation is the form of mediation in this study since the direct effect is significant after the mediator enters the model (Figure 1).

Discussion and Implications

The study aimed at investigating the mediating role of assessment techniques on the partnership between PBL and the integration of critical thinking skills among technical college students. Identifying the mediating role of assessment techniques on the relation between PBL and the integration of critical thinking skills among technical college students was considered based on the hypothesis testing. Both EFA and CFA methods were engaged in the data analysis process. In this scenario, certain redundant elements were omitted in the model to achieve unidimensionality from the research performed through the SEM method. At the end of the operations, the validity andreliability of all constructs had been reached. The SEM analysis showed that a significant relationship exists among the variables of the study. The study has confirmed that problem-based learning is significant in the development of critical skills among students of technical colleges. PBL is a teaching approach that encourages students to attempt to find solutions to real-world problems by engaging cooperatively in collective works. This finding is in line with Akçay (2009) and Barber, King, & Buchanan, (2015) who in their separate studies affirmed that the PBL approach allows students to develop their critical thinking skills, evaluate and solve complex, real-world problems, function in community cooperation, and interact verbally and in written form.

Assessment strategies were found to mediate PBL's relationship with improving critical thinking abilities among technical college students. Implementation of appropriate assessment techniques promotes students' attitudes towards the development of skills as well as providing feedback on the development of the competencies (Deardorff, 2004). This study supported the findings by Tosuncuoglu (2018) and Hea-jin (2005) who point out in their distinct studies that assessment help teachers to classify and evaluate students, obtain, review and plan their lessons accordingly for optimal integration of students' skills. The findings validate assessment techniques' efficacy in mediating the relationship between PBL and the development of critical thinking skills among technical college students. It would, therefore, be assumed that enhancing critical thinking skills amongtechnical college students would be achieved when the elements of PBL are employed in collaboration with suitable assessment techniques. This study has a direct link with the constructivist theory adopted. For instance, the finding revealed that a significant relationship exists between PBL which practically involves collaboration, teamwork, and self-expression and the development of critical thinking skills.

By the findings of this study, policymakers will be encouraged to reinforce technical teachers with the required training on the design and implementation of assessment tasks for the effective development of soft skills among technical college students. The findings of the study will provide curriculum designers with the information necessary to upgrade the curriculum of the technical colleges to fit the PBL elements and assessment techniques considered essential for the effective integration of soft skills among the students. Given the findings of the study: i) Government should establish an effective supporting atmosphere for PBL practices to enhance the integration of critical skills; ii) For effective development of soft skills, technical teachers should employ the PBL identified elements in the teaching and learning of technical subjects at technical colleges. Technical teachers should employ the identified elements of PBL in collaboration with the

appropriate assessment techniques for the effective development of critical thinking skills among students of technical colleges.Having come out with these findings, further research needs to be conducted to determine technical teachers' preparedness toward critical thinking skills development among technical college students.

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Evaluation of the Implementation of Metalwork Curriculum in Technical Colleges in Abuja

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Abstract
The paper evaluated the implementation of metalwork curriculum in technical colleges in Abuja, Nigeria. two research questions and one null hypothesis was used to guide the study. The study adopted a descriptive survey research design. The study was conducted in all the three technical Colleges in Abuja. The population of the study was 15 respondents. No sampling technique was used as the whole population was used for the study. The instruments used for data collection was an observation checklist. The reliability coefficients of the instrument were determined using Cronbach's Alpha and found to be 0.89 and 0.91. The study employed the use of mean to answer the research questions and z-test to test the null hypotheses. Findings from the study revealed that tools and equipment for teaching as contained in metalwork curriculum in technical colleges in Abuja were not adequately provided. The study recommended among others that, Government should improve in the provision of tools and equipment for teaching as contained in metalwork technology curriculum in technical colleges in Abuja

Keywords: Technical Colleges, Metalwork, Curriculum & Evaluation

Introduction
Technical colleges are the institutions where students are trained to acquire relevant knowledge and skills in different occupations for employment in the world of work as craftsmen and master craftsmen. The goals of technical colleges are to provide trained manpower in the applied sciences, technology and business particularly at craft, advanced craft and technician levels; provide the technical knowledge and vocational skills necessary for agricultural, commercial and economic development; and give training and impart the necessary skill to individual who shall be self-reliant economically (Federal Republic of Nigeria, 2013). According to Umunadi (2019) technical colleges are principal vocational institutions in Nigeria which are designed to prepare the individuals to acquire practical skills, knowledge, and attitude at sub-professional level, primarily established to train craftsmen in various occupations. The occupational trades offered in technical colleges include the following programmes; block laying, bricklaying and concreting; carpentry and joinery; electrical installation and maintenance works; motor vehicle mechanic works; and metalwork technology.

Metalwork technology is a skill-based trade programme offered in technical colleges in Nigeria. It is designed to equip the trainees with knowledge, attitude and skills to carry out sheet metal work, gas welding, arc welding and cutting jobs on all types of metals and produce simple finished

structural steel work projects (National Board for Technical Education NBTE, 2001). The major goal of the programme in the technical colleges is to produce competent craftsmen and master craftsmen for industrial and technological development in Nigeria. The production of competent craftsmen requires the provision of adequate facilities for teaching and learning. Kilishi *et al*. (2014) stated that, due to the cost intensity of the facilities required for effective realization of the goals of metalwork technology, both the Federal and States governments are not meeting up with the provision of tools and equipment for effective running of the programme at technical colleges as contained in the curriculum.

Curriculum is the set of courses, their contents and facilities required for achieving the objectives of the course. According to Ololube (2006) curriculum is prescriptive and is based on a more general syllabus, which merely specify what topics must be understood, what facilities are required, and to what level to achieve a particular grade or standard. That is, a curriculum may be referred to as all courses offered at a school. The importance of curriculum in school system cannot be over emphasized. According to Elom (2009) the goal of numerous educational courses including metalwork technology are not achieved due to non-provision of tools and equipment as contained in the curriculum. Agwubike and Ogbouma (2010) noted that, for effective realization of metalwork technology goals at technical college, there must be adequate provision of the curriculum contents such as tools and equipment.

Tools and equipment could be seen as facilities required for the achievement of certain practical goal. According to Puyate (2002) the present state of tools such as tongs, hacksaw and blades, anvil, swage block, chipping hammers, sledge hammer, G-clamps assorted and equipment such as power guillotine of capacity 10swg x 36 in length, swing beam folder 10swg x 3'-6' capacity, bending roller capacity 40"x2" diameter, power-operated drilling machine maximum capacity 3/8" in technical colleges in Nigeria is very poor. Astsumbe (2002) also observed that, due to tools and equipment in technical colleges, normal workshop practice which forms 60 percent in technical colleges curriculum is fast disappearing which threatens the chances of achieving the goals of metalwork technology. Hence, there is need to evaluate the curriculum for metalwork technology trade in technical colleges ascertains the extent to which the curriculum contents are provided for effective teaching.

The major goal of the metalwork technology in the technical colleges is to produce competent craftsmen and master craftsmen for industrial and technological development in Nigeria. Unfortunately, the stated goals seem not achievable considering the documented lack of requisite skills among technical college students, including metalwork technology students. The skill shortage recorded signaled unemployment for welding and fabrication students after graduation. In attempt to address the lack of requisite skills for gainful employment among technical college students, Chukwumezie (2020) attributed the challenge to the non-provision of facilities such as textbooks, tools and equipment as mentioned in the curriculum. Despite the importance of these facilities to support the acquisition of skills among students, there is lack of empirical data to provide the extent to which they are provided as contained in the curriculum. Hence, this study sought to evaluate the curriculum for metalwork technology trade in technical colleges in Abuja to ascertain the extent to which the curriculum contents are provided for effective teaching.

Aim and Objectives of the Study

The aim of the study was to evaluate the implementation of metalwork curriculum in technical colleges in Abuja. Specifically, the study sought to achieve the following objective:

1. To determine the extent to which tools and equipment's are available for the teaching has contain in metal work curriculum in technical colleges in Abuja.
2. To determine the extent of utilization of the tools and equipment in the teaching process has contain in metal work curriculum in technical colleges in Abuja.

Research Questions

The following questions guided the study:

1. To what extent are tools and equipment being available for teaching has contained in metalwork curriculum in technical colleges Abuja?
2. To what extend are the utilization of the tools and equipment in the teaching process has contained in metal work curriculum in technical colleges in Abuja?

Hypothesis

The following null hypothesis was formulated to guide the study:

HO_1: There is no significant different between the responses of metalwork teachers and workshop attendants as regards the extent to which tool and equipment are utilized for the teaching has contained in metal work curriculum in technical colleges Abuja.

Methodology

The study adopted survey research design, specifically, using cross-sectional study. The cross-sectional design allow researcher to collect information from group of respondents at the same time. The study was conducted in Abuja, Nigeria. The population for the study was 15 that consisted of 12 metalwork teachers and three workshop attendants from the three technical colleges in Abuja. The study did not employ any sampling technique used simply because of the relatively small size of the population. The instrument for data collection was an observation checklist. The instrument was designed on four-point scale of Utilized, Moderately Utilized, Slightly Utilized and Not Utilized, with numerical values of 4, 3, 2 and 1 respectively. The instrument consisted of three parts, A, B and C. The Part A sought personal information of the respondents, Part B was designed to collect data on the extent to which tools and equipment for teaching are being available, and Part C was used to find out the extent to which tools and equipment for teaching are being utilized. The instrument was subjected to both face and contents validation by three technical education experts from Federal University of Technology, Minna, Nigeria. The reliability coefficients of the instrument were determined using Cronbach's Alpha and found to be 0.89 and 0.91 for Part C and the overall reliability coefficients of the instrument was found to be 0.90. Data collection was achieved through hand delivery. Data collected were analyzed using mean to answer the research questions and t-test to test the null hypotheses at 0.05 level of significance.

Results:

Research Question One

1.What are the tools and equipment available for teaching has contained in metal work curriculum in technical colleges Abuja?

Table 1: Percentage responses of respondents on the extent to which tools and equipment's for teaching are being available has contained in metalwork curriculum in technical colleges in Abuja

S/N	Tools	NBTE MIN.	Quantity Average	Percentage %	Remark
1	Left- and right-hand snips	5 each	2	40	Not Available
2	Straight snips	5	2	40	Not Available
3	"kit" of tools consisting of hammer, mallet, steel rule, scriber and wing compass, etc	2	2	100	Available
4	Straight edge	10	4	40	Not Available
5	Trammels dividers (set)	10	4	40	Not Available
6	Hammers	10	3	30	Not Available
7	Chisels	10	3	30	Not Available
8	Punches	10	3	30	Not Available
9	Try-squares	10	4	40	Not Available
10	Steel rules	10	4	40	Not Available
11	Smith open forge	1	0	0	Not Available
12	Vee blocks	10	3	30	Not Available
13	Electrode holders and clamps	10	4	40	Not Available
14	Electrode drying oven	1	0	0	Not Available
15	Wire brushes	10	4	40	Not Available
16	Pliers – assorted	5	3	30	Available
17	Tongs	5	3	60	Available
18	Hacksaw and blades	24	10	41.7	Not Available
19	Anvil	2	2	100	Available
20	Swage block	2	2	100	Available
21	Chipping hammers	20	9	45	Not Available
22	Sledge Hammer	2	2	100	Available
23	G. Clamps – assorted	10	4	40	Not Available
24	Self-grip pliers – assorted	6	2	33.3	Not Available
25	Magnetic clamp	3	1	33.3	Not Available
26	Flatters	2	0	0	Not Available
27	Mole grip	2	0	0	Not Available
	Equipment				
28	Power guillotine of capacity 10swg x 36 in length	1	0	0	Not Available
29	Swing beam folder 10swg x 3'-6' capacity	1	0	0	Not available

30	Bending roller capacity 40"x2" diameter	1	0	0	Not available
31	Bench mounted cone roller	2	0	0	Not available
32	Power bench grinding machine	2	0	0	Not available
33	Double-ended buffer and polisher	1	0	0	Not available
34	Universal beading and swaging machine	1	0	0	Not available
35	Power-operated drilling machine maximum capacity 3/8"	1	0	0	Available
36	Fly Press	1	1	100	Available
37	Hand nibbling Machine	2	0	0	Not Available
38	Power saw cutting machine 10mm	1	0	0	Not Available
39	Disc cutting machine	1	0	0	Not Available
40	Profile cutting machine with gas cutting nozzles	2	0	0	Not Available
41	Pillar drilling machine	2	2	100	Available
42	Straightening machine	2	0	0	Not Available
43	Cropping machine	2	0	0	Not Available
44	Heavy duty grinding machine	1	0	0	Not Available
45	Bench-type grinding machine	2	0	0	Not Available
46	CO2 cylinders	5	2	40	Not Available
47	Transformers With rectifiers (with all Instruments)	10	3	30	Not Available
48	Electrical beaters	1	0	0	Not Available
49	Oxygen regulators	5	2	40	Not Available
50	Acetylene regulators	5	1	20	Not Available
51	Hoses and clips and all attachments set	5	2	40	Not Available
52	Blowpipes (low and high pressure	5	2	40	Not Available
53	Power operated profile cutter with turntable	2	0	0	Not Available
54	D.C generators with all connections	10	4	40	Not Available
55	A.C transformer (Argon) with all the connections	5	2	40	Not Available
56	Argon cylinders	5	1	20	Not Available

57	Regulators with flow meters	3	1	33.3	Not Available
58	Water to carbide generators	4	1	25	Not Available
59	Carbide to water generators	4	1	25	Not Available
60	Overhead projector	1	0	0	Not Available
61	Computer set	1	0	0	Not Available
62	Oxy-acetylene welding blow pipe (High pressure & low pressure)	5	2	40	Not Available
63	Gas cutting torch	2	2	100	Available
64	Set of welding and cutting nozzles	2	2	100	Available

This implies that: AV/QR × 100

Table 1 revealed that 11 out of the 64 items on the extent to which tools and equipment's are available for teaching had percentage value above 40. This indicated that, the check list are of the opinion that only the 11 items were tools and equipment's are available has contained in metalwork curriculum in technical colleges in Abuja.

Research Question Two

To what extent are the utilization of tools and equipment's for teaching has contained in metalwork curriculum in technical colleges in Abuja?

Table 2: Mean responses of respondents on the extent to which tools and equipment for teaching are being utilized has contained in metalwork curriculum in technical colleges in Abuja

S/N	Tools	$\bar{X}_1$	$\bar{X}_2$	$\bar{X}_t$	Remark
1	Left- and right-hand snips	1.61	1.88	1.65	Not utilized
2	Straight snips	1.16	1.16	1.16	Not utilized
3	"kit" of tools consisting of hammer, mallet, steel rule, scriber and wing compass, etc	3.65	3.51	3.63	Utilized
4	Straight edge	1.36	1.11	1.33	Not utilized
5	Trammels dividers (set)	1.28	1.18	1.27	Not utilized
6	Hammers	1.74	1.46	1.70	Not utilized
7	Chisels	1.62	1.33	1.58	Not utilized
8	Punches	1.28	1.03	1.25	Not utilized
9	Try-squares	1.77	1.21	1.70	Not utilized
10	Steel rules	1.89	1.68	1.80	Not utilized
11	Smith open forge	1.04	1.10	1.05	Not utilized
12	Vee blocks	1.85	1.45	1.80	Not utilized
13	Electrode holders and clamps	1.54	1.14	1.49	Not utilized
14	Electrode drying oven	1.68	1.77	1.69	Not utilized

15	Wire brushes	1.85	1.91	1.86	Not utilized
16	Pliers – assorted	3.59	3.58	3.59	Utilized
17	Tongs	3.51	3.76	3.54	Utilized
18	Hacksaw and blades	1.91	1.56	1.86	Not utilized
19	Anvil	3.61	3.51	3.60	Utilized
20	Swage block	3.67	3.71	3.68	Utilized
21	Chipping hammers	1.18	1.17	1.18	Not utilized
22	Sledge Hammer	3.61	3.68	3.62	Utilized
23	G. Clamps – assorted	1.11	1.31	1.23	Not utilized
24	Self-grip pliers – assorted	1.85	1.78	1.84	Not utilized
25	Magnetic clamp	1.00	1.11	1.01	Not utilized
26	Flatters	1.85	1.81	1.84	Not utilized
27	Mole grip	1.92	1.54	1.87	Not utilized
	Equipment				
28	Power guillotine of capacity 10swg x 36 in length	1.11	1.01	1.08	Not utilized
29	Swing beam folder 10swg x 3'-6' capacity	1.77	1.13	1.69	Not utilized
30	Bending roller capacity 40"x2" diameter	1.61	1.11	1.54	Not utilized
31	Bench mounted cone roller	1.18	1.61	1.23	Not utilized
32	Power bench grinding machine	1.60	1.53	1.59	Not utilized
33	Double-ended buffer and polisher	1.18	1.17	1.18	Not utilized
34	Universal beading and swaging machine	1.61	1.68	1.62	Not utilized
35	Power-operated drilling machine maximum capacity 3/8"	3.74	3.51	3.63	Utilized
36	Fly Press	3.85	3.78	1.84	Utilized
37	Hand nibbling Machine	1.00	1.11	1.01	Not utilized
38	Power saw cutting machine 10mm	1.85	1.81	1.84	Not utilized
39	Disc cutting machine	1.92	1.54	1.87	Not utilized
40	Profile cutting machine with gas cutting nozzles	1.69	1.69	1.69	Not utilized
41	Pillar drilling machine	3.44	3.61	3.51	Utilized
42	Straightening machine	1.51	1.61	1.52	Not utilized
43	Cropping machine	1.04	1.10	1.05	Not utilized
44	Heavy duty grinding machine	1.85	1.45	1.80	Not utilized
45	Bench-type grinding machine	1.54	1.14	1.49	Not utilized
46	CO2 cylinders	1.68	1.77	1.69	Not utilized
47	Transformers With rectifiers (with all Instruments)	1.85	1.91	1.86	Not utilized
48	Electrical beaters	1.11	1.11	1.11	Not utilized
49	Oxygen regulators	1.66	1.79	1.68	Not utilized
50	Acetylene regulators	1.91	1.56	1.86	Not utilized
51	Hoses and clips and all attachments set	1.61	1.51	1.60	Not utilized

52	Blowpipes (low and high pressure	1.67	1.71	1.68	Not utilized
53	Power operated profile cutter with turntable	1.61	1.88	1.65	Not utilized
54	D.C generators with all connections	1.16	1.16	1.16	Not utilized
55	A.C transformer (Argon) with all the connections	1.65	1.51	1.63	Not utilized
56	Argon cylinders	1.36	1.11	1.33	Not utilized
57	Regulators with flow meters	1.28	1.18	1.27	Not utilized
58	Water to carbide generators	1.74	1.46	1.70	Not utilized
59	Carbide to water generators	1.62	1.33	1.59	Not utilized
60	Overhead projector	1.28	1.03	1.25	Not utilized
61	Computer set	1.77	1.21	1.70	Not utilized
62	Oxy-acetylene welding blow pipe (High pressure & low pressure)	1.89	1.68	1.80	Not utilized
63	Gas cutting torch	3.56	3.62	3.57	Utilized
64	Set of welding and cutting nozzles	3.41	3.69	3.55	Utilized
	Grand Mean	**2.36**	**2.34**	**2.35**	**Not** utilized

Table 2 revealed that 11 out of the 64 items on the extent to which tools and equipment for teaching are being utilized had average mean value above 3.49. This indicated that, the respondents are of the opinion that only the 11 items were the tools and equipment utilized has contained in metalwork curriculum in technical colleges in Abuja.

Hypothesis

There is no significant difference between the mean responses of metalwork teachers and workshop attendants on the extent to which tools and equipment for teaching are being utilized as contained in metalwork curriculum in technical colleges in Abuja

Table 3: T-test analysis for the test of significant difference between the mean responses of metalwork teachers and workshop attendants on the extent of utilization of the tools and equipment for teaching process as contained in metalwork curriculum in technical colleges in Abuja

Respondents	N	Mean	SD	df	t-value	p-value	Remark	Decision
Teachers	12	2.44	0.68	13	0.677	0.505*	No Significant	Accepted
Workshop Attendants	3	2.36	0.55					

The p-value of t-test for equality of means with variance not assumed presented on Table 3 was 0.505 which is larger than the stated level of significance (0.05). This connoted that, there was no statistical significant difference between the mean responses of metalwork teachers and workshop attendants on the extent to which tools and equipment for teaching are utilized as contained in metalwork curriculum in technical colleges in Abuja**.** Consequently, the null hypothesis was upheld.

Findings

1. Tools for teaching as contained in metalwork curriculum in technical colleges in Abuja were not adequately provided
2. Equipment for teaching as contained in metalwork curriculum in technical colleges in Abuja were not adequately provided
3. There was no significant difference between the mean responses of metalwork teachers and workshop attendants on the extent to which equipment for teaching are adequately being provided as contained in metalwork curriculum in technical colleges in Abuja.

Discussion of Findings

Findings on the extent to which tools for teaching are being adequately provided has contained in metalwork curriculum in technical colleges in Abuja revealed not adequately provided. The findings concord with the view of Onyejemezi (2001) who stated that, many schools in Nigeria experiences inadequacy of tools for practical activities. The finding of this study is further supported by the work of Yaduma and Moses (2005) who found that, workshop tool in vocational centres and technical colleges in Bauchi State were low in supply. This implied that, effective implementation of learning contents in the curriculum for metalwork technology cannot be guaranteed.

Findings on the extent to which equipment for teaching are being adequately provided as contained in metalwork curriculum in technical colleges in Abuja revealed not adequately provided. The finding is in-line with the finding of Jacob (2012) who revealed that equipment for teaching are grossly inadequate for teaching and learning of automobile technology in tertiary institutions in South-South, Nigeria. Ajayi (2011), lamented about the inadequate equipment allocation to the education sector particularly when compared with other sectors of the economy as very inadequate and result to the low educational outcomes. The implication of this finding is that, the goals of metalwork technology of equipping students with skills cannot be achieved due to the manifested lack of adequate equipment as stipulated in the curriculum.

Nevertheless, the test for difference between the mean responses of metalwork teachers and workshop attendants on the extent to which equipment for teaching are being adequately provided as contained in metalwork curriculum in technical colleges in Abuja revealed not statistical significant. This indicated that, metalwork teachers and workshop attendants are unanimous in their views on the extent to which equipment for teaching are being adequately provided as contained in metalwork curriculum in technical colleges in Abuja. The finding is related to the findings of Jacob (2012) who discovered that, there was no significant difference between the opinions of teachers and students on the adequacy of automobile technology instructional facilities in tertiary institutions in South-South, Nigeria.

Conclusions

The study provided insights on the extent to which tools and equipment for teaching are being available has contained in metalwork curriculum in technical colleges in Abuja. Findings that emerged from this study revealed that, tools and equipment for teaching are not being available has contained in metalwork curriculum in technical colleges in Abuja. This implied that, with inadequate a tools and equipment for teaching in the technical colleges, effective teaching and learning and acquisition of practical skills needed by metalwork technology students for

productive work cannot be achieved. Therefore, tools and equipment for teaching are being adequately provided as contained in metalwork curriculum in technical colleges in Abuja should be made available in order to enhance development of practical skills for gainful employment among metalwork technology students.

Recommendations

Based on the findings of this study, the following recommendations were made:

1. The Federal and State Governments should improve in the provision of tools and equipment for teaching has contained in metalwork technology curriculum in technical colleges in Abuja.
2. Industries sited in communities where technical colleges are located should support in the provision of tools and equipment for teaching metalwork technology curriculum in technical colleges in Abuja.

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Assessment of Resources Required for Woodwork Technology Education Programme in College of Education, Minna, Niger State.

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Abstract
The paper examines' the adequacy of resources required for Woodwork Technology Education Programme in College of Education Minna, Niger State, Nigeria. A survey research design was adopted for the work. The inventory of wood workshop and Minimum Standard for Vocational and Technical Education produced by the National Commission for Colleges of Education, Abuja, Nigeria were used for the study. The instrument for data collection used was a questionnaire and the data were analysed using Mean and Standard Deviation. The findings of the study revealed that there is adequate and qualified teachers and technicians. Infrastructural facilities, hand tools, woodworking power tools and consumables available for the programme are inadequate. Recommendations were made which would boast resource provision for effective running of Woodwork Technology education programme in College of Education Minna, Niger State. These recommendations include Head of Section of Woodwork Technology should assess the resources and equipment in the workshop at the end of every month to know the damaged or missing tools and report to the College management for replacement. The National Commission for Colleges of Education in charge of evaluating Colleges of Education in Nigeria should take the issue of facilities very serious if not the objectives of the programme will not be achieved.

Keyword: *Assessment, Facility, Woodwork Technology Education*

Introduction
Woodwork Resources refers to the physical environment, human and material resources, facilities and instructional services designed to achieve the objectives of Woodwork Technology. When the required resources are not provided, effective Woodwork Technology Education cannot take place especially in the aspect of the acquisition of practical skills.

Uwaifo (2010) explained that most Technical Education departments in Nigeria Colleges of Education do not have standard workshop space let alone usable equipment and other resources and where they exist, they are grossly inadequate, as the workshops only have the equipment that was provided when the departments were established. It is, however, most surprising to know that most Technical Education departments still depends on workshop and lecturers to teach Technical Education concepts in this 21st century. The available resources as of today are inadequate quantitatively and qualitatively and besides, most of the equipments obsolete.

There is a dearth of ICT resources for the training of students. The high cost of computer and teaching aids ownership is a major constraint to the acquisition of the items. Access to affordable and reliable internet connectivity is only available in a few institutions and offices, even then,

power fluctuations have considerably reduced the reliability of the access and inadequate bandwidth also makes access difficult. This means that the objectives of Technical Education will be difficult to achieve.

Sara (2001), observed that more than 60 per cent of the staff teaching Woodwork Technology could not perform the skills or provide technical services they were expected to teach others despite their high-level paper qualifications. This is of course due to non-skill acquisition from their respective institutions of higher learning.

Okwori (2012) revealed that after visiting ninety-one (91) technical colleges across the country by the National Board for Technical Education (NBTE) to assess their resources, it was discovered that eight or 1.5 percent had adequate equipment. If students do not practice craftwork they would not appreciate and advance in technology. Assessment of technical and vocational education programmes refers to the process of determining the strengths and weaknesses of the programme using some criteria. Uwaifo (2010) viewed assessment of technical and vocational education programmes as the process of providing information to people as they designed the curricular after obtaining some data about the programme.

Objectives of Technical Education in Nigeria

The National Commission for Colleges of Education, (2002) stated the objectives of the Technical Education programme in Colleges of Education in Nigeria which Woodwork Technology is inclusive. The objectives include:

1. To produce qualified technical teachers and practitioners of technology capable of teaching introductory Technology in the Junior Secondary Schools.
2. To produce NCE teachers who will be able to inculcate scientific and technological attitudes and values into society.
3. To produce qualified technical teachers motivated to start the so much desired revolution of technological development right from the Nigerian Schools.
4. To prepare technical teachers to qualify them for an undergraduate programme in Technical Education. It can be seen from the objectives that Resources are very essential to produce qualified Woodwork Technology teachers who can inculcate scientific, technological attitudes and values into society.

Statement of the Problem

Resources in the woodwork programmes are used by teachers and students to make it easy. Resources help teachers to translate abstract ideas to concentrate ideas. Okwori (2012), explained the contributions of using resources as follows: aid in attracting the attention of students and as a result improve their interest level, stimulate students' interest to participate in the activities, help students to picture reality in what has been taught and create an interactive learning environment thereby facilitating effective. When students in Woodwork Technology education are trained without facilities, they find it difficult to teach the practical aspect of the course after graduation. Umar and Ma'aji (2011), pointed out that the goal of Vocational and Technical Education institutions is to prepare students for successful employment in the labour market and this condition can be met through a well-equipped workshop with relevant training resources.

Purpose of the Study

The study assessed:

1. The availability of human resources for Woodwork Technology Education in College of Education, Minna, Niger State.
2. The adequacy of infrastructural facilities for Woodwork Technology Education in College of Education, Minna, Niger State.
3. The adequacy of hand tools for Woodwork Technology Education in College of Education, Minna, Niger State.
4. The availability of power tools for woodwork technology education in College of Education, Minna, Niger State.
5. The availability of consumable materials for woodwork technology education in College of Education, Minna, Niger State.

Research Questions

The following research questions guided the conduct of this study:

1. What are the human resources available for woodwork technology education in the College of Education, Minna, Niger State?
2. What are the infrastructural facilities available for woodwork technology education in the College of Education, Minna, Niger State?
3. What are the hand tools available for woodwork technology education in the College of Education, Minna, Niger State?
4. What are the power tools available for woodwork technology education in the College of Education, Minna, Niger State?
5. What are the consumable materials available for woodwork technology education in the College of Education, Minna, Niger State?

Literature Review

Resources for teaching Woodwork Technology in Colleges of Education are essential for the students to practice what they have learnt in class. When students acquire the needed practical skills while in school then they can easily set up their private workshops after graduation and those who will take up an appointment with the government or industries can effectively perform well in the practical aspect. According to Okwori (2012), Woodwork Technology is that type of training intended to prepare the students to earn a living in an occupation in which success is dependent largely on an understanding of technology as applied to modern technology and design. This type of education provides skills, knowledge and attitudes necessary for effective employment in a specific occupation (Okoro, 1993). Woodwork Technology, therefore, involves the engagement of both teachers and students in theory and practice.

The developed technology has contributed immensely to the high economic and social standards of most of the developed countries of the world. Therefore, the development of Woodwork Technology in our Colleges of Education cannot be achieved without adequate resources. Olumese, explained that Nigeria like most developing nations of the world requires a well-articulated Woodwork Technology to enable her to achieve economic and technological development but with the prevailing problems of Woodwork Technology (especially inadequate equipment) its dependence as a base for the nation's progress cannot be a reality except quick steps are taken to forestall it.

For effective teaching of Woodwork Technology to take place, it is considered quite appropriate that prospective teachers should interact with the teaching environment. The students start to learn when they are involved in the learning situation. At present we have Woodwork Technology teachers who emphasize more on theoretical aspects in the workshop with no emphasis on practical due to lack of facilities. If the Woodwork Technology course is well taught in Colleges of Education many of the students graduating from these institutions will engage in business or open their workshops instead of waiting for government work. Jackden and Okwori (1997) advised the Federal and State Governments to invest in Woodwork Technology to hasten the nation's technological advancement. The key to national development is technology and this can be acquired and attained if we have a proper investment in Woodwork Technology. They warned that there would be no technological breakthrough without the development of the necessary infrastructure for qualitative education. Inadequate investment in Woodwork Technology makes it difficult to compete in the structural work in terms of skills and expertise so we have to act to move away from the era that focuses mainly on liberal arts. Ntoiden (2003) pointed out that if we have the necessary equipment, and workforce to manufacture our vehicles, household furniture and so on, it will help us to be more self-reliant and conserve foreign exchange for other uses. Most of the products of technology are imported into the country. This makes them very expensive for the average person to afford. If we can produce such things in Nigeria using locally sourced raw materials, the cost will be reduced.

Methodology

The research design adopted for this study was a descriptive survey research design. A descriptive survey employs the use of questionnaires, interviews and direct observation to ascertain the opinions, attitudes, perceptions and preferences of individuals under study. This study was carried out in the Department of Technical Education, College of Education, Minna, Niger State. The targeted population for this study is 16 comprising 10 woodwork technology students,3 Woodwork Teachers, 2 technicians and the Head of the Department. The entire population was used since it is manageable. A structured questionnaire that contains 84 items was used to collect the needed data from the respondents. The questionnaire was categorised and labelled A – E with the category representing the research question. The questionnaire items were structured using a three-point rating scale with response options of Adequate (A) – 3, Inadequate (IA) – 2, Not Available (NA) – 1, for all the research questions. The instrument was validated by a lecturer from the Industrial and Technology Education Department, Federal University of Technology, Minna. It was trial tested in Hassan Usman Katsina Polytechnic with a population of 5 respondents from the woodwork section of the Technical Education department. Cronbach's Alpha value of 0.80 was obtained using the population of the pilot study. The data was analysed using Mean and Standard Deviation.

Results

Research Question 1

What is the adequacy of human resources available for woodwork technology education in the College of Education, Minna, Niger State?

Table 1. Mean Response of staff and Woodwork Technology students on the adequacy of Human Resources available for Woodwork Technology Education in College of Education Minna, Niger State

S/N	ITEMS			
	The following human resource are available in the department	**Mean**	**SD**	**Remarks**
1	Qualified Woodwork Teacher	2.50	0.63	Adequate
2	Qualified Woodwork Technicians	2.50	0.73	Adequate
3	Workshop Attendants	1.56	0.73	Inadequate
Grand Mean and SD		**1.64**	**0.52**	

Table 1 revealed that there is adequate qualified woodwork teachers and technicians but inadequate workshop attendants for woodwork Technology Education in the Technical Education Department of College of Education Minna, Niger State.

Research Question 2

What are the infrastructural facilities available for woodwork technology education in the College of Education, Minna, Niger State?

Table 2.Mean Response of staff and Woodwork Technology students' on the adequacy of infrastructural facilities for Woodwork Technology Education in College of Education Minna, Niger State

S/N	ITEM			
	The following infrastructural facilities are available and adequate in theCollege	**Mean**	**SD**	**Remarks**
1	Classroom Blocks	1.44	0.63	Inadequate
2	Workshop	1.50	0.73	Inadequate
3	Store	1.50	0.52	Inadequate
7	Library	1.50	0.63	Inadequate
8	Staff office	1.75	0.77	Inadequate
9	Toilet	1.81	0.66	Inadequate
10	Bore hole	1.63	0.81	Inadequate
11	Extinguishers (including fire buckets)	1.56	0.73	Inadequate
12	Workbench	1.56	0.73	Inadequate
13	First aid box	1.63	0.81	Inadequate
Grand Mean and SD		**1.44**	**0.64**	

Table 2 revealed that classroom Blocks, workshop, store, Library, staff offices, toilets, Boreholes, Extinguishers (including fire buckets), workbench and First Aid box for woodwork Technology Education in the Technical Education Department of College of Education Minna are inadequate.

Research Question 3

What are the hand tools available for woodwork technology education in the College of Education, Minna, Niger State?

Table 3. Mean Response of staff and Woodwork Technology students on the adequacy of Hand tools available for Woodwork Technology Education in College of Education Minna, Niger State.

S/N	ITEM			
	The following hand tools are available and adequate in the Wood workshop	**Mean**	**SD**	**Remarks**
1	Paint brushes (various sizes)	1.69	0.70	Inadequate
2	Marking gauge/mortise gauge	1.63	0.62	Inadequate
3	Marking knives	1.69	0.79	Inadequate
4	Try square	1.75	0.68	Inadequate
5	Mitre square	1.56	0.73	Inadequate
6	Sliding bevel	1.69	0.79	Inadequate
7	Measuring tape (metric)	1.44	0.51	Inadequate
8	Jack plane	1.75	0.77	Inadequate
9	Smoothing plane	1.81	0.75	Inadequate
10	Rebate plane	1.56	0.73	Inadequate
11	Multi plough plane	1.69	0.79	Inadequate
12	Spoke shaves (straight/round)	1.50	0.63	Inadequate
13	Rip saw	1.63	0.81	Inadequate
14	Crosscut/handsaw	1.75	0.77	Inadequate
15	Tenon saw	1.69	0.70	Inadequate
16	Panel saw	1.19	0.40	Inadequate
17	Coping saw	1.56	0.51	Inadequate
18	Keyhole saw	1.50	0.63	Inadequate
19	Dovetail/back saw	1.56	0.63	Inadequate
20	Sets of firmer chisel	1.63	0.81	Inadequate
21	Sets of mortise chisel	1.50	0.63	Inadequate
22	Sets of turning chisel	1.75	0.86	Inadequate
23	Sets of twists bits	1.94	0.68	Inadequate
24	Countersink bit	2.13	0.89	Adequate
25	Rose	1.50	0.52	Inadequate
26	Ratchet braces	1.69	0.79	Inadequate
27	Auger bits	1.63	0.62	Inadequate
28	Sets of drill bits	1.75	0.86	Inadequate
29	Sets of screw drivers	1.69	0.60	Inadequate
30	Mallet	1.75	0.77	Inadequate
31	Craw hammer	1.75	0.77	Inadequate
32	Pein hammer	1.81	0.75	Inadequate
33	Warrington hammer	1.75	0.77	Inadequate
34	Bradawl	1.75	0.68	Inadequate
35	Pincers	1.81	0.91	Inadequate
36	F-cramp	1.50	0.73	Inadequate
37	Sash cramp	1.69	0.79	Inadequate
38	G-cramp	1.50	0.73	Inadequate
39	Bench-hold fast	1.63	0.72	Inadequate

40	Sets of triangular files	1.69	0.79	Inadequate
41	Flat files	1.75	0.77	Inadequate
42	Scraper (flat)	1.50	0.63	Inadequate
43	Dividers	1.44	0.51	Inadequate
44	Sets of round files	1.69	0.87	Inadequate
45	Half-round files	1.50	0.63	Inadequate
46	Scraper (cabinet)	1.56	0.81	Inadequate
47	Callipers (set) inside and outside	1.44	0.63	Inadequate
48	Dowelling jig	1.75	0.86	Inadequate
49	Rasps	1.75	0.86	Inadequate
Grand Mean and SD		**1.62**	**0.70**	

Table 3 revealed that all tools available for woodwork Technology Education in Technical Education Department of College of Education Minna are inadequate except for countersink bit.

Table 4. **Mean Response of staff and Woodwork Technology students' on the adequacy of woodworking power tools available for Woodwork Technology Education in College of Education Minna, Niger State.**

S/N	**ITEM**			
	The following woodworking power tools are available and adequate in the Wood workshop	**Mean**	**SD**	**Remarks**
1	Circular saw bench	1.69	0.79	Inadequate
2	Thicknesses (optional)	1.50	0.63	Inadequate
3	Surface planner	1.50	0.52	Inadequate
4	Wood-lathe	1.63	0.72	Inadequate
5	Band saw (optional)	1.31	0.60	Inadequate
6	Compressor and spraying units	1.81	0.91	Inadequate
7	Circular saw	1.75	0.77	Inadequate
8	Router	2.00	0.82	Adequate
9	Orbital sander	1.81	0.66	Inadequate
10	Disc sander	1.81	0.83	Inadequate
11	Jig saw	1.63	0.72	Inadequate
12	Blower	1.56	0.63	Inadequate
13	Spraying Machine unit	1.44	0.51	Inadequate
14	Drill Press	1.44	0.73	Inadequate
Grand Mean and SD		**1.53**	**0.66**	

Table 4 revealed that all woodworking power tools available for woodwork Technology Education in Technical Education Department of College of Education Minna are inadequate except for Router.

Table 5. Mean Response of staff and Woodwork Technology students' on the adequacy of consumable materials available for Woodwork Technology Education in College of Education Minna, Niger State.

S/N	ITEM			
	The following consumable materials are available and adequate in the Wood workshop	**Mean**	**SD**	**Remarks**
1	Wood (Solid and Manufactured Boards)	1.44	0.63	Inadequate
2	Nails of various sizes	1.50	0.63	Inadequate
3	Wood glue	1.56	0.73	Inadequate
4	Screws of various sizes	1.50	0.63	Inadequate
5	Abrasive Papers (Different grades)	1.56	0.73	Inadequate
6	Cellulose Thinner	1.63	0.72	Inadequate
7	Finishes	1.56	0.73	Inadequate
8	Fittings	1.69	0.60	Inadequate
Grand Mean and SD		**1.38**	**0.60**	

Table 5 revealed that all consumable materials available for woodwork Technology Education in Technical Education Department of College of Education Minna are inadequate.

Discussion of Findings

Equipment are an integral part of Woodwork Technology for imparting practical skills to learners. The finding of the study revealed that Router and Countersink bit were found available and adequate. Musa (1993) decried the level of inadequacy in infrastructural provisions in our technical institutions. He said that there have been cases where technical students graduate without adequate skills on how to use tools and machines. Therefore, assessment of Resources in technical workshops is very essential and the recommendations to the appropriate authority for supplying the unavailable ones are necessary.

Olumese (2004) quoted a previous report of the National Board for Technical Education (NBTE), which revealed that after visiting 91 Technical Colleges across the country to assess their resources, it was discovered that eight or 1.5 percent had adequate equipment. Sharing a similar opinion, Ike *et al* (2011) pointed out that there is a need for adequate resources in school workshops. He suggested that the only way of determining the level of available tools and equipment in the workshops is to check the tools and machines available in woodwork departments. He emphasized that sustainable technological development cannot be achieved if school workshops are amid inadequate equipment. While Jackden and Okwori (1997) asserted that many Colleges of Education do not have the necessary power tools and hand tools essential for students' use. Teachers and students can only develop new technologies when they have enough hand tools and machines to practice what they have learnt in theory. This will also encourage discovery in technology.

Recommendations

The following recommendations were made based on the finding of the study:

1. Woodwork Technology Head of the section should assess the resources available in the department at the end of every month to know the damaged or missing tools and report to the college management for replacement. The unavailable machines should also be requested.

2. The storekeeper should be very vigilant to prevent missing tools and machines in the store and report any missing and worn-out tools.

3. After assessing the tools, some vital ones that are not available can be improvised.

4. National Commission for Colleges of Education in charge of evaluating Colleges of Education in Nigeria should take the issue of the facility very serious if not the objectives of the programme will not be achieved.

Conclusion

It is difficult for learners to acquire the needed practical skill when Resources are inadequate. Therefore, assessment of Resources in the Woodwork Technology workshop is very essential since it is a practically orientated course that needs adequate equipment so that the graduates can establish their wood workshops without relying on the government for employment. Government alone cannot provide all the resources needed for Woodwork Technology education. Therefore, the college and the department should explore other avenues like an industrial enterprise for acquiring resources that are neither inadequate nor available in wood workshops for students' practical.

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Effects of Scaffolding Teaching Strategy on Junior Secondary Schools Students' Achievement in Basic Science in Kontagora, Niger State

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Abstract
The study investigated the effect of scaffolding strategy on junior secondary school student's achievement in basic science subject in Kontagora, Niger State. The study adopted quasi-experiment research design where an Experimental and a Control groups were used. Two junior secondary schools were selected and designed as experimental and sample size of 46(28 males and 18 'females). Reliability coefficient of 0.86 was obtained for Basic Science Achievement Text (BSAT) was administered on the student. The research questions were answered using t-test, mean and standard deviation while Analysis of Covariance (ANCOVA) was used to test the hypothesis using Statistical Package for Social Sciences (SPSS) version 20 to conduct the statistical analysis. The study revealed that students taught basic science using scaffolding strategy performed better than those taught using conventional lecture method. Also male students performed better than the female counterparts. Based on the findings, it was recommended amongst others that scaffolding teaching strategies should be used for teaching and learning processes at all level of education in Nigeria.

Keywords: Scaffolding Teaching Strategy, Science, Basic Science.

Introduction
Education generally is a vital instrument to technological and socio-economic development of every nation. Science is concerned with finding out about things in our environment. The knowledge we gather about environment constitutes the field of the study called "science". It is the intellectual and practical activity, a systematic study of the structure and behavior of the physical and natural world (environment), through observation and experimentation (MDGS projects, 2012). Thus, science has two major components, science content and process. The content is the knowledge we accumulate about our community while the process deals with ways in which scientist go about gathering knowledge about the environment. The process of science called Science process skilled are metal tools which practitioners of the science employ in discovering and acquiring scientific knowledge.

Ohakwe (2009) said, science have made a phenomenal impact in bringing about technological and scientific discoveries which have helped man to cope with his environment. These discoveries led to the continuous development of tools and method of implementation in specific areas. These tools may be practical as in machines or abstract as in concept, models, principles, theories and laws.

Basic science according to Grayiling, 2010) is the science at the heart of human knowledge. It is an approach to the study of science defined in some details whereby we do not distinguish between

the various disciplines, it is really a "fundamental" science. The basic objectives of basic science is to arouse interest in the pupils through exposing them to concrete rather than to abstract experiences. Basic science subjects is offered at the junior secondary schools level in Nigeria system of education. It seeks to lay a foundation for the development of knowledge, skills and attitudes that will make the learners capable of understanding and manipulating evens and happenings in the environment. The subject also offered the students the opportunity to learn about themselves. To attain the above, teachers of basic science must be acquainted with appropriate teaching strategies and also develop the ability to creatively use different approaches and that was what necessitated the use of scaffolding method.

Scaffolding according to MDGS- project (2012) is used when building high structure such as storey building. Scaffolding are pillars for support to both the building and the builders. Inferably, the teachers who is builders can use gifted fast learners as scaffolding to aid or build up the slow learners, having understood the teacher fast. The gifted students then serve as go-between through interaction with the slow learners after the class students learn better and faster from each other. Verhagen and Collis (1996) describe scaffolding strategy as a temporary support made available for students' leaning until the students can perform independently of that support. The performance of the study is coached, articulated and elucidated by the learner as support is gradually being removed.

Gaskins, Rauch and Genemer (2000) explained scaffolding as a form of coaching and modeling support to students as they develop new skills to learn new concepts and when the children achieve competence, the support is removed, the students continue to develop the skill or knowledge on his/her own. They further stated that scaffolding allows students to perform task that would normally slightly be beyond their ability without the assistant and guidance of the teachers.
In order to carry out scaffolding strategy, the teacher must be first identify and determine:

i. What student can accomplish independently.
ii. What student can accomplish with guidance
iii. Teacher then provides the instructions that are just enough to support the learner in task beyond reach without teacher's support.

Winnips (2001) in another view, define scaffolding as "providing support to student learning and retreating that support so that the student becomes self reliant". He suggested the analogy of learning to swim with a punctured swimming tube". You learn to swim as the tube slowly deflects. Gbodi and Laeye (2006) on effects of videotaped and scaffolding instruction on learning of basic science and gender as moderating factor said that gender in relation to achievement must be an issue of interest and concern to researchers in education. There are varying opinions in which gender (either male or female) achievers better than the others, the issue of gender therefore becomes crucial in this study. Also the interactive evidence in academic achievement due to gender has necessitated the need to verily how scaffolding strategy can influence students achievement and gender being modervating factors on basic science in junior secondary school in Kontagora, Niger state.

Research Questions

The study was guided by the following questions:

1. What is the difference in the mean score of students' achievement when scaffolding strategy is used in junior secondary school basic science?
2. What is the difference in the mean score of male and female students' academic achievement when scaffolding strategy is used in junior secondary school basic science?

Research Hypotheses

The following null hypotheses were formulated and tested at 0.05 level of significance.

HO_1: There is no significant difference in the means score of students' academic achievement taught basic science using scaffolding strategy in junior secondary school Kontagora.

HO_2: There is no significant difference in the mean score of male and female students' achievement taught basic science using scaffolding strategy in junior secondary school in Kontagora.

Methodology

A quasi-experimental research design was used. it adopted a protest and post test non-equivalent and non-random group design. Two group were used for the study, it includes scaffolding instructional strategy while conventional teaching method was used for control group. A total of eighty-eight (88) junior secondary school student consisting of forty six (46) for Experimental group and forty two (42)for Control group. Twenty-eight (28) males and eighteen (18) females of the Experimental group were considered for the study.

The instrument used for the study was designed from the topic matter in basic science. Basic Science Achievement Test (BSAT) was Constructed on the topic and validated by experts that checked the clarity and sustainability.

Kuder-Richardson (R21) was used to find the reliability of the study and reliability coefficient of 0.86 was obtained. The basic science achievement test consisted 25 multiple choice questions drawn from JSS 3 standardized examination questions.

The topic matters and all sub-topics under it were taught to the experimental group using scaffolding strategy and the control group was taught using traditional teaching method. The data obtained were subjected to T-test, mean, standard deviation, Analysis of Covariance(ANCOVA).

Results.

Table 1: T-test comparison of pretest mean score of experimental and control groups.

TEST	GROUP	N	dt	X	SD	t-value	P
Pretest	Experiment	46		45.43	9.67		
			86			4.65	0.00
	Control	42		55.21	10.05		

The table above shows the T-test comparison of pretest score of experimental and control groups. An examination of the table shows that P-value (0.00) is less than 0.05 alpha level. This means that there was a significant difference between the mean score of the two group ($t(86)= 4.65$, $p< 0.05$).

Answering Research Question One

What is the difference in the means scores of students exposed to scaffolding strategy and those taught using conventional method in basic science.

Table2: post-test mean score of students exposed to scaffolding strategy and conventional method.

Group	N	Mean (X)	SD
SCFDM	46	75.67	8.00
CLM	42	67.00	6.43

SCFDM = Scaffolding Method

CLM = Conventional Lecture Method

The Table 2.1 above shows the student exposed to scaffolding method had a mean scores of 75.67 with standard deviation of 8.00 while those exposed to conventional lecture method had mean score of 67.00 with standard deviation of 6.43. This implies that the students exposed to scaffolding method performed better than those exposed the conventional lecture method in basic science subject.

Answering Research Question Two

What is the difference in the mean score of male and female students' academic achievement when scaffolding strategy is used in junior secondary school basic science subject.

Table 2. post test mean score of male and female students exposed to scaffolding teaching strategy.

Gender	N	Mean (X)	SD
Male	28	77.68	7.252
Female	18	72.56	8.3-51

The above result in table 3 shows that the male students in scaffolding teaching strategy obtained a mean score of 77.68 in basic science while the female counterpart hand a mean score of 72.56. This shows that the male students performed better than the female student that are exposed to scaffolding teaching method.

Null Hypothesis one (HO_1)

There is no significant difference in the mean score of students' academic achievement taught basic science using scaffolding method in junior secondary school, Kontagora, Niger State.

Table 3: ANCOVA of post test score of experimental and control groups.

Source	Sum of square	Dt	Mean square	F	Sig
Corrected model	1661.830	2	830.915	15.477	.000
Intercept	15386.996	1	15386.996	286.563	.000
Covariate (protest)	1556.764	1	778.382	14.50	.000
Mean effect (treatment)	1425.066	1	1425.066	26.540	.000
Error	4564.068	85	53.695		
Total	456533.000	88			
Corrected total	6225.898	87			

Significance of 0.05 Level

The ANCOVA result of the post test score of the Experimental and Control groups above shows that the p-value (0.00) of the mean effect is less than 0.05 alpha level ($p<0.05$). the sum of square gave 1425.066, the mean square, 1425.066 and the f-value of 26.540 which was significant; the result revealed that the difference is in favor of scaffolding teaching method. **Hypothesis two (HO_2)**

There is no significant difference in the means score of male and female students' achievement taught basic science using scaffolding teaching method in junior secondary school in Kontagora, Niger state.

Table 3: ANCOVA Post-test Mean Score of Male and Female Students Exposed to Scaffolding Teaching Strategy

Source	sum of square	dt	mean square	f	sig.
Corrected model	473.28	2	236.629	4.228	.021
Intercept	7375.265	1	7375.265	131.764	.000
Covariate (protest)	185.701	1	185.701	3.318	.076
Main effect (gender)	407.116	1	407.116	7.273	.010
Error	2406.851	43	55.973		
Total	266301.00	46			
Corrected total	2880.109	45.			

Significant of 0.05 alpha level

Table 3.1: above shows the ANCOVA analysis of the posttest of male and female basic scxience students taught scaffolding teaching method. The table shows that p-value (0.010) of the gender main effect is less than 0.05 alpha level ($p<0.05$), $f = 7.273$. On this basis, hypothesis two was rejected. The result revealed that there is significant difference between the mean achievement of male and female when they were exposed to scaffolding teaching method in basic science subject.

Discussion

Scaffolding teaching strategy had a positive impact on the mean achievement score than conventional lecture method. This finding was supported by Winnips (2001) that learning becomes

easy when student received adequate support. It also agrees with Gaskin, et al (2000) as explained that scaffolding is in form of modeling that support students as they develop new skills or learn new concepts. When the students achieve competence, the support is remove and the students continue to develop the skills or knowledge on his/her own

Male student performed better that the female students in the same group of scaffolding strategy when taught basic science subject, this finding was in agreement with Abodi and Laleye (2006) on effects of video tapped and scaffolding instructions on learning of basic science where gander was used as moderating factors, it was revealed that male students performed will and higher than female counterparts.

Conclusion

Based on the findings in this study, scaffolding strategy had a positive impact on the mean achievement scores than conventional lecture method. Teachers are therefore employed not to stick to on a particular method of teaching but should endeavour to use variety cognivance of the topic and the need of the students.

Recommendations

Based on the findings, the following recommendations are made:

1. Scaffolding teaching strategy should be used be for teaching process at all level of education in Nigeria schools. There is need to integrate leaving concepts in the delivery of educational programmes. This will enable the students to develop new knowledge and skills so as to achieve competence.
2. The used of scaffolding teaching strategy is gender friendly, therefore it should be encouraged in the classroom to enhance male and female performance in basic science at junior secondary school education level. This will make learning interesting and also improve the male and female students' participation in the classroom.
3. Including and use of scaffolding teaching strategy in teacher education should be urgently encouraged. This will help in producing teachers who will help in shift from teacher-centered to students- centered approaches. This is because, scaffolding is a temporary support for students learning until the student can perform these independent to that support (winnips,2001)
4. Workshops and training programmes on the benefits and procedure of scaffolding teaching strategy should be frequently carried out by poling maker.

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Assesment of Tasks and Procedures Necessary for Students Practical Work in Block/Brick Laying and Concreting in Technical Colleges in Niger State

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Abstract
This study was designed to assess tasks and procedures for practical work in Brick/Blocklaying and Concreting in Technical Colleges in Niger State. Three research questions were formulated to guide the study. One null hypothesis was formulated and tested at the probability of 0.05 level of significance. Thirty nine structured questionnaire items were developed and used for the study while three experts were engaged to face-validate the instrument. The instrument was pilot tested on 15 students and reliability coefficient of the entire instrument was 0.87. Research and design was adopted, the respondents for the study was 69 made up of 49 Building Technology Teachers, and 20 Registered Builders. The major findings of the study include among others that, some tasks has been identified appropriate for inclusion in the instrument for assessing practical work in Brick/Blocklaying and Concreting in Technical Colleges in Niger State. It was recommended that Brick/Blocklaying and Concreting teachers should be acquainted with the developed instrument to enhance uniform standard in assessing student's practical work.

Keywords: Tasks, Procedures, Assessment, Practical work, Block/Bricklaying, Concreting

Introduction
Among the institutions that provide technical education in Nigeria are the technical colleges. Technical colleges impart necessary skills that lead to the production of craftsmen and technicians who are enterprising and self reliant (FRN, 2013). Programmes offered in technical colleges are skill oriented and performance-based (Odu, 2019). These programmes allow for effective training and assessment of craftsmen in a wide range of trade subjects that help the students to achieve various instructional objectives in the different domains of learning (Igbo, 2017).

The national curriculum for technical colleges centres around the psychomotor domain with relevant emphasis on cognitive and effective domain (FRN, 2013; NBTE, 2013). By implication, much attention is focused on psychomotor or practical component of studies in technical colleges but this is done without overlooking the relevant emphasis on critical areas of cognitive and effective components. The psychomotor component requires that the appropriate materials that are' necessary for effective training of the craftsman in his/her chosen trade must be available. The availability and effective utilization of materials would help to achieve the skills of technical education as out lined in the national policy on education (N.P.E, 2013), therefore includes: To provide trained manpower in applied science, technology and business particularly at the craft, advanced craft and technical levels; and to give training and impart the necessary skills to individual, who shall be self-reliant economically. Another goal of Technical and vocational Education in Nigeria is the production of skilled, self reliant and enterprising craftsmen and

technicians who can apply their technical knowledge and vocational skills for solving industrial, and economic problems of the nation (FRN, 2013). Part of the effort for achieving this objective is the implementation of National Technical certificate (N.T.C) and Advanced Technical Certificate (A.N.T.C) programmes in Technical colleges. The N.T.C and A.N.T.C programmers are aimed at producing technical and vocational craftsmen who can aspire to higher level of education in achieving professionalism in various technical programmes among which is Brick/Block laying and concreting.

Brick/Block laying and concreting like other courses are carried out in classroom and workshop learning and training environments and each complement the other. Workshop environment in college setting is the introduction of industry in learning situation, designed to equip students for work in their chosen occupation as demanded by the labour market (N.B.T.E; 2020) Brick/Blocklaying and concreting at Technical college level is designed to provide the trainee with the essential knowledge and skill that will enable him perform competently in all aspects of Brick-work in the construction industry. On completion of the programme, the trainee should be able to manipulate various tools and equipment in the brick/block laying and concreting trade. Manipulative skills are required in brick/ block laying and concreting. Skills are those aspects of technical and vocational education which involve hands-on the-job experience by the students.

The National Policy on Education (2013) further outlined general education, theory and related courses, workshop practical, and industrial training/production works as the four components, which the curriculum of each technical training should consist of Brick/Blocklaying and concreting involve knowledge and training in woodwork and joinery, painting and decoration, building drawing and construction among others (FRN, 2013). The importance of shelter and need for a conducive environment for domestic and industrial works has necessitated the demand for quality building. The development of an appropriate instrument for assessing the performance of students in brick / block laying and concreting will help to improve the quality of products.

Identification of tasks is the process of identifying the major learning activities or operation for carrying a job. (Ede, 2020) identification of tasks could be used for improving skills training in complex tasks. While task analysis is the process of breaking down complex takes for easy learning. The major types of tasks analysis that could be used to improve learning are cognitive task analysis and tradition al task analysis. Cognitive task analysis and extension of behavioral task analysis task analysis to yield information on mental process necessary for task performance. While traditional task analysis on the other hand is the process of breaking down large and complex task in the behaviours that support performance of a give job. Yalama (2000) viewed the process of assessing student manipulative skills as which should comprise of assessing student skills, to be carried with a stated degree of accuracy in performing tasks. Due for the potentials of cognitive task analysis (CTA) and Traditional task analysis (TTA) incorporated in to an instructional guide may be used to enhance students' performance in brick/ blocking and concreting practical work in Technical colleges.

Procedures: is the accepted and correct way of doing something. In relation to workshop procedures in building construction, procedure on be seen as the correct and accepted ways of deriving set objectives of the programmes from planned and systematic follow – up of activities designed for the purpose. Procedures in workshop activities are process – based, (Nwachukwu,

2016). Process in this sense refers to series of actions, activities or events which have a particular result. Procedures as noted, workshop environment in school setting is the introduction of industry in learning situation as demanded by the solo economic needs of the people (Ezeji, 2014) school workshop brings about technology of industry in educational curriculum in which students are exposed to practical learning situation for optimum utilization of potentials abilities, creative imagination and aptitude in using available materials and tools for production works (Olson, 2012, Nwachukwu, 2016). Technology of industry has to do with methods, processes and procedures in technical schools should be same as the procedures of industry (Olson, 2012) in the same vein, workshop procedure in building construction programmes should be same as procedures in building industry, and should reflect workshop procedures in technical education programmes.

Assessment in any educational programme determines learning outcomes in terms of knowledge, skills attitudes, ability and intelligence acquired in the course of study. In education, decisions about staff and students promotion are based on outcome of assessment. Assessment is the process by which the success or failure of students, teachers or school heads performance is obtained. Kenneth and Keith (2012) viewed assessment as the process of examining as carefully, thoroughly and objectively as possible an individual, and group of products or programmes in order to ascertain strength and weakness. From the foregoing, therefore, assessment can be seen as the systematic process of judging the worth desirability, effectiveness or adequacy of something, according to a given criteria. Okorie and Ezeji (2015) emphasised that in educational programme, some unique methods of assessing practical activities are required when students are engaged in a practical task which have to do with repairs of whatever nature, be it individual or in groups. The methods of assessment in manipulative subjects like brick/block laying and concreting require an assessment which employs the use of rating scales or checklist on students as they physically carry out some given tasks. Mohammed (2018) and Makienko (2015) also asserted that a special method for assessment of manipulative skills is necessary because in performing any operation or task such as in brick/block laying, certain techniques and attributes to be noticeable in students which cannot be guessed at or judged intuitively must be critically considered when assessing students, performance. Assessment should be based on a laid down criteria regarding the quality or characteristics of the finished products, or final tasks (Okoro, 2019). It is pertinent to note that a good test must be valid and reliable. Validity implies that the test measures correctly what it suppose to measure while reliability means that the test measures consistently at repeated administrations, what it is designed to measure. Hoover (2015) stated that test validity is the extent to which the inferences, conclusions and decisions made on the basis of test scores are appropriate and meaningful. According to him, if a test is not valid there is no point in discussing reliability because test validity is required before reliability can be discussed in any meaningful way.

A reliable score is dependent upon standard method of assessment instrument, particularly in the practical work. Hence the need to reward every step or procedure is paramount. According to the National Board for Technical Education (N.B.T.E) (2013) Brick/Block laying and concreting graduates from technical colleges in Niger state and other states in Nigeria are expected to, upon completion of the course, have acquired practical skills to secure paid employment or set up their own and become self employed and be able to employ others.

National Business and Technical Examination Board (NABTEB) (2014) chief examiners report revealed that candidates' performance in Brick/Block laying and concreting practical examination

was too low. This is affirmed by the preliminary study carried out by the researcher in Niger state. Similarly, NABTEB (2012) marking scheme on rating skills in Brick/Blocklaying and concreting practical examination clearly shows that some tasks are not included in the scheme which could affect student performance. This is in line with Goton (2018) who stated that lack of problem identification, practical guide or instrument for teaching and assessing students work, diagnosis, evaluation and decision making had led to the decline of educational standard in technical colleges in Nigeria. Although Increased emphasis has been placed on skill acquisition in both secondary and vocational schools in Nigeria to equip students with useful skills and to improve their employability opportunities, the practical tasks carried out need to be assessed so as to generate and sustain confidence as well as to maintain standard (Okoro, 2019). Garba (2019) had noted that some building technology teachers assess students' practical project performance by taking cursory at the finished works and assigning grades they like. This must be mostly due to lack of valid instrument for such assessment. The study was, therefore designed to identify tasks and procedures necessary for assessing students in practical work in Brick/Block laying and concreting in Technical Colleges in Niger state.

Purpose of the Study

The major purpose of this study was to develop and validate an instrument for assessing practical work in Brick/Blocklaying and Concreting in Technical Colleges in Niger State. Specifically the study was to:

1. Determine tasks appropriate for inclusion in the instrument for assessing practical work in Brick/Blocking and Concreting.
2. Determine procedures for developing assessment instrument in Brick/Blocklaying and Concreting.
3. Determine facilities required for assessing student's practical work in Brick/Blocklaying and Concreting.

Research Questions

The following research questions guided the study.

1. What are the appropriate tasks for inclusion in the instrument for assessing practical work in Brick/Blocking and Concreting in technical collages in Niger State?
2. What are procedures for developing an assessment instrument in Brick/Blocklaying and Concreting in technical collages in Niger State?
3. What are the facilities required for assessing students practical work in Brick/Blocklaying and Concreting in technical collages in Niger State?

Hypotheses

The following hypotheses were formulated and tested for the study at 0.05 level of significance

$H0_1$: There is no significant difference in the mean responses of Brick/Blocklaying and Concreting Teacher and Registered builders on task appropriate for inclusion in the assessment instrument.

$H0_2$: There is no significant difference in the mean responses of Brick/Blocklaying and Concreting Teachers and Registered builders on procedures for developing assessment instrument in Brick/Blocklaying and Concreting in technical collages in Niger State

Methodology

The descriptive survey research design was used for the study. This design was adopted for this study because it enables the researcher to elicit information from the entire population. This study was carried out in Niger State in order to develop an instrument for assessing practical work in Brick/Blocklaying and Concreting in Technical Colleges in the state based on the report from Niger State Ministry of Education on poor performance of students in National Business and Technical Examination (NABTEB) practical examination in Brick/Blocklaying and Concreting in 2020.

The target population for this study is 69 which comprised 49 Brick/Blocklaying and Concreting teachers of all the Technical Colleges in the state Science and Technical School Board, and 20 Registered Builders from Ministry of Housing and Environment respectively. The teachers and registered builders were chosen because they are involved in practical in brick/ blocklaying and concreting. No sample was taken because the population was of a manageable size. The preliminary instrument that was used for data collection is structured questionnaire consisting of 48 items developed by the researcher through extensive literature review based on the research questions. A 5 point rating scale was used for Section B, C, D, and E with response options as Very Appropriate (VP), Apprproiate (A), Fairly Appropriate FD), Disagreed (D), strongly Disagree (SD). The weighted value assigned to response options are 5, 4, 3, 2, and 1 respectively. The preliminary survey instrument for this study was validated by two experts from Department of Industrial and Technology Education, Federal University of Technology Minna and one registered builder, in the ministry of housing and environment Minna. Therefore, 48 items were found suitable for the study and produced in the final drafting of the instrument. To establish the reliability of the instrument, the validated instrument was trial tested on 15 students at Federal Science and Technical College Orozo Abuja, with the same demography of the study area. The data obtained from the trial testing was analysed using Cronbach Alpha reliability formular to establish internal consistency of the instrument for the study. The reliability coefficient obtained was 0.87. The instrument was administered by the researcher with the help of one research assistance from each Technical College in Niger State. The data collected for the study was analysed using mean and standard deviation to answer the research questions while, t-test statistic was used to test the hypothesis at 0.05 level of significance. For selecting the task appropriate for inclusion in the instrument a mean cut up of 3.50 was chosen. The resulting mean scores was interpreted relatively to the concept of the real lower and upper limit of numbers 1-5 as used on the rating scale adopted for the study. Therefore, any task with mean of 3.50 and above is appropriate, and any task with mean score of 3.49 or less is not appropriate.

Results and Discussion

Research Question 1

What are the tasks appropriate for inclusion in the instrument for assessing students In determining the tasks appropriate for inclusion in the instrument, 20 items were provided to the respondents in order to express their opinions the responses to the research question, are presented in Table 1.

Table 1: Task Appropriate for Inclusion in the Instrument for Assessing students' Practical work in Brick/Blocklaying and Concreting

S/N		Mean	S.D	Remarks
1	Ability to read and interpret drawings	4.54	0.61	Appropriate
2	Ability to analyse the building plan work	4.67	0.68	Appropriate
3	Ability to identify and select tools for a given task	4.54	0.74	Appropriate
4	Ability to identify and select equipment for the given task	4.72	0.54	Appropriate
5	Ability to use appropriately the identified tools and equipments	4.72	0.54	Appropriate
6	Ability to prepare ground for a given task	4.57	0.65	Appropriate
7	Ability to select suitable materials for the given task	4.49	0.80	Appropriate
8	Ability to use correct specifications for given task	4.59	0.63	Appropriate
9	Ability to measure accurately the parameters of a given task	4.59	0.63	Appropriate
10	Ability to apply technical information to a given task	4.70	0.55	Appropriate
11	Ability to record properly all dimensional specifications of a given task	4.64	0.62	Appropriate
12	Ability to construct the given task properly without errors	4.48	0.70	Appropriate
13	Ability to take appropriate care of tools during and after work	4.57	0.70	Appropriate
14	Ability to follow the various work stages correctly	4.61	0.62	Appropriate
15	Ability to follow operational sequences in performing a given task	4.65	0.64	Appropriate
16	Observation of relevant precaution in performing a task	4.51	0.68	Appropriate
17	Ability to complete all the work stage as on a given task	4.55	0.70	Appropriate
18	Ability to answer oral questions as it relates to a task completion	4.50	0.76	Appropriate
19	Ability to provide level surface for given task	4.62	0.60	Appropriate
20	Ability to have adequate comportment during work	4.54	0.76	Appropriate

Analysis of mean responses of the two groups of respondents from Table 1 reveals that all the items are agreed with mean ranging from 4.48-4.72 This shows that the task are appropriate for inclusion in the instrument for assessing students practical work in brick/ blocklaying and concreting in all technical colleges.

Research Question 2

What are the procedures in the development of assessment instrument in Brick/ Blocklaying and Concreting?

In answering this research question 9 items were provided to the respondent in other express their opinions.

Table 2
Mean Responses of the Teachers and the Registered Builders on the Procedures in the Development of Assessment Instrument

S/N	Procedures for Developing an Assessment Instrument in BBC	Mean	S.D	Remarks
1	By reviewing existing instrument	4.58	0.67	Appropriate
2	By determining the domains be included and the items inthe instrument	4.77	0.46	Appropriate
3	By determining the response categories to be included in each domain	4.60	0.62	Appropriate
4	By establishing the reliability and validity of the instrument	4.54	0.80	Appropriate
5	By developing training materials to accompany the assessment instrument	2.80	1.52	Not Appropriate
6	By clearly defining the aim of the study in the assessment instrument	4.61	0.60	Appropriate
7	By listing out all the attributes or characteristics that need to be observed in the instrument	4.55	0.65	Appropriate
8	By deciding on the recording system to be used in assessment instrument	4.48	0.76	Appropriate
9	By constructing the requirement model for recording Observation	4.74	0.56	Appropriate

The analysis of the data presented in Table 3 revealed that the respondents on 8 out of the 9 items on the procedures in the development of assessment instrument with the mean ranging from 2.80-4.77 but item 5 was rated disagreed. This signifies that the assessment instrument possess all 8 characteristics outlined in the table but the item relating to developing training materials to accompany the assessment instrument was disagreed.

Research question 3
What are the facilities required in carrying out practical work in Brick/ Blocklaying and Concreting?

In answering this research question, 10 items were provided to the respondent in other to express their opinions.

Table 3
Mean Responses of the Teachers and the Registered Builders on the facilities required in Carrying out Practical Work in Brick/ Blocklaying and Concreting.

S/N	Facilities for Assessing Student Practical Work in BBC	Mean	S.D	Remarks
1	Brick towel and steel square are necessary in carrying out practical exercise	4.63	0.57	Appropriate
2	Plumb rule, spirit level, and guage rule are required in carrying out practical exercise	4.60	0.60	Appropriate
3	Jointing board and straight edge are required	4.57	0.69	Appropriate
4	Corner block and triangle plate are required in carrying out practical exercise	4.58	0.65	Appropriate
5	Club hammer and block case are required in carrying outpractical exercise	4.65	0.61	Appropriate
6	Pointing trowel, wooden hork and wire brush are requiredin carrying out practical exercise	4.48	0.71	Appropriate

The analyses of the data presented in Table 4 revealed that the respondents on 6 items on the facilities required in assessing students' practical work with appropriate mean ranging from 4.45-4.67. This signifies that all the facilities listed are required.

Hypotheses
$H0_1$ There is no significant difference between the responses of teachers and registered Builders' with respect to the tasks appropriate for inclusion in the instrument for assessing students practical work.

Table 4
t-test Analysis of the Responses of Teachers and Registered Builders on the Tasks Appropriate for Inclusion in the Instrument for Assessing Students' Practical work in BBC

S/N	Items	Teachers N_1=49 Mean $_1$	$S.D_1$	Registered builders N_2=20 $Mean_2$	$S.D_2$	t-cal	Sig.(2 tailed)	Remarks
1	Ability to read and interpret drawings	4.53	0.61	4.55	-.119	0.60	.905	NS
2	Ability to analyse the building plan work	4.71	0.57	4.55	0.89	.911	.366	NS
3	Ability to identify and select tools for a given task	4.43	0.79	4.80	0.52	-1.93	-.058	NS
4	Ability to identify and select equipment for the given task	4.71	0.58	4.75	0.44	-.248	.805	NS

5	Ability to use appropriately the identified tools and Equipments	4.61	0.70	4.35	0.87	1.309	.195	NS
6	Ability to prepare ground for a given task	4.55	0.65	4.60	0.68	-.281	.780	NS
7	Ability to select suitable materials for the given task	4.61	0.63	4.65	0.49	-.237	.814	NS
8	Ability to use correct specifications for given task	4.61	0.70	4.35	0.87	1.309	.195	NS
9	Ability to measure accurately the parameters of a given task	4.61	0.63	4.65	0.49	-.237	.814	NS
10	Ability to apply technical information to a given task	4.61	0.70	4.35	0.87	1.309	.195	NS
11	Ability to record properly all dimensional specifications of a given task	4.53	0.68	4.90	0.31	-2.326	.023	S
12	Ability to construct the given task properly without errors	4.61	0.63	4.65	0.49	-.237	.814	NS
13	Ability to take appropriate care of tools during and after work	4.61	0.70	4.35	0.87	1.309	.195	NS
14	Ability to follow the various work stages correctly							
15	Ability to follow operational sequences in performing a given task	4.67	0.66	4.60	0.60	.432	.667	NS
16	Observation of relevant precaution in performing a task	4.45	0.71	4.65	0.59	-1.120	.267	NS
17	Ability to complete all the work stage as on a given task	4.61	0.64	4.40	0.82	1.150	.254	NS
18	Ability to answer oral questions as it relates to a task completion	4.39	0.81	4.80	0.52	-2.095	.040	S

19	Ability to provide level surface for given task	4.61	0.63	4.65	0.49	-.237	.814	NS
20	Ability to have adequate comportment during work	4.61	0.70	4.35	0.87	1.309	.195	NS

NS= Not Significance

Data presented in Table 5 revealed that the t- calculated values for twenty items were less than the t- table values. T. Calculated values ranged from 0.40 to 0.905 which less than t. Table values.

$H0_2$ there is no significant difference between the responses of teachers and registered builders with respect to the procedures in developing assessment instrument.

Table 5

t-test Analysis of the Responses of Teachers and Registered Builders on the Procedures for Developing Assessment Instrument in BBC

S/N	Items	Teachers N_1=49		Registered builders N_2=20		t-cal	Sig.(2 tailed)	Remarks
		Mean $_1$	$S.D_1$	$Mean_2$	$S.D_2$			
1	By reviewing existing instrument	4.73	0.69	4.65	-.119	0.64	.905	NS
2	By determining the domains o be included and the items inthe instrument	4.70	0.87	4.56	0.89	.917	.366	NS
3	By determining the response categories to be included in each domain	4.73	0.70	4.84	0.62	-1.83	-.058	NS
4	By establishing the reliability and validity of the instrument	4.51	0.68	4.85	0.46	-.248	.805	NS
5	By developing training materials to accompany the assessment instrument	4.60	0.70	4.33	0.87	1.309	.195	NS
6	By clearly defining the aim of the study in the assessment instrument	4.56	0.65	4.60	0.78	-.281	.780	NS

7	By listing out all the attributes or characteristics that need to be observed in the instrument	4.61	0.53	4.65	0.48	-.237	.814	NS
8	By deciding on the recording system to be used in assessment instrument	4.61	0.70	4.35	0.89	1.389	.195	NS
9	By constructing the requirement model for recording Observation	4.61	0.63	4.65	0.49	-.237	.814	NS

Data presented in Table 5 revealed that the t- calculated value for nine items were less than the t-table values. T-calculated values ranged from 0.104 to 0.715 which were less than t. Table value. Hence there was no significant difference

Discussion of Findings

The finding of this study revealed that tasks identified, are appropriate for inclusion in the instrument for assessing practical work in Brick/Blocklaying and concreting for better performance. This finding was in line with the views of Yalams (2000) who observed that in combining process and product evaluations, certain attributes of the learners such as ability to analyse the plan work, the skills and procedures in the use of care of tools and equipment, ability to construct the given task properly without errors among others could be easily and systematically observed, objectively and comprehensively assessed. In support of the above, Oranu (2012) stated that the best means available for assessing the effective, psychomotor as well as cognitive skills of the learner includes, direct observation, rating scale, check list, interest invention, participation charts and interview since process assessment has to do with observing a performance and objectively passing a valued judgement over it. Similarly UNESCO (2012) observed that some quality or skills of the student's to be assessed when assessing and grading specific stage of a given work piece should include ability to complete all the work stage on a work piece on schedule supporting this view, Oroge (2012) stressed that process grading has become imperative as this may involve assessing and grading students' ability to read and interpret drawings. In line with above, Uzoagulu (2016) opined that practical task must be evaluated properly so as to induce high standard students' who are expected to think (cognitive), execute, design and construct (psychomotor) and exhibit good cooperative attitude towards others and the use of tools and equipment (affective). It is through observing, rating tasks such as tools election and usage, comportment of the students' care for the tools and equipment, adherence to safety practices of both worker and others.

Research question two dealt with procedures in developing assessment instrument. The finding in table 3 revealed that all the procedures were found to be relevant in developing assessment instrument in Brick/ Bricklaying and concreting except item five which is on developing training materials to accompany the assessment instrument. This finding was in line with views of white and Ahmadu (2013) who suggested that to achieve the goal of developing an assessment

instrument, the researcher should review the existing instruments, determine the domains to be included in the items; define the response categories to be included in each domain. Supporting this findings Ogbozo (2016) noted that for a valid and effective assessment instrument, the following criteria should be considered: define clearly the aim of the study in the instrument, list out all the attributes or characteristic that need to be observed in the study, decide on the recording system to be used and construct the required model for recording observation. Research question three dealt with the facilities required in assessing students' practical work in Brick/Blocklaying and concreting. The findings in Table 4 revealed that all the facilities listed are required in assessing students' practical work. This finding is line with the views of Ezeji, (2004) who observed that adequate provision of facilities in carrying out practical exercise helps students acquire industrial technical knowledge and skills through creative and problem solving, learning experiences involving such activities as experimenting, planning, constructing evaluating, and using tools machines materials and processes. The instructional and laboratory experiences help students to make wiser and more valid educational and career initial consideration concerns the goals of a sound programme which facilities plays a greater role. Supporting this finding, Abdulllahi, (2014) emphasized that for adequate training of students in skill acquisition in their subject areas, the required facilities in the workshop must be provided for effective training.

Conclusion

Based on the findings of this study, the following conclusions are drawn:
The graduates of Technical Colleges required relevant skills to perform competently on the practical work. An assessment instrument developed if adopted for use in all the Technical Colleges in the state will help the students to improve on their practical performance.

Recommendations

Based on the findings of the study the following recommendations were made:

1. Brick/blocklaying teachers at technical colleges should de-emphasis the use of product assessment only but, rather combine both product and process assessment method
2. Examination bodies such as National Business and Technical Board (NABTEB), National Examination Council (NECO), West African Examination Council (WAEC) should consider and adopt the developed instrument for assessing student's practical performances in Brick/Blocklaying and Concreting at NTC and ANTC levels.
3. Brick/blocklaying teacher's should be acquainted with the developed instrument to enhance uniform standard in assessing student's practical work
4. All the characteristics or attribute that need to be observed in students should be listed out with the required mode of grading before assessing students practical work
5. Niger state science and technical schools board should also adopt the developed instrument for assessing student's practical performance at technical college level.

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Assessment of Facilities and Method of Improving Students Performance in Electrical Installation and Maintenance Work in Technical College Kaduna State, Nigeria.

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Abstract
The purpose of this study was to assess student performance of electrical installation and maintenance works in technical college Malali in Kaduna, state Nigeria". The study was guided by three research questions and three null hypotheses was conducted in technical college Malali in Kaduna State using descriptive survey research design. The population of the study was 70 which comprised of 10 technical teachers 60 student of technical college Malali Kaduna state. The entire population was used because it was manageable as such there was no sampling. A 19item structured questionnaire was developed for assessment of Students of electrical Installation and Maintenance Works in technical college Malali Kaduna state. Questionnaire developed, was validated by three experts from department of Electrical and Electronics Technology Education Kaduna polytechnic.Test retest method was used to establish the reliability of the instrument and reliability coefficient of 0.78 was obtained using Pearson Product Moment Correlation Coefficient method. Data collected for the study were analyzed using Mean statistics to answer the three research questions while t-test of different between two means was used to test the three null hypotheses at 0.05 level of significance. Findings of the study revealed among others. Inadequate equipment and facilities for studentspractical,Unqualified and inadequate trained technical teachers. Based on the findings the following recommendation were madegovernment should provide fund for building infrastructure and the purchase of new equipment and facilities, adequate qualified and trained technical teachers should be provided, strategies for teaching and learning technical education should be provided, government and teachers should set up advisory committee to bring about desired performances, proper planning and adequate supervision should be made in technical college Malali Kaduna state.

Keywords: Assessment,Students'Performance, Electrical Installation and Maintenance Work.

Introduction
Assessment bridges the gap between teaching and learning. Perhaps second only to teaching, assessing student performance is fundamental role in the life of a teacher.Assessment is important because it provides students with feedback about their performance;this information reinforces their areas of strength and highlights areas of weakness.Using this feedback,students can direct their study strategies and seek addition resources to improve their performance (Springer 2014).

Feedback is an important aspect of learning in education. Feedback can be in the form of advice, criticism or information about how good or useful a given task was carried out especially from students (Hornby, 2006). A learner cannot be said to have learnt until there is a process of assessing whether the skill has been acquired or not. Learning outcomes include the cognitive, the affective and the psychomotor, but most often the cognitive aspects are assessed (Olaitan, & Ali, 2000). Many activities in science and technology involve application of manual dexterity and therefore call for assessment of practical skills acquisition to ensure that learning has taken place (Mager,1997).In the same vein, Ningi (2001) postulated that, assessment of teaching and learning processes in technical and vocational education is still conducted using traditional way without injecting new approaches by teachers which is actually depriving the students from learning the right skills needed for self-employment.

Electrical technology however, not only involves the design and production of all |be electrical systems mentioned, but also the installation, testing and maintenance of these systems. A number of challenges arise with the implementation of mathematics, science, and engineering to develop these modern wonders. These challenges include problem-solving skills, ability to diversify, a strong educational background, and continuing learning (Aggeliki2018).

ln the same vein, Nwachukwu, Bakare and Jika (2011) submitted that technical collage provides students through training with, the relevant and adequate knowledge, skills and attribute for employment under the guidelines of a teacher in related occupations. The place of skills acquisition in technical education cannot be over emphasized and to achieve these objectives,too many trades are learnt in technical collages. Ede, Miller and Bakare (2010) identified that students undertaking technical education programmes are trained in auto-mechanics, wood, plumbing, computer craft, mechanical trades, radio, television. (RTV) and electronics works, electrical installation and maintenance works.

In view of the National Board for Technical Education programme "(NBTE, 2013) electrical/electronic offers trade in Application maintenance and repairs Electrical installation and maintenance works Instrument Machine Radio, television (RTV) and maintenance works.

In light with the above, electrical installation and maintenance works as offered in technical collage prepares an individual with job-satisfying requirements towards employment and self-reliance. Electrical installation and maintenance work provides technical training to meet the demands of electrical industry and needs of the individual allowing the students to identify their career objectives. Skills is the ability to do something well, usually gained through training or experience.Skill acquisition in electrical installation and maintenance works employs measures and develops jobs in electrical installation geared towards making students confident and self-reliant. Electrical installation and maintenance works curriculum is design to prepare the student to acquit entry level knowledge and manipulative skills for employment in the electrical industry in Nigeria and Kaduna s state in particular. Students in Electrical installation trades are expected to possess skills for excellence in installation of electrical machines and equipment, winding' of electrical machines, testing and inspection of electrical installations and repair of electrical machines. Electrical installation and maintenance is one of the technical courses run in technical colleges in Kaduna state.

Electrical installation is an assembly of components that allows you to reliably and safely use electrical power around your home. An electrical installation comprises all the fixed electrical equipment that is supplied through the electricity meter. It includes the cables that are usually hidden in the walls and ceilings, accessories.AccordingRaskar (2019) said Electrical maintenance involve fault diagnosis, routine services and repair of electrical components of machine, households electrical/electronic equipment. Despite the effort of government and nongovernmental agencies in enhancing the educational development in Nigeria, the Kaduna state ministry of education, report (2015) shows that the academic performance in electrical installation and maintenance work in technical colleges has declined greatly it was also observed that failure of students in electrical installation and maintenance is high -in Government technical college Malali in recent years.

However, it is discovered that most consumable materials, tools and even power supply has contributed to the poor performance of the students. In view of the above, the researcher ought to investigate the factors responsible for failure of students in electrical installation and maintenance work in technical college Malali, Kaduna state.

Purpose of the Studies

The purpose of this study is to assess the performance of the students of the electrical installation and maintenance in technical college Malali in Kaduna state. The researcher intends to:

1. Identify the facilities for teaching electrical installation and maintenance work.
2. Determine the teaching techniques used by the Teachers in teaching electrical installation and maintenance work.
3. Determine the strategies for improving the performance of students of electrical installation and maintenance work.

Research Questions

The following research question guided the study.

1. What are the equipment facilities for teaching electrical installation andmaintenance work?
2. What are the teaching techniques used by the teachers for teaching electrical installation and maintenance work in technical college Malali?
3. What are the strategies to be used -for improving the students' performance in electrical installation and maintenance work in technical college Malali?

Hypotheses

The followingnull hypotheses were tested at 0.05 level of significance

HO_1: There is no significance difference between mean responses of teachers and students on theequipment and facilities for teaching electrical installation andmaintenance work

HO_2 There is no significance difference between mean responses of teachers and student on Techniques used in teaching electrical installation and maintenance work in technical college

HO_3 There is no significance difference between mean responses of teachersand student onstrategies to be used -for improving the students' performance in electrical installation and maintenance. Work in technical college.

Methodology.

A descriptive survey research design was adopted for this study. The study was carried out in Government technical college Malali of Kaduna State. The targeted population for this study was70 respondents which comprises 60 Students and 10 Teachers of Government Technical College Malali Kaduna State. The entire population was used for this study. Hence there was no sampling. A Structured questionnaire titled Electrical Installation Maintenance Work Students' Performance Questionnaire (EIMWSPQ) developed by the researchers and validated by three experts was used for data collected for the study .All sections of research questions were structured so that respondents expressed their opinion on a four rating scale of Strongly Agree(4), Agree(3), Disagree(2) and Strongly Disagree(1).The reliability coefficient of instrument was 0.78 through Pearson Product Moment reliability coefficient. 70 copies of questionnaire were distributed to Teachers and Students by the researchers in Government Technical College Malali Kaduna State. Thus, 67 copies duly filled by the respondents were returned to the researchers and returned rate is 95.7%.Mean was the statistical tool used to analyze the data for answering research question. A mean score of 2.50 was used as a bench mark for accepting or rejecting items. Therefore, items with mean score of 2.50 and above were considered agreed; where items with mean score of 2.49 and below were considered disagreed.

Research Question 1

What are workshop equipment and facilities for teaching electrical installation and maintenance work in technical collage Malali?

Table I: The mean responses of data of both teachers and students on workshop equipment and facilities.

S/No	Items	Mean	Decision
1.	There are enough multi meters in the school workshop.	3.08	Agreed
2.	The existing instruments/equipment in the electrical workshops are outdated.	2.91	Agreed
3.	There are adequate text books in the library.	2,03	Disagreed
4.	Enough wires are provided to carry out electrical installation practical.	2.03	Disagreed
5.	The workshop has enough screw driver for the student.	2.50	Agreed
6.	There are enough micro meters for carrying out practical in electrical installation workshops.	1.58	Disagreed
7.	The electrical workshop has no enough boards for installation practical.	2.33	Disagreed

Table I above showed that respondents agreed with items 1, 2, and 5 that there are enough multimetre in the workshop for students practical, and that the existing equipment and instrument in the electrical workshop are outdated and that the workshop has enough screw driver in the workshop. But both the teachers and the students disagreed with items 3,4, 6 and 7 that there are adequate textbooks in the library, there areenough-wires for practical work in electrical installation and maintenance work in the school, there are enough micro meters in electrical/electronics workshop this shows the department has no standard workshop for electrical installation and maintenance practical.

Research Question 2

What are the teaching techniques used by the teachers for teaching electrical installation and maintenance work in technical college malali?

Table 2: The mean responses of data analysis of both teacher and students on teaching techniques used by teachers in electrical installation and maintenance work

S/No	Items	Mean	Decision
1.	Teachers possess electrical installation and maintenance work practical, skills.	3.05	Agreed
2.	The teachers teaching electrical installation and maintenance know various method of teaching.	3.08	Agreed
3.	Electrical installation and maintenance teachers master the subject.	2.58	Agreed
4.	The teachers teaching electrical installation and maintenance work demonstrate the' subject practically with the students.	2.33	Disagreed
5.	Electrical/electronics technology teachers are competent to tech electrical installation and maintenance work.	2.91	Agreed
6.	Electrical/electronics technology' teachers evaluate students practically	2.03	Disagreed
7.	The interpersonal relationship between teachers and student is encouraging.	2.33	Disagreed
8.	Electrical/electronics technology' teachers evaluate students practically	2.03	Disagreed

Table 2: indicated that the mean scores of item 8, 9, 10, and 12 agreed and the mean scores of item 11, 13, and. 14 disagreed that the teachers teaching electrical installation and maintenance work demonstrate the subject without practically with the students; electrical/electronic technology teachers always evaluate the students without practical. They also disagreed that the relationship between them and the teachers is encouraging. While the mean scores of item 8, 9,10 and 12 agreed that the teachers have no mastery the subject, and know various method of teaching electrical installation and maintenance subject matter, the teachers teaching electrical installation and maintenance teaches the subject effectively; electrical and electronics technology teachers are not competent toteach electrical installation and maintenance work.

Research Question 3

What are the strategies to be used for improving for student performance of electrical installation and maintenance work in Technical College?

Table 3: The mean responses of data analysis of research question (3) of both teachers and students on strategies for improving the performance the performance of student in electrical installation and maintenance work.

S/No	Items	Mean	Decision
1.	Provision of skilled and experienced teachers of electrical installation and' maintenance work in the school	2.91	Agreed
2.	Adequate provision of workshop -facilities in the school.	3.08	Agreed
3.	Provision. of well trained technicians.	2.34	Disagreed

4.	Provision of adequate library facilities that helps the environment of students examination.	2.33	Disagreed
5.	Enough time should be allocated for electrical installation and maintenance work practical.	3.05	Agreed

Table 3: indicated that the mean scores of items 15,16, 17,18, and 19 agreed that skilled and experienced teachers of electrical installation should be allocated to the school, adequate provision of workshop facilities, equipment will help improve electrical installation and maintenance subject in the school, and provision of will trained' technician and teachers will help also, enough time should be allocated for practical.

Findings/Discussion .

The study revealed that Teachers Related Factors Responsible for Students performance in Electrical Installation and Maintenance Work in Technical College Malali of Kaduna State, includes teachers do not always take students to workshop during practical period, teachers do not allowed students to participate during process of instruction, Improper use of teaching method, inadequate workshop facilities among others. This is in line with the opinion of Benjamin (2006) who stated that, the finding of teachers related factors in student performance in electrical installation and maintenance work in technical collages include:- teachers do not always take students to workshop during practical period, teachers do not allowed students to participate during process of instruction, improper use of teaching method.

Furthermore the study showed that facilities Related Factors Responsible for Students performance in 'Electrical Installation and Maintenance Work in Technical College Malali in Kaduna state, includes inadequate galvanometer, multimeters, Inadequate qualified teachers, among others. This is according to Bukar (2009) who stated that, the finding is in line with facilities related factors responsible for students' performance in electrical installation and maintenance work. There are un-qualified teachers, teaching electrical installation and maintenance work in technical college Malali in Kaduna State.

Finally, the study revealed that the strategies for improving Students performance in Electrical Installation and Maintenance Work Technical College Malali of Kaduna State, includes Workshop should be well equipped with tools and material for students use. Teachers need more training both practically and theoretically to enables the teachers to install and maintain electrical installation, Opportunity for training and retraining of teachers should be provided among others. This is according to the findings of Ali (2004) who found that strategies for improving studentperformance in electrical installation and maintenance work in technical college Malali of Kaduna state,include: - workshop should be well equipped with tool and materials for students use, teachers need more training both practical and theory to enable the teachers to installed and maintained electrical installation, opportunity for training and retraining of teachers should be provided.

Conclusion

In conclusion, in order to improve the performance of students in electrical installation and maintenance work in Kaduna state, the government, teachers and students should work together collectively for the betterment of Kaduna state. From the result of the data analyzed, interpreted and discussed, some important implications of them have been revealed. Study conducted by expert notably (Fafunwa 1974) have

suggested very important ways in which the government and the teachers must communicate to bring about the revolution. Government and the teachers must set up advisory committees to bring about desired performances. This action on the part of the two agents could only be achieved if there is a forum "where government and teachers could express their feelings to bring about the revolution. Although there are many strategies that facilitate effective performance, the implementation is that there must be alot of planning and supervision on the part of the policy makers. Government in term of finance, curriculum, location of schools and constitution of the committee members.

Recommendation

The following suggestions were offered as a stepping stone towards improving students' performance:

1. Government should provide qualified and well trained teachers to technical collages.
2. Adequate fund should be provided for the provision of workshop facilities and equipment
3. Provision of strategies that will help improve teaching and learning in technical college Malali kaduna
4. Government should set up advisory committee to bring about desired performances which could be achieved through forum where teachers and students could express their feelings to bring about revolution.
5. Proper planning and adequate supervision should be made from the part of the policy makers for effective implementation.

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Relationship between Interest, Motivation and Chemistry Performance among Secondary Schools Students in Edu/Patigi Educational Zone of Kwara State

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Abstract
The need to identify and encourage factors that bring about meaningful learning at all level of education is in the forefront of academic discourse. Therefore, this study investigated the relationship between Interest, Motivation and Chemistry Performance among Secondary Schools Students in Edu/Patigi Educational Zone of Kwara State. Correlation survey design was adopted for this study. The population include allthe Chemistry students of Kwara state-owned secondary school students in Edu/Patigi Educational Zone while the sample size for this study were three hundred (300) chemistry students' (180 male and 120 female). A simple random sampling technique was used to select six (6) schools from the zone. The research instruments used for this study were questionnaires titled Interest Inventory in Chemistry (INIC) and Motivation Inventory in Chemistry (MIC) which were developed by the researcher and subjected to face validity. While the reliability of the (INIC and MIC) was established using Cronbach's Alpha method 0.83and 0.84 was obtained. Linear Regression was used in testing the hypotheses at P<0.05. The result of the study revealed that there was no significant relationship between students' interest and their performance. The strength of the association was negative in this population. There was no significant relationship between students' motivation and their performance, however, the strength of the association was positive in this population. The researchersrecommended that teachers should employ relevant and instructional strategies and materials for teaching and learning. Instructional content should link to real world situation that could motivate and enhance students' meaningful learning of science.

Keyword: Interest, Motivation, Performance and Chemistry.

Introduction
Education is an investment as well as an instrument that can be used to achieve a more rapid economic, social, political, technological, scientific and cultural development in any society or country. It is a total process that involves the acquisition of knowledge, competencies and skills is imparted, faculties trained and skills developed. Science education is becoming more relevant to the economy of the 21st century because its innovations are driven by the knowledge of science. The skills and knowledge of science and chemistry in particular gained are very useful in many areas of people's lives, for example, controlling environmental pollution and production of a variety of drugs. As noted by Twoli (2016), a few areas where chemistry knowledge is important include: Food production and preservation, contribution towards better health, for example production of a variety of drugs, enhancement of life through the production of plastics and synthetic clothes; large scale industries, for example, in production of cosmetics, in detergent industries and petroleum refining plants and career opportunities since it can enable a learner to

pursue a science- based career, for example, in pharmacy, engineering or teaching. Chemistry addresses the needs of majority through its relevance and functionality in content, practice and application.

Enhancing meaningful learning at the secondary school level is critical because secondary schools not only occupy as strategic place in the educational system in Nigeria, but the link between primary and the university levels of education (Alam, 2009). According to Asikhai (2010) education at secondary school level is supposed to be the be rock and the foundation towards higher knowledge in tertiary institutions. It is rather unfortunate that the secondary schools today are not measuring up to the standards expected of them. There have been public out cries one of the most potent barometers so far, if not the strongest, of measuring school performance of students is through public examinations such as Senior School Certificate Examination (S.S.C.E.) in Nigeria. Consequently, there is persistently poor performance of secondary school students in public examinations (Adeyemo2011). According to Nwokocha and Amadike (2015), academic performance of students is they and sticks foresting the educational quality of animation. Ajayi (2012), Nwokocha and Amadike (2015), and Adeyemo (2011) have all shown the extent of poor performance of students in public examinations. The persistent decline in students' performance in public examinations is not only frustrating to the students and the parents, but its effects are also equally grievous on the society. Hence, it is expedient to maintain a high performance in internal and mostly external examinations. Some of the factors responsible for students' underachievement could be teacher factor, student, psychological and social factors among others. For instance, some of the psychological and students' factors that could influence learning could include interest and motivation.

Previous literature indicated that there is relationship between interest and students' performance, but these studies were conducted outside the population of this study. For instance, Ezike (2018), the study investigated classroom environment and students' academic interest as correlates of achievement in Senior Secondary Chemistry. Result showed significant relationships between students' academic interest and achievement in Chemistry. Composite contribution of classroom environment and academic interest was significant. Chakradhara and Arundhathi (2017) observed that interest is a great motivating force that persuades an individual to engage in a cognitive and affective behaviour leading to improved performance

Muratha (2017) accepted that a high achievement in Chemistry can be determined by many factors, some of which can be related to teachers, others to students and also school administration. Some of the factors that are learner related include; learners' cognitive ability, and interest, among others Student's motivation towards science learning makes science learning effective (Sarıbıyık, Altunç ekiç & Yaman, 2014). Similarly, Cavas (2011) reported that student motivation plays a crucial role in science learning which in turn enhance students' achievement. Students' motivation towards science learning has contributed a considerable impact on students' science achievement (Pintrich & Schunk, 2012). Most of these studies were conducted outside the population of this present study.

Statement of the Problem

The factors affecting academic achievement of students in WAEC and NECO in science subjects especially in chemistry has continued to be a major concern to educational authorities in Nigeria

and other education stake holders. Over the years, the majority of students that sat for the May/June West African Examinations Council (WAEC) and National Examination Council (NECO) have been recording mass failure, not only in the area of overall performance of the students, but also in the core subjects like English, Mathematics, Sciences (Biology, Physics, Chemistry).

Attempts have been made by educational stakeholders to find ways of improving students' performance in the subject, some of which have focused on identifying appropriate teaching methodology (Bello, 2011), improving on teachers' mastery of content and provision of instructional materials (Adeyemo, 2011 & Fashiku, 2012). Despite all these efforts, the performance of students in chemistry is still below expectation; it is therefore pertinent to consider other factors that could be responsible for under-performance in the subject. Student factors such as interest and motivation could influence students, performance. A student with positive interest towards chemistry may likely perform significantly better than a student with negative interest. Similarly, students who are motivated to learn may perform better in chemistry than those who are not motivated to learn chemistry. What a learner pays attention to and how effectively they process any information is affected by motivation (Larson, 2012). This study therefore seeks to determine the relationship between students' interest and motivation on secondary school students' performance in chemistry with a view this study could yield important finding that could help to improve meaningful learning.

Objectives of the Study

The aim of this study is to investigate students' interests and motivation as correlates of chemistry performance among secondary school students in Edu/Patigi Educational Zone of Kwara State, Nigeria. Specifically, the study is striving to achieve the following objectives:

1. To examine the relationship between student's interest and their performance in chemistry
2. Explore the relationship between student's motivation and their performance in chemistry

Research Questions

The following research questions were address in this study:

3. Is there any relationship between students' interest and their performance in chemistry?
4. What is the relationship between students' motivation and their performance in chemistry?

Research Hypotheses

The following null hypotheses were formulated and were tested at 0.05 level of significance.

HO_1: There is no significant relationship between students' interest and their performances in chemistry.

HO_2: There is no significant relationship between students' motivation and their performances in chemistry.

Research Methodology

The research design that was adopted for this study is correlation research designs. The choice of correlation design was because it measures a relationship between two variables without the researcher controlling either of the variables. In this study, the relationship between the chemistry students' interest and motivation and their Academic Performance was determined. The total Sample of chemistry students in Edu/Patigi Educational Zone of Kwara State are 1061(658 male students and 403 female students).The sample

size for this study is three hundred (300) chemistry students (180 male and 120 female) which were selected using simple random sampling technique.

The research instrument used for data collection in this study was questionnaire. The questionnaire consists of three sections (sections A, B, and C). Section A was used to collect demographic data of the respondents. Sections B contain statements to express interest which is a 4-point Likert type scale of Highly Interested (HI), Moderately Interested (MI), Interested (I) and Not Interested (NI) with a corresponding weighing of: Highly Interested (HI) = 4, Moderately Interested (MI) =3, Interested (I) =2 and Not Interest (NI) =1. Section C contains statement that express respondents' motivation towards learning chemistry which was a 4-point Likert type scale of Highly Motivated (HM), Moderately Motivated (MM), Motivated (M) and Not Motivated (NM) with a corresponding weighing of 4, 3, 2, and 1, respectively. The Science Students chemistry performance data was collected by the researcher directly from the Science schools. The instrument was validated for face and content validity by two science education specialist and one expert in test and measurement. The instrument was pilot tested and it yielded a reliability of 0.83 and 0.84 reliability coefficient respectively. The questionnaire was administered and the data obtained was analyzed using liner regression and the analysis is presented in the next section.

Results

Research Hypotheses

The following null hypotheses were formulated and were tested at 0.05 level of significance.

HO1: There is no significant relationship between students' interest and their performances in chemistry. To test this formulated hypothesis, linear regression was used and the analysis presented in Table 1a

Table 1a: Linear Regression Model Summary on the relationship between students' interest and their performances in chemistry

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.029[a]	.001	-.003	18.036

a. Predictors: (Constant), Interest

Table 4 shows the regression coefficient for the independent (predictor) variables; Student Interest while the dependent or criterion variable; Student performance. The result shows r (2,298) = .029, r^2 = .001. Indicating that only 1% of the variance in research and academic activities can be explained by students' interest among chemistry students in Edu/Patigi Educational Zone of Kwara State. To determine whether the model was a good predictor, ANOVA result presented in Table 2

Table 2: Regression ANOVA on Students' Interest and Students' Performance

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	79.241	1	79.241	.244	.622[b]
	Residual	96943.439	298	325.314		
	Total	97022.680	299			

a. Dependent Variable: Performance

b. Predictors: (Constant), Interest

Table 2: display ANOVA results, the finding shows that there is no significant difference between the predictors (Students Interest), and the dependent variable (Students performance), $F(2,298) = 0.24$, $p(0.62) > 0.05$. This indicates that the model is not a good predictor of the relationship between respondents' interest and their performance. The regression coefficient is presented in the next Table 3

Table 3: Linear Regression Coefficient between Students' Interest and Students Performance

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	T	Sig.
1	(Constant)	66.071	33.348		1.981	.048
	Interest	-.187	.379	-.029	-.494	.622

a. Dependent Variable: Performance

Table 3 shows the regression coefficient of Students' Interest on Students performance. The result shows students' interest is not a significant predictor of Students performance ($B = -.029$ $t = -.494$, $p(0.62) > 0.05$). The regression coefficient indicates that for any increase in one unit of students' interest will cause an increase in -0.029 units of students' performance (when all other factors are constant) among chemistry students.

Hypotheses Two: There is no significant relationship between students' motivation and their performances in chemistry. To test this formulated hypothesis, linear regression was used, and the analysis presented in Table 4

Table 0 Linear Regression Model Summary on the relationship between students' Motivation and their performances in chemistry

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.002[a]	.000	-.003	18.044

a. Predictors: (Constant), Motivation

Table 4 shows the regression coefficient for the independent (predictor) variables; Student Motivation while the dependent or criterion variable; Student performance. The result shows $r(2,298) = .002$, $r^2 = .000$. Indicating that only 0% of the variance in research and academic activities can be explained by students Motivation among chemistry students in Edu/Patigi Educational Zone of Kwara State. To determine whether the model was a good predictor, ANOVA result presented in Table 5

Table 5 Regression ANOVA on Students' Motivation and Students' Performance

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	.316	1	.316	.001	.975[b]
	Residual	97022.364	298	325.578		
	Total	97022.680	299			

a. Dependent Variable: Performance,

b. Predictors: (Constant), Motivation

Table 5 display ANOVA results, the finding shows that there is no significant difference between the predictors (Students Motivation) and the dependent variable (Students performance), $F(2,298) = 0.001$, $p(0.98) > 0.05$. This indicates that the model is not a good predictor of the relationship between respondents' Students Motivationand Students performance. The regression coefficient is presented in the next Table 6

Table 6 Linear Regression Coefficient between Students' Motivation and Performance

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	T	Sig.
1	(Constant)	50.665	33.529		1.511	.132
	Motivation	-.012	.381	-.002	-.031	.975

a. Dependent Variable: Performance

Table 6 shows the regression coefficient of students' Motivation on Students performance. The result shows students' motivation is not a significant predictor of Students performance (B = -.002 t = -.031, $p(0.98) > 0.05$). The regression coefficient indicates that for any increase in one unit of students' motivation will cause an increase in -0.02 units of students' performance (when all other factors are constant) among chemistry students in Edu/Patigi Educational Zone of Kwara State.

Discussion of Results

The study investigated the relationship between interest, motivation, and chemistry performance among secondary school students in Edu/Patigi Educational Zone of Kwara State. Data was collected and analysed which yielded some findings.

Firstly, the finding shows that there is weak positive relationship (1%) between students' interest and their performance; however, the relationship was not significant between the two variables. This finding concurs with Ezike (2018), the study investigated classroom environment and students' academic interest as correlates of achievement in Senior Secondary Chemistry. Result showed significant relationships between students' academic interest and achievement in Chemistry. Composite contribution of classroom environment and academic interest was significant. Chakradhara and Arundhathi (2017) observed that interest is a great motivating force that persuades an individual to engage in a cognitive and affective behaviour leading to improved performance

Muratha (2017), a high achievement in Chemistry can be determined by many factors, some of which can be related to teachers, others to students and also school administration. Some of the factors that are learner related include; learners' cognitive ability, and interest, among others the finding shows that there was no significant relationship between motivation and students' performance. This result agrees with Sarıbıyık, Altunç ekiç and Yaman, (2014) who reported that Student's motivation towards science learning makes science learning effective and further enhance their achievement in science. Similarly, the finding of the study agrees with Cavas (2011) who reported that student motivation plays a crucial role in science learning which in turn enhance students' achievement. Students' motivation towards science learning has contributed a considerable impact on students' science achievement (Pintrich & Schunk, 2012).

Conclusion

Given the finding of the study, it will be logical to conclude that the interest and motivation of the students in this population to learn science and in particular chemistry did not seem to influence the students' performance in chemistry. This implies that low interest and motivation towards the learning of science will negatively impact students' academic activities.

It is therefore recommended that teachers should employ instructional strategies, materials and should link their studies to real world situation that could motivate and enhance student's meaningful learning of science.

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The Self-Concept of Secondary School Students towards Biology Learning In Minna, Niger State

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Abstract
Classroom instruction is influenced by both internal and external factor; Internal factors consist of psychological factors (self-desire, motivation, and self-concept, among others). External factors consist of environmental factors, such as family, friends, facilities and infrastructure at school. Therefore, this study investigated self-concept of secondary school students towards biology learning in Minna, Niger State. This study adopted descriptive survey design. The population of the study was made up of all SS II Biology students in senior secondary schools across Bosso local government in Niger State. The total population for the study comprises 9,541 Male Students and 8,457 Female Students making a total sum of 17,998 students. A sample size of 376 students was selected randomly from twelve 12 Selected Schools.The results indicated that the respondents in this population have high academic self-concept and high self-concept towards biology learning. The findings further revealed states that there is no significant difference between male and female secondary school students' self-concept towards biology learning. The study recommended that there should be availability of internal and external factor so as to help increase students' self-concept towards their academic performance. Parents, teachers and stakeholders should serve as counselors and guides to improve students' performance and also build their self-esteem.

Keywords: Academic Self-concept, Physical Self-concept, Biology Learning.

Introduction
Learning is one of human efforts to improve his abilities, both intellectually and emotionally and, as well, a complex process to change behavior through exercises, observation, and other learning processes(Rodiah1, et al., 2020). According to Lindholm (2010) learning process is influenced by internal and external factors (Internal factors consist of physiological factors (physical health) and psychological factors (self-desire, motivation, and self-concept). External factors consist of environmental factors, such as family, friend facilities and infrastructure at school (Rodiah1, et al., 2020). Learning environment at school influences students' attitudes towards learning which could impact on their academic achievement (Tanner, 2008 in Byers: 2018). According to Jensen *et al.*, (2019) the main factor which influences a learning process and outcome of science subject is academic self-concept.Jansen, *et al*. (2019) stated that some large-scale studies such as PISA have examined students' self-concepts in general science, while other researchers have developed different steps in the science subdomain. Their findings indicated that students with good self-concepts can distinguish their academic self-concepts in biology, physics or chemistry.According toMagdalena (2015) academic learning is a type of learning that has superior quality features such as autonomy, intrinsic motivation, self-control, self-direction and self-regulation of the activity of students.

Obialor & Osuafor (2019) affirmed that learningis the process of acquiring new or modifyingexisting knowledge, behaviors, skills, value or preference. Obialor et al. (2017) also

stated that whenstudents are successful in biology examination, they will have the feeling of pride that they madesuccess through their own effort and skills.Such little success can even give them sense of achievement and accomplishment. However, students' performance in this subject(biology) at external examination had remained persistently poor (Obialor, et al., 2017). The poor performance of students in biology has been attributed mainly to poor teaching methodadopted by most biology teachers (Okoye, 2014).As a result, there is the need for improvement on teaching strategies to boost biology students' self-concept.

In senior secondary schools across West African countries, students are exposed to various science subjects, one of which is biology.Biology is a branch of science that boosts the development of scientific and technologicalattitudes in students. It is a branch of science that studies life (Ramalingam, 2011). Biology is arequirement for further learning, training, and development for many science-related professionalcourses such as medicine, pharmacy, botany, zoology, agriculture, biotechnology, biomechanics,conservations biology and ecology (Larkum,2011). Similarly, Neteiyin (2012) and Abubakar (2012)observed that biology as a discipline has contributed tremendously to financial, physical andaesthetic benefits of humanity and to nation building. Biology also helps the individual to understandhimself, the environment, appreciate the nature and also control environmental pollution. It exposesman on how to maintain good health through clean water, clean air, good hygiene and sanitation,balanced diet, vaccination against diseases, exercise and adequate rest. Consideringthe importance of biology to humanity, students are expected to manifest high level of achievementin this school subject both at internal and external examination.

Students in senior secondary classes are mostly adolescents and tend to grow as they move from one class to another. So their self-concept increases and thereby rediscovering themselves more and more. Self-concept covers a set of students' attitude, belief, and perception based on their intelligence or performance and skill (Cokley in Khalaila, 2014). According to Mcleod (2013), knowing the self also helps one to build his/her image, ability and uniqueness. Self-concept is a perception every human has about himself. It is an element of personality development which shows what the individual is and how one's fits into the world (Laryea *et al.,* 2014). Therefore, self-concept is seen as an attribute, characteristic, qualities and capabilities of an *individual*. It also includes; deficiencies, limits and values among others that individuals perceive of themselves. Therefore, self-conceptis available data concerning one's identity as perceived by him or her. Laryea *et al.,* (2014) opined that these are set of attitudes that one assigns to oneself or attributes that can be used to describe oneself. An individuals' self-concept is formed through his/her perception, personal experiences and interactions with the environment and other individuals. Self-concept has been reported to influence students' academic achievement in science and mathematics among secondary school students (Klapp, 2018). Self-concept can be categorized into academic self-concept, social self-concept, religious self-concept and physical self -concept.

Self-concept has had a long history within Psychology and Education because it provides a gauge to determine the effects, academic and social functioning on the emotional wellbeing of the individual (DuPaul, 2016). The notion of self-concept was first established by Carl Rogers and Abraham Maslow. Self-concept is multi-faceted, hierarchical, organized and structured, descriptive and evaluative, stable, and yet increasingly situation specific (Bakari & Balarabe,

2013). Isah (2015) alluded that this explanation is consistent with the multidimensional and hierarchical models of self-concept by Arens et al. (2014).

Several studies have examined the relationship between self-concept and academic achievement or performance. Most of thesestudies support the belief that self-concept is a strong facilitator of academic achievement and that a positive or negative changein self-concept tends to produce a commensurate change in academic achievement or performance (Erdogan &Sengu, 2014). For example,research on senior secondary school II students in South-West Nigeria found that studentswith high and positive self-concept perform satisfactorily in Mathematics (Yara 2010 in Shopelu et al., 2021). On this premise, it could be conjectured that studentswho think positively about their mathematics abilities feel highly delighted in solving mathematical problems, act promptly inlearning mathematics, place high value on the benefits accruable to them in having good grades in mathematics and evaluatethemselves as being capable of performing favorably in mathematics, are likely to perform creditably in the subject. Shopelu et al. (2021) investigate and found that when studentscan develop high positive self -concept of themselves, theycould as well perform greatly in Biology.However, the relationship between self-concept and performance in Biology has not been established nor research as most ofthe review work is diverse and contradictory. Thus, the pertinent question relevant in this study is "Does self-concept relate to Biology learning?" Therefore, this study seeks toprovide concise answer to the question raised.

Yara 2010 conducted research on senior secondary school II students in South-West Nigeria and found that students with high and positive self-concept perform satisfactorily in Mathematics.
Clark and Seevers (2003) investigated the relationship between student self- concept, both in a global sense and more specific areas, with achievement scores in reading and mathematics. Student self-concept was assessed with the Piers- Harris Children's

Self-Concept Scale and academic achievement was measured by the Texas Assessment of Academic Skills annual test battery. A significant positive correlation was found between global self- concept and reading achievement and a weaker positive correlation for mathematics achievement.

Awanetal. (2011) made a study on relationship between achievement motivation, self-concept and achievement in English and mathematics at secondary level and found that self-concept has a significant relationship with achievement motivation.

Self-concept questionnaire was adopted from Dr. Raj Kumar to assess their self-concept. The result shows that there was no significant difference between the self-concept of boys and girls & there was no significant difference between the physical, social, temperamental, educational, moral and Intellectual self-concept among the boys and girls adolescent students.

Aim and Objective

This paper aimed at investigating the relationship between self-concept and Biology learning among secondary schoolstudents in Minna, Niger State with focus on the determination of the link between self-concept' perception and Biology learning of secondary school students in Minna.

Research Questions

The following research questions were raised to guide the study;

1. What is the extent of secondary school students' academic self-concept towards biology learning?
2. What is the extent of secondary school students' social self-concept towards biology learning?
3. What is the mean difference between male and female secondary school students' self-concept towards biology learning?

Research Hypotheses

This research hypothesis was formulated and tested at 0.05 significance level

Ho_1: There is no significance difference between male and female secondary school students' self-concept towards biology learning.

Methodology

This study employed a correlational descriptive survey design to investigate self-concept perception as factor that influence Biology learning among secondary school students in Minna, Niger State. This design seeks to clarify phenomena throughcareful data collection and analysis (Creswell, 2015 & Fraenkel & Wallen, 2006).

The population for the study consists of all SS II Biology students in senior secondary schools across Bosso local governmentin Niger State. The total population for the study comprises 9,541 Male Students and 8,457Female Students making a total sumof 17,998 students. A sample size of 376 students was selected randomly from twelve selected schools.

There are Twenty (20) public secondary schools in Bosso local government that have students offering biology. Twelve (12)of the schools were randomly selected from each stratum and a sample size of 376 students was selected randomly fromthese 12 Selected Schools. This is exactly 10% of the twelve (12) selected schools under the study.

A researcher instrument named 'Questionnaire on Self-Concepts' was adapted from previous researchers and modified to suit thepurpose of this research study. The questionnaire QSC is divided into sections (A and B); section A sought demographicinformation from the respondents' gender, age and school location. Section B sought participants' opinions on their academicself-concept and gender differences. The instrument for data collection is a structured 4-point Likert type questionnaire; Strongly Agree (SA), Agree (A) Disagree (D) and Strongly Disagree (SD) with the scale of 4,3,2 and 1 respectively.

To determine whether the research instruments was actually relevant to the constructs to be measured and how related they are tothe set criteria, the construct and criterion validity of the instruments was carried out by science education and psychology expertat Federal University of Technology, Minna and three biology experts from selected secondary schools in Minna. They examined how presentable theresearch instruments were, and its appropriateness, suitability for target population in term of clarity, depth of coverage andlanguage. Vital inputs that were made by all the experts, their suggestions and corrections were affected by the researcher and theresearch instruments were finally found fit for the research.

The reliability of the research instruments was determined after conducting a pilot study on 30 students at Day Secondary schools Limawa Minna and Day Secondary school Gidan Magoro Minna who were among the population, but not part of thesample for the main study was used. The researcher carefully administered the instruments once on the respondents and data obtained were analyzed using Cronbach Alpha. A reliability computation on Academic self-concept showed 0.72 alpha level, and Social self-concept showed 0.71 Cronbach alpha level respectively. Reliability coefficients equal or above 0.70 are considered acceptable (George & Mallery, 2003). The data collected from the sampled students were analyzed using descriptive and inferential statistics. All the research questionswere answered using descriptive statistics of mean and standard deviation. In section B, C and D decision mean of 2.50 was used.The significant difference was ascertained at 0.05 alpha levels. The Statistical Package for Social Science (SPSS) version 23.0was used for the analysis.

Result

Research Question One: What is the mean score of the extent of secondary school students' academic self-concept towards biology learning? To answer this question, mean and standard deviation was used and the analysis presented in Table 1

Table 1: Mean and Standard Deviation of the Extend of Students Academic Self-Concept towards Biology Learning

S/No	Statement	N	Mean	Std. Deviation	Remarks
1	I always have good grades in Biology	240	3.43	.61	High
2	I have no issues with spelling biological /botanical words	240	3.04	.84	High
3	I enjoy studying Biology	240	3.53	.59	High
4	I am good in drawing and labeling Biology diagrams	240	3.00	.94	High
5	I have no problems pronouncing biological words	240	3.24	.73	High
6	Learning Biology enhances my understanding of other science subjects	239	3.16	.73	High
7	I do better in Biology than other subjects	240	3.08	.83	High
8	Biology is relevant to my daily life activities	240	3.23	.76	High
9	Biology is not boring to me at all	240	3.17	.86	High
10	I have interest in Biology	240	3.50	.63	High
	Valid N (listwise)	239	3.24	0.75	

Table1 shows the results of the mean and standard of the extent of secondary school students' academic self-concept towards biology learning. The average mean of 2.50 and above was used as the benchmark for **'High Academic Self-concept'** and the mean of below 2.50 is considered **'low Academic Self-concept**'. Consequently, the table shows that all the items have a mean of 2.50 and above indicating that the respondents in this population have high Academic self-concepttowards biology learning. It is important to highlight that more respondents in this population agreed that they enjoy studying Biology and are interested in studying biology.

The grand mean of 3.24 shows that secondary school students have high self-concept towards the learning of biology in this population. The standard deviation of the respondents' academic self-concept was between 0.59 and 0.94, while the standard deviation grand mean is 0.75. Indicating

that there is no meaningful deviation of respondents' perception from each other and the standard deviation mean of the group.

Research Question Two: What is the extent of secondary school students' social self-concept towards biology learning? To answer this research question, mean and standard deviation was used and the results presented in Table 2

S/No		N	Mean	Std. Deviation	Remarks
1	I find it interesting discussing Biology with my parents	240	3.12	.83	High
2	I make friends easily as an individual	240	3.35	.74	High
3	I am loved by everybody	240	3.38	.69	High
4	I have many friends among my classmates	240	3.46	.71	High
5	I get along easily with those older than me	240	3.21	.74	High
6	It's pleasure to be around friends	240	3.33	.79	High
7	I get along very well with opposite sex	240	2.86	1.01	High
8	I have no problem getting along with my class mates	240	3.41	.63	High
9	I learn better during peer tutoring in school	240	3.33	.68	High
10	I love sharing biology learning content with my classmates	240	3.59	.57	High
	Grand Mean	240	3.30	0.74	

Table 2 shows the results of the mean and standard of the extent of secondary school students' social self-concept towards biology learning. The average mean of 2.50 and above was used as the benchmark for **'High Social Self-concept'** and the mean of below 2.50 is considered **'low SocialSelf-concept**'. Consequently, the table shows that all the items have a mean of 2.50 and above indicating that the respondents in this population have high social self-concept towards biology learning. It is important to highlight that more respondents in this population agreed that they love sharing biology learning content with their classmates.

The grand mean of 3.30 shows that secondary school students have high Social self-concept towards the learning of biology in this population. The standard deviation of the respondents' academic self-concept was between 0.57 and 1.01, while the standard deviation grand mean is 0.74. Indicating that there is no meaningful deviation of respondents' perception from each other and the standard deviation mean of the group.

Research Question Three: What is the mean difference between male and female secondary school students' self-concept towards biology learning? To answer this research question, mean and standard deviation was used and the results is presented in Table 3

Table 3: Mean and Standard Deviation between Male and Female Secondary School Students' Self-Concept Towards Biology Learning

Gender	N	Mean	Std. Deviation	Mean Difference
Male	126	79.98	9.71	1.97
Female	114	81.95	11.05	

Table 3: shows the mean and standard deviation of the male and female secondary school students' self-concept towards biology learning. The male respondents' mean was 79.98, while the female perception of their social self-concept towards learning biology was 81.95. The mean difference between the male and female was 1.97 in favour of the female. An independent t-test was used to determine if the mean difference is significant.

Ho_1: There is no significance difference between male and female secondary school students' self-concept towards biology learning. To test this formulated hypothesis, independent t-test was used and the results presented in Table 4.

Table 4: Relationship between male and female secondary school students' self-concept towards biology learning.

Gender	N	Mean	SD	Df	t-value	p-value
Male	126	79.98	9.71	238	1.40	0.14
Female	114	81.95	11.05			

Table 4 shows there is no significant relationshipbetween the male and female secondary school students' perception of academic self-concepts towards learning biology t(238)=1.40, p=0.14 (p>0.05). This indicated that hypothesis one, which states that there is no significant difference between male and female secondary school students' self-concept towards biology learning, is not rejected. The female students mean (81.95) is not significantly higher than the mean of the male (9.71).

Discussion of Results

The Finding of the study indicated that secondary school students in this population had high academic self-concept towards biology learning. This finding agrees with the results ofErdogan and Sengu(2014) that students with high and positive self-concept perform satisfactorily in Mathematics. It could be conjectured that students who think positively about their mathematics abilities feel highly delighted in solving biology problems, act promptly in learning biology, place high value on the benefits accruable to them in having good grades in biology and evaluate themselves as being capable of performing favorably in biology, are likely to perform creditably in the subject. This is also established in table 1shows that all the items have a mean of 2.50 and above indicating that the respondents in this population have high Academic self-concept towards biology learning. It is important to state that more respondents in this study population agreed that they enjoy studying Biology and are interested in studying biology.

Conclusion

From the findings, it is logical to conclude that self-concept is influencedby academic performance of secondary school students in biology learning in Bosso Local Government area of Niger State.

Recommendations

The study recommendsthat there should be availability of internal and external factor so as to help increase students' self-concept towards their academic performance. Parents, teachers and stakeholders should serve as counselors and guides to improve students' performance and also build their self-esteem.

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Perception and Attitude of Undergraduate Students on E-assessment of Universities in Niger State, Nigeria.

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Abstract
This study investigates the perception and attitude of undergraduate students on e-assessment of universities in Niger State, Nigeria. Descriptive survey research was adopted and undergraduate students of universities in Niger State were employed as research participants. Four research questions and two null hypotheses guided the study and a 20-item questionnaire was used as instrument for data collection. The questionnaire was validated by experts in educational technology. Pilot test was carried out and reliability coefficients of 0.75 and 0.81 were obtained for the two sections of the questionnaire. Data collected from the administration of the research instrument were analyzed using descriptive statistics of Mean and Standard Deviation for research questions and inferential statistics of t-test for research hypotheses. A decision rule was set, in which a mean score of 3.0 and above was considered agreed, while a mean score below 3.0 was considered disagreed. Findings revealed that undergraduate students of universities in Niger state had positive perception on e-assessment with grand mean score of 3.73, also the finding revealed that undergraduate students of universities in Niger state had positive attitude on e-assessment with grand mean score of 3.30. Based on these findings, it was recommended that National University Commission should collaborate with experts in ICT and education to develop 21st-century learners centred applications for assessment with interactive elements to correct challenges and anomalies faced by students with immediate feedback that can further strengthen the use of e-assessment in tertiary institutions.

Keywords: Perception, attitude, undergraduate students, e-assessment, universities

Introduction
Education is one of the most powerful things in life. It allows us to find the meaning behind everything and helps improve lives in a massive way. Education gives us an understanding of the world around us and offers us an opportunity to use that knowledge wisely. Irrespective of race, creed, and gender, education makes it possible for people to stand out as equal with all the other persons from different walks of life. According to Halili (2019), education is the process of facilitating learning, or the acquisition of knowledge, skills, values, morals, beliefs, and habits. Educational methods include teaching, training, storytelling, and discussion-directed research (Saurombe*et al.*, 2017).

Education frequently takes place under the guidance of educators; however, learners can also educate themselves (Shulga*et al.*, 2019). Education can take place in formal or informal settings and any experience that has a formative effect on the way one thinks, feels, or acts may be considered educational (Diamond *et al.*, 2016). In this 21st Century, Preschool or kindergarten, primary school, secondary school, and ultimately higher education are the most typical phases of

formal education and most of these educational settings use information communication technology to impart knowledge (Tan & Koh, 2014). Almost all higher institutions today are Information Communication Technology (ICT) inclined; this is base on the importance of ICT in the academic world (Ohei*et al*., 2019). The importance of information and communication technology (ICT) in the field of education has proved its worth round the globe (Akbar &Qureshi, 2015). The outcome of this realization resulted into an increased number of computers and networking in educational institutes (Tümen, 2016). In addition, a number of researchers have claimed that the place it has gained today will remain on an increase in the future (Gao, 2021).

Today, information and communication technologies expand further to encompass computers and computer-related products, email, multimedia messaging service (MMS), and other forms of communication (Larkin et al., 2012).It is similar to Information Technology (IT) but focuses primarily on communication technologies (Mandal &Jirli, 2016). This includes the internet, wireless networks, cell phones and other communication media. The use of communication media will be effective through the use of scientific, technological and engineering discipline and management technique. According to Nitchot*et al*. (2021), ICT include the use of the following techniques such as scientific, technological and engineering discipline and management which effectively helps in handling information, its application and association with social, economic and cultural matters. Socially, ICT aims to empower students who are unable to assess technological gadget outside the school premises by ensuring sufficient access to those students, also equip learners with the appropriate social skills required to work together with fellow ICT learners for a productive learning experience (Ratheeswari, 2018). Economically, application of ICT to learning have the power to improve skills that will motivate and engage students, to enable them relate learning to entrepreneurship, thereby providing self-employment for tomorrow's workers, while strengthening teaching techniques in a cultural setting (Ukpe, 2013). Culturally, it's objectives is to assist students to appreciate the beauty of culture, foster global citizenship through world wide networks that make it possible for people to take diverse classes through the use of ICT (Musa *et al*., 2018).

Information and communication technologies are influencing all aspects of life. The influences are felt more and more at schools, because ICTs provide both students and teachers with more opportunities in adapting learning, teaching to individual needs, and also helps to determine the primary aim and objectives of knowledge impacted as stated in the curriculum (Eze *et al*., 2018). Society is forcing schools respond to this technical innovation. Ratheeswari (2018) states the potentials of ICTs in increasing access and improving relevance, quality and means of assessment of education in developing countries.

According to Huda *et al*. (2015), assessment which could also mean evaluation, plays a major role in student learning. There are many new approaches to assessment with an emphasis on the process of learning along with the product of learning. del Mar Sánchez-Vera and Prendes-Espinosa (2015) says advancement in information and communication technology has thrown open numerous possibilities for assessing student learning and providing feedback. Assessment can be classified into various types or approaches based on the purpose, they include: formative; summative; diagnostic; and authentic assessment. Formative assessment which provides feedback and information during the instructional process while learning is taking place. Summative assessment takes place after the learning has been completed and provides information and feedback that sums

up the teaching and learning process. Diagnostic assessment helps you identify your students' current knowledge of a subject, their skill sets and capabilities, and to clarify misconceptions before teaching takes place. Authentic assessment describes the multiple forms of assessment that reflect student learning, achievement, motivation, and attitudes on instructionally relevant classroom activities. It emphasizes what students know, rather than what they do not know or requires students to develop responses instead of selecting them from predetermined options. An authentic assessment usually includes a task for students to perform and a rubric by which their performance on the task will be evaluated. Performance assessment is one which requires students to demonstrate that they have mastered specific skills and competencies by performing or producing something. Assessment in this century has gone beyond pen and paper to electronic assessment which is thriving in many higher institutions today (Okada *et al.,* 2019).

Farzin and Dahlan (2016), says e-assessment in its broadest sense, is the use of information technology for any assessment-related activity. This definition embraces a wide range of student activity ranging from the use of a word processor to on-screen testing. Due to its obvious similarity to e-learning, the term e-assessment is becoming widely used as a generic term to describe the use of computers within the assessment process. E-assessment can be used to assess cognitive and practical abilities. Cognitive abilities are assessed using e-testing software; practical abilities are assessed using e-portfolios or simulation software. An e-testing system comprises two components: an assessment engine and an item bank. E-assessment is becoming widely used. It has many advantages over traditional (paper-based) assessment some of which are: lower long-term costs, instant feedback to students, greater flexibility with respect to location and timing, and improved reliability (machine marking is much more reliable than human marking). Some of the disadvantages are: they are expensive to establish and not suitable for every type of assessment (such as extended response questions). Presently, almost all tertiary institutions in Niger State use e-assessment to evaluate students (Osuji, 2021). Higher institutions in Niger State using e-assessment comprises of Federal University of Technology Minna, Ibrahim Badamasi Babangida University Lapai, and College of Education Minna. Students in these schools are from different socio-economic backgrounds which also affect students' perception and attitudes towards e-assessment (Umar & Wilson, 2019).

Perception refers to the way sensory information is organized, interpreted, and consciously experienced (Abbasi *et al*., 2020). Perception is made of the buttom-up and top-down processing. Bottom-up processing estimate the perceptions are built from sensory input. On the other hand, top-down processing is the interpretation of those sensations which is affected by available knowledge, experience, and thoughts that tells the nature of stimuli (Oderinu & Adegbulugbe, 2020). Stimuli are any units of inputs from objects that are perceived by any one of the five senses-vision, sound, touch, taste and smell (Amaya et al., 2019). These five senses are unique to each individual depending on the quality of human's sensory receptors (for instance, eyesight or hearing) and the intensity of the stimuli to which one is exposed. Perception consists of three elements which are exposure, attention and interpretation. It begins with receiving information from outside, selecting information, organizing information and end with interpreting the information (Olalla-Soler, 2019). The information received, include diverse amount of variables that affect or expose the students (for instance, the nature of e-assessment, its operation and so on). Furthermore, students will perceive information differently in accordance with their needs, expectations and past experiences. Also, this perceptual step is facilitated by schema which is the

set of knowledge and beliefs held by various students. This schema provides a filtering procedure for a student who concentrates on only a small amount of the original stimuli. In addition, students then organize information in physical configuration which is now interpreted into a logical picture. Finally,after the conclusion of the selection and organization process, student interprets the chosen stimuli. This process is unique to student because it serves as a basis of expectation and previous experiences. The continuous existence of these variables determines the perception of individual student and this process is part of the source of students' attitude.

According to Adewole-Odeshi (2014), attitude is an inner psychic state influencing behaviour. Inner state of a student can be understood from his/her actions and words. For instance, one may presume that a student actively avoiding a computer has a negative attitude towards it. Attitude is not an inborn, instinct phenomenon; it mainly depends upon a student's experience and its impact in a new situation (Unger &Meiran, 2020). Consequently, attitudes are formed in the process of experience and their change is possible due to the internal and external factors. In other words, attitude towards e-assessment in this study is the ways of thinking and feelings of undergraduate students towards conducting or taking computer-based test. This attitude is enforcing the actualisation of using ICT in education and most especially in assessing the ability of students in any examination is the ballpoint fulcrum (Falode & Ayodele, 2019).Thus, for a successful implementation of Nigerian curriculum for Senior School Certificate Examination, it is extremely important for the school administrators to have the knowledge, skills, attitudes and values that the curriculum for Senior School Certificate Examination requires.
In simple term, an attitude is the way a student one think, feel and act toward some aspect of the environment (e-assessment) as well as a complex mental concept of motivational, emotional, perceptual and cognitive processes to evaluate an object of thought and response in certain ways (Petty *et al.*, 2014). The attitude can be anything that students discriminate and hold in mind and thereby express in either positive or negative way (Huda *et al.*, 2017). Student's lifestyle is dramatically influenced by attitudes which are consisted of three elements: cognitive (beliefs), affective (feelings) and behavioral (response tendencies) which may be determined by their gender (Hansmann*et al.*, 2020).

Gender refers to the social attributes and opportunities associated with being male and female, the relationships between women and men and girls and boys, and the relations between women and between men (Clark & Horton, 2019). These attributes, opportunities and relationships are socially constructed and learned through the socialization processes. Gender is not based on sex, or the biological differences between men and women. Gender is shaped by culture, social relations, and natural environments like higher institution (Hyde *et al*., 2019). Thus, men and women in various parts of the world have established diverse gender roles on beliefs, conventions, customs, and laws; these gender stereotypes were protected and instilled in the lives of students by tertiary institution (Sam *et al.*, 2019). Tertiary institution is post-secondary education. Tertiary education, according to Aboagye *et al.* (2016), is an institution of higher learning that trains certain subjects in higher learning capacity. Nigeria's desire for higher education is channeled through high-level personnel education, self sufficiency, national applicability, and international knowledge. In order to achieve this goal, the Federal Republic of Nigeria (FRN, 2013) divided higher education institutions into phases, which included Universities, Polytechnics, Monotechnics, and colleges of education, among others (Falode*et al.*, 2018). These higher institutions have being given the obligation to equip students. One of the ways through which equipping of students is effective is through

consistent evaluation. Universities have now adopted e-assessment to check the progress of their student's perception, attitude and satisfaction even to the mode of assessment. The perception and attitude expression of male and female students might probably not be the same because it is possible to have a high or low response base on learner's gender of e-assessment (Moskowitz & Dewaele, 2021). Hence, this study investigates perception and attitude of undergraduate students on e-assessment of universities in Niger State, Nigeria.

Research Questions

The following research questions were raised to guide the Study:

1. What is the perception of undergraduate students on e-assessment in Universities in Niger State?
2. Are undergraduate students having positive attitude towards e-assessment in Universities in Niger State?
3. How does gender affect the perception of undergraduate students towards e-assessment in Universities in Niger State?
4. Does gender affect undergraduate students' attitude towards e-assessment in Universities in Niger State?

Research Hypotheses

The following null hypotheses were tested in the study:

1. There is no significant difference between male and female undergraduate students' perception level of e-assessment in Universities in Niger State.
2. There is no significant difference between male and female undergraduate students' attitude in e-assessment in Universities in Niger State.

Methodology

Descriptive survey design was adopted for this study will be a descriptive survey design. The methodology involved the use of questionnaire to elicit needed responses from undergraduate students on their perception and attitude on e-assessment.

Participants

The population of the study comprises of the entire 35,679 students of 2019/2020 academic session in universities in Niger State. Multi-stage sampling technique was employed in this study. Purposive sampling procedure was used to select the faculty/school of Education. This is because, education students could only be found in the faculty/school of education. Thereafter, proportionate stratified sampling was used to select an even percentage of thestudents across the departments in faculty/school of Education. After this, purposive sampling procedure was used to select 200level students in the selected institutions because students at this level have fresh experience of e-assessment, and are thus already familiar with the concept of e-assessment. Thereafter, simple random sampling technique was used to select the 380 respondents using the Krejcie and Morgam (1970) table for determining sample size as a guide.

Instrumentation

A researcher-designed questionnaire named "Questionnaire on undergraduate students' perception and attitude on e-assessment (QUSPAE)'' was used for data collection. The questionnaire was divided into three sections; section A, consists of demographic information about the respondents.

Section B consists of statements to assess perception of undergraduate students on e-assessment while section C consist of statement to assess attitude of undergraduate students on e-assessment using the 5-point Likert scale. A mean score above 3.0 will be adjudged as Agreed, while a mean score below 3.0 will be adjudged Disagreed. The questionnaire was validated by two educational technology experts. To determine the internal consistency of the instrument, a pilot test was carried out on 20 respondents within the study population but outside the selected study sample. The instrument was administered once and the scores obtained were computed using Cronbach Alpha's formula. Reliability co-efficient of 0.75, and 0.81 were obtained, hence, the questionnaire was considered as having high reliability and therefore suitable for data collection.

Data Collection and Analysis

A researchers-developed questionnaire was used for data collection. The questionnaire consists of three sections (Sections A, B, & C). Section A was used to collect the respondents' demography while Section B and C consists of 10 items each on perception of undergraduate students on e-assessment while section C consist of statement to assess attitude of undergraduate students on e-assessment.

The data collected was analyzed using descriptive and inferential statistics. Mean and Standard Deviation will be used to answer the research questions. A Mean score of 3.0 and above was considered as Agreement to the items while a mean score below 3.0 was considered as Disagreement to the items. For hypotheses testing, independent t-test was used to determine whether significant difference exists between the mean scores of the two groups.

Results

The responses of the entire 380 participants were used to provide answers to research question one and two. For the purpose of comparing the responses of participants based on gender, research questions three and four were hypothesized. Thereafter, the responses of 229 male and 151 female respondents who participated in the study were collated and analyzed for testing hypotheses one and two. Descriptive statistics of Mean and Standard Deviation were used to answer the research questions as presented in Tables 1 and 2, while t-test were used to test the hypotheses as presented in Tables 3 and 4.

Table 1 helps to provide answers to the first research question. The results of data illustrate that the mean score for items 1 to 10 ranged between 3.30 and 4.30 and were therefore agreed by the respondents.

Table 1: Mean Response of Undergraduate Students' Perception on E-assessment

No	Items	N	x□	S.D	Decision
1	E-exam is an effective method for assessing one's amount of knowledge.	380	3.80	1.47	Agree
2	Online assessment gives me immediate feedback about my performance.	380	4.30	1.06	Agree
3	Online assessment provides faculty with feedback to improve learning.	380	3.50	1.43	Agree
4	Online assessment provides a unbiased grading.	380	3.60	1.40	Agree

5	Online assessment helps in improving the quality of assessment in higher education.	380	3.95	1.25	Agree
6	Online assessment enhances self-learning.	380	3.85	1.06	Agree
7	Online assessment reduces exam stress.	380	3.30	1.38	Agree
8	Online assessment improves my technical skills.	380	3.70	1.42	Agree
9	I prefer online assessment rather than the traditional one	380	3.45	1.29	Agree
10	Online assessment is appropriate for all subjects.	380	3.85	1.43	Agree
	Grand Mean		**3.73**		**Agree**

Decision Mean = 3.0

Table 1 shows the Mean and Standard Deviation of perception of undergraduate students on e-assessment. The table reveals the computed mean score of 3.80 with Standard Deviation of 1.47 for item one, 4.30 with Standard Deviation of 1.06 for item two, 3.50 with Standard Deviation of 1.43 for item three, 3.60 with Standard Deviation of 1.40 for item four, 3.95 with Standard Deviation of 1.25 for item five, 3.85 with Standard Deviation of 1.06 for item six, 3.30 with Standard Deviation of 1.38 for item seven, 3.70 with Standard Deviation of 1.42 for item eight, 3.45 with Standard Deviation of 1.29 for item nine, and 3.85 with Standard Deviation of 1.43 for item ten. The table revealed further that, the grand mean score of responses to the ten items was 3.73 which was greater than the decision mean score of 3.0. This implies that undergraduate students of universities in Niger state had positive perception towards e-assessment.

Table 2 helps to provide answers to the second research question. The results of data illustrate that the mean score for items 1 to 10 ranged between 2.35 and 4.10 and were therefore agreed by the respondents.

Table 2: Mean Response of Undergraduate Students' Attitude on E-assessment

No	**Items**	N	x□	S.D	Decision
1	E-exam is suitable for assessing students at any course	380	2.35	1.49	Disagree
2	E-exam serves as an accurate and reliable assessment method	380	4.10	1.26	Agree
3	E-exam enables help to identify the problems and weaknesses that students suffer from.	380	2.60	1.47	Disagree
4	E-exam serves as a flexible assessment method	380	2.70	1.55	Disagree
5	E-exam improves the quality of the teaching-learning process	380	3.05	1.57	Agree
6	E-exam enables educational institutions to save cost	380	3.85	1.06	Agree
7	E-exam makes me feel less stressed than paper-based exam.	380	3.30	1.38	Agree

8	E-exam enables me to show a better academic achievement.	380	3.70	1.42	Agree
9	E-exam is an effective method for assessing one's skills	380	3.45	1.29	Agree
10	E-exam is an effective method for assessing one's amount of knowledge	380	3.85	1.43	Agree
	Grand Mean		**3.30**		**Agree**

Decision Mean = 3.0

Table 2 shows the Mean and Standard Deviation of undergraduate students' attitude on e-assessment. The table shows the calculated mean score of 2.35 with Standard Deviation of 1.49 for item one, mean of 4.10 with Standard Deviation of 1.26 for item two, mean of 2.60 with Standard Deviation of 1.47 for item three, mean of 2.70 with Standard Deviation of 1.55 for item four, mean of 3.05 with Standard Deviation of 1.57 for item five, mean of 3.85 with Standard Deviation of 1.06 for item six, mean of 3.30 with Standard Deviation of 1.38 for item seven, mean of 3.70 with Standard Deviation of 1.42 for item eight, mean of 3.45 with Standard Deviation of 1.29 for item nine and mean of 3.85 with Standard Deviation of 1.43 for item ten. The table reveals further that, the grand mean score of responses to the 10 items is 3.30 which was greater than the decision mean score of 3.0. This implies that undergraduate students of universities in Niger state had positive attitude towards e-assessment.

Table 3: t-test analysis of cumulative mean responses of male and female undergraduate students' perception on e-assessment in Niger State

Group	N	Df	x□	SD	t-value	p-value
Male	229		37.29	4.15		
		378			0.068^{ns}	0.945
Female	151		37.32	4.11		

Not Significant at 0.05 Alpha level

Table 3 shows the t-test analyses of mean response of male and female undergraduate students' perception on e-assessment in Niger State. The result indicated the mean score of the male and female are 37.29 and 37.32 respectively. The t-value of 0.068 was not significant at 0.05 alpha level, and the p-value of 0.945 is greater than 0.05. Therefore, hypothesis one was accepted. This indicates that there is no significant difference between male and female undergraduate students' perception on e-assessment in Niger State. This implies that both male and female undergraduate students' had positive perception on e-assessment.

Table 4: t-test analysis of cumulative mean responses of male and female undergraduate students' attitude on e-assessment in Niger State

Group	N	Df	x□	SD	t-value	p-value
Male	229		32.95	4.42		
		378			0.011^{ns}	0.991
Female	151		32.95	4.34		

Significant at 0.05 Alpha level

Table 4 shows the t-test analyses of mean response of male and female undergraduate students' attitude on e-assessment in Niger State. The result indicated that the mean score of the male and

female are 32.95 and 32.95 respectively. The t-value of 0.011 was significant at 0.05 alpha level, and the p-value of 0.991 is greater than 0.05.Therefore, hypothesis two was accepted. This indicates that there is no significant difference between male and female undergraduate students' attitude on e-assessment in Niger State. This implies that both male and female undergraduate students' had positive perception on e-assessment.

Discussion and Conclusion

The findings of this study revealed that undergraduate students had positive perception on e-assessment in Universities in Niger State. This agrees with the findings of Bandele *et al.* (2015), who reported that the undergraduates favoured the use of e-exams in the university. It also agrees with the Cigdem and Oncu (2015) study which revealed that perceived usefulness had great influence on behavioral intention – substantiating the TAM literature. Similarly, Ranganath*et al.* (2017) study revealed that most students preferred MCQs based E-assessment. In addition, the findings of Afacan*et al.* (2020) revealed that Turkisk learners found online exams less stressful and more reliable and fairer than traditional paper-based exams when compared with their Kyrgyz counterparts. The findings of this study disagree with that of Bichi*et al.* (2018) revealed that students perceived 13 topics (65%) difficult to comprehend. Similarly, study by Khalil *et al.* (2020) highlighted that students did not comprehend the need for online assessments.

Finding emanating from this study also revealed that male and female students had positive perception of e-assessment in Universities in Niger State. This finding agrees with the findings of Afacan*et al.* (2020) revealed that the quantitative analysis, learners' perceptions differed according to gender, major, and prior online course experience variables. Likewise, Bichi*et al.* (2018) showed that students' gender had a significant influence on their perception of difficult topics in mathematics [t (198) =2.34, P =0.020, α = .05] and the nature of students' schools had no significant influence on their perception of difficulty in mathematics [t (198) = -.444, p = 0.657, α = .05].

Findings emanating from this study also revealed that undergraduate students had positive attitude towards e-assessment in Universities in Niger State. This finding agrees with the finding of Tella and Bashorun (2012) study which revealed that the students have positive attitude towards computer based test. Similarly, Dammas (2016) study revealed that the majority of respondents have positive attitude towards CBT, (83.7 %) of students said they were competent with the use of computer due to their prior experience.

Recommendations

Based on the findings that emanated from this study, the following recommendation were made:

1. E-assessment could be used to reduce the gender gap that exists in the use of ICT tools. Therefore, male and female students should be properly enlightened on the use of e-assessment to enhance their academic performance.
2. Male and female could perform equally well if enabling environment with adequate infrastructure are provided, therefore, university management should provide conducive and enabling environment to both male and female students for them to effectively use e-assessment.
3. Students had positive perception, attitude and are satisfied with e-assessment, therefore, higher institutions should organise orientation programmes, seminars where psychological and ICT

experts will make aware of the opportunities that e-assessment can provide in improving their performance.

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Prior Knowledge of Students in Mathematics as A Predictor of Academic Achievement in Physics Among Senior Secondary School Students in Abaji, FCT, Abuja

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Abstract

The study examined the prior knowledge of students in mathematics as a predictor of academic achievement in Physics in senior secondary schools in Abaji Area Council, Abuja. Data was collected from one hundred (100) students (male and female) from public secondary schools in Abaji Area council. The instrument for the study was self-structured questionnaire to collect data from them. A test-retest method was employed to ascertain the reliability of the instrument, using Pearson product moment correlation. Three research questions and hypotheses were used for the study. They were analyzed using Pearson product moment correlation. The study concluded that: there was significant relationship between students' background knowledge of mathematics and their academic achievement in Physics in Abaji senior secondary schools and that there was significant relationship between students' attitude towards mathematics and their academic achievement in Physics. Therefore, the following recommendations were made: all science students should be encouraged to offer mathematics as this will enhance their performance in Physics. Teachers of mathematics should teach the subject very well so that students will understand and apply the knowledge in other areas.

Introduction

A complete understanding of the concepts in physics requires fluency in the mathematical language in which these concepts are couched. However, many introductory, algebra-based physics students perform poorly on mathematical problem-solving tasks in physics. Physics as one of the physical science subjects plays an important role in the technological development and industrial revolution of any nation. The knowledge of scientific skill in physics is of tremendous use in solving diverse problems of humanity and providing solution to natural and artificial problems in the world at large. According to Esiobu (2015), Science, Technology and Mathematics (STM) education play a dominant role in the developmental effort of nations.

Science and technology are seen as the foundation of national power and productivity. Technological advancement seems to be the gateway to present day economic growth, social well-being, political power and military superiority. It means that the knowledge of physics contributes to the cognitive reservoir that facilitates the sustenance and advancement of technologically oriented society. Physics links the principle learnt and the phenomena observed in the classroom to applications in engineering and allied fields.

The importance of physics cuts across human endeavor such as medicine, pharmacy, agriculture, petroleum engineering, geology, engineering, industries and computer. It could be rightly said that every sector of the society now depends on science and technology for proper functioning and mathematics as the creation of human mind (Awofala, 2013) is the universal language used to describe the problems arising in most branches of science and technology.

Mathematics, the creation, representation analysis, interpretation of numbers and symbols affects all aspects of the human environment significantly but at varying degrees. The social, economic, political, geographical, scientific and technological aspects of man's life centre on number. One very important fact is that all other disciplines of numbers- Arithmetic, statistics, accounts etc. are integral parts of mathematics. The earliest civilization of mankind came through mathematical manipulation. The pyramid of Egypt constructed several years ago still remains tourist attraction to date.

The construction of the pyramids involved sound and intelligent mathematical calculation. The marriage of mathematics to the evolution and development of the civilization and overall advancement of human world confirms its importance, owing to its numeral and symbolic nature, it is more married to the scientific and technology facets of our world than to any other aspect. It occurs and reoccurs in physical and natural sciences which are mainly represented by physics and chemistry in our secondary schools.

Based on this circumstance, it is an established fact that mathematics is and remains a dominant contributing factor to the performance of student in physics and chemistry and the control tool of mathematics remains the basic skills underlying all scientific and technological skills. Mathematics is a subject that is related to other science subjects such as physics and chemistry in areas like Number and numeration–fractions, logarithms indices, Algebraic processes – solution of equations, variation, graph, and also in volume and students often perform poorly in the sciences (Jegede, 2012; Mkpananga, 2015).

Although, science has been accepted by many people including students as the bedrock for technological development they still feel that mathematics is not necessary for achieving good performance in science. The reason for this can be attributed to the controversy surrounding the nature of mathematics (Hailikari., 2007) and one question beckoning for answer is under what branch of studies should mathematics be classified? While one school of thought agrees that mathematics is a science another argues that mathematics must be an art.

This later school of thought is based on the fact that mathematics, in its application, is purely an art. On the other hand, students view mathematics as a difficult school subject and so many of them try to avoid it. The physical sciences (Physics, Chemistry and Mathematics) are studied in our secondary schools as separate subjects having little or no direct relationship with one another, even when the same teacher teaches the two or more of these subjects. The lack of coordination, integration and purposeful planning makes students fail to understand the interrelatedness among the various subject fields in mathematics and physics.

Physical sciences are deeply rooted in mathematics, and as such they should not be studied in isolation of mathematics. The poor approach of teachers to the inter-relatedness of these subjects or the total lack of it makes the students believe that mathematics is not necessary for them to perform well in physics. However, mathematics has been accepted as the compulsory pre-requisite for admission into universities.

In addition, poor grounding in mathematics is manifested in their overall performance in physics which over the years have faced a continuous downward trend in Senior Secondary School Certificate Examination results. In spite of all the advantages derived and the recognition given to physics as one of the core science subjects and as a pivot upon which technological and economic development rest, there are wide gaps between curriculum planner intention, the implementers, (physics classroom teachers) and what goes on in the classroom.

This has led to the negative perception of students that physics is a difficult school subject. More often than not the interrelatedness of mathematics and physics is not always emphasized in physics teaching. What students already know about the content is one of the strongest indicators of how well they will learn new information relative to the content. Commonly, researchers and theorists refer to what a person already knows about a topic as "background knowledge."

Numerous studies have confirmed the relationship between background knowledge and student achievement (Nagy., 2007;Dochy., 2009). In this study the reported average correlation between a person's background knowledge of a given topic and the extent to which that person learns new information on that topic in Prior research has attempted to measure the impact of secondary school physics courses on students' success in undergraduate physics (Hart &Cottle, 2003; Alters, 2005). These American studies generally found that students who performed well in secondary school mathematics and physics subjects also did well in undergraduate physics. However, the present study was undertaken to investigate the background of students in mathematics as a predictor of academic achievement in Physics in Abaji senior secondary schools of FCT.

Statement of Problem

The teaching and learning of Physics have standards to be followed by the science teachers if effective learning is to be achieved.

Despite the fact that government has invested a lot on science education, there are some persistent problems in our secondary schools. Students' low success level in Physics as a subject has been a worry for a long time in many countries including Nigeria. Despite stringent measures and strategies employed by the Nigerian government to ensure that educational standards are maintained in secondary schools, students, after passing through all these vigorous teaching and learning strategies, still performs far below expectations. In an attempt to put sound education on ground worldwide, many factors have been mentioned as being responsible for falling standard of physics education. Such factors include; students' attitudes to learning, poor infrastructure, students' background knowledge in mathematics.

All these have been posing a great challenge to students' achievement in various subjects, especially in Physics.

Physics is unpopular and known to be a boring and tough subject among students compared to other pure sciences, biology and chemistry in secondary schools. If this phenomenon is not addressed, students who are neither interested nor motivated to learn this subject will increase and

this will lead to negative attitude and perception towards Physics (Business Coalition for Education Reform (2002). Furthermore, according to Guzel (2004), the decrease in Physics academic achievement is alarming.In schools, teachers have always commented that failure in Physics achievement by some students is due to their poor background knowledge in Mathematics. Shallow of mathematical concept affects internal motivation which in turn affects the academic achievement and students' participation in various subjects, especially in Physics (Visser, 2007).

Physics is not only difficult to be grasped but students also consider finding solutions to any problems related to Physics as complicated (Seth, Fatin, &Marlina, 2007). The relevant question to be asked whether students' background knowledge in mathematics contribute significantly to their achievement in physics in secondary schools. Hence, this research works intends to investigate the background of students in mathematics as a predictor of academic achievement in Physics in Abaji senior secondary schools of FCT.

Aim and Objectives

The general objective of this study is to examine the background knowledge of students in mathematics as a predictor of academic achievement in Physics in Abaji senior secondary schools. The study intends to specifically;

1. Investigate the relationship between male and female students' prior knowledge of mathematics and their academic achievement in Physics.
2. Determine the relationship between students' attitudes towards mathematics and their academic achievement in Physics.
3. Find out the relationship between male and female students' mathematical ability and their degree of readiness to learn physics.

Research Questions

1. What is the relationship between male and female students' prior knowledge of mathematics and their academic achievement in Physics?
2. What is the relationship between students' attitudes towards mathematics and their academic achievement in Physics?
3. What is the relationship between male and female students' mathematical ability and their degree of readiness to learn physics?

Research Hypotheses

The following research hypotheses are formulated to guide the study;

1. There is no significant relationship between male and female students' prior knowledge of mathematics and their academic achievement in Physics.
2. There is no significant relationship between students' attitudes towards mathematics and their academic achievement in Physic.
3. There is no significant relationship between male and female students' mathematical ability and their degree of readiness to learn physics.

Research Method

The study employed a descriptive survey design. A descriptive survey design was used due to the fact that it enables information to be obtained from a representation. The target population of this study consisted of all students in Abaji senior secondary schools.

The sample for the study is made up of one hundred (100) students. Purposive and stratified random sampling technique was used to select twenty-five (25) students each from the four (4) selected senior secondary schools making a total of one hundred (100) students in Abaji. The students were selected from four (4) senior secondary school in Abaji. The schools were:

1. Government science secondary school, Abaji.
2. Government girls secondary school, Abaji
3. Government secondary school Yaba, Abaji
4. Federal government college, Abaji

Questionnaire was used to collect all the relevant data for this study. It was divided into sections: section A and section B. Section A contains personal information of the students while section B, their opinions. The questionnaire was given to project supervisor who went through the items and gave necessary corrections and modifications in ensuring its validity. The reliability of the instrument was established by administering the test on 20 non-includesive students. The split half reliability method was used in which the responses to the instrument after administering were subjected to a split half reliability co-efficient analysis.Correlation was used in analyzing the data collected.

Result

Hypothesis 1: There is no significant relationship between male and female students' background knowledge of mathematics and their academic achievement in Physics.

Table 1: Correlation between male and female responses to students' background knowledge of mathematics and their academic achievement in Physics.

Variable	X	Df	r-cal	r-table	Remark
Male	24.83	198	0.71	0.195	Rejected
Female	24.64				

Not Significant at $P \leq 0.05$

The result from Table 1 indicates that there is significant relationship between male and female students' background knowledge of mathematics and their academic achievement in Physics. This shows that the mean students' background knowledge of mathematics correlate significantly with their academic achievement in Physics.

Therefore, from the analysis above the result correlation coefficient is significant ($P<.05$), the null hypothesis is therefore rejected and concluded that there is significant relationship between students' background knowledge of mathematics and their academic achievement in Physics.

Hypothesis 2: There is no significant relationship between students' attitudes towards mathematics and their academic achievement in Physics.

Table 2: Correlation between students' attitudes towards mathematics and their academic achievement in Physics.

Variable	X	Df	r-cal	r-table	Remarks
Students attitude in mathematics	42.304	198	0.198	0.195	Rejected
Academic achievement in physics	21.066				

Not Significant at $P \leq 0.05$

The result from Table 2 indicate that there is significant relationship between students' attitudes towards mathematics and their academic achievement in Physics in Abaji secondary schools, this is because Pearson correlation coefficient r of 0.195 at 0.05 level of significance is less than the critical value of 0.198.

This shows that students' attitudes towards mathematics correlate significantly with their academic achievement in Physics. Therefore, from the analysis above the result (r) is significant ($P<0.05$), the null hypothesis is therefore rejected and concluded that there is significant relationship between students' attitudes towards mathematics and their academic achievement in Physics.

Hypothesis 3: There is no significant relationship between male and female students' mathematical ability and their degree of readiness to learn physics.

Table 3: Correlation between male and female responses to students' mathematical ability and their degree of readiness to learn physics.

Variable	**X**	**Df**	**r-cal**	**r-table**	**Remarks**
Male	**25.08**	**198**	**0.79**	**0.195**	**Rejected**
Female	**24.02**				

Not Significant at $P \leq 0.05$

The result from table 3 indicates that there is significant relationship between male and female students' mathematical ability and their degree of readiness to learn physics, the means of the male and female are not close.

Therefore, from the analysis above the result correlation coefficient is significant ($P<.05$), the null hypothesis is therefore rejected and concluded that there is significant relationship between male and female students' mathematical ability and their degree of readiness to learn physics.

Discussion of Findings

From the analysis of data, Hypothesis 1 which stated that there is no significant relationship between students' background knowledge of mathematics and their academic achievement in Physics in secondary schools, was rejected. The researcher concluded that there is significant relationship between students' background knowledge of mathematics and their academic achievement in Physics. The result agrees with Odousoro (2000) who affirmed that mathematics has been found to be very important because it is needed for all scientific, technological research and technical training. No doubt, science subjects are inter-related because, a student that is good at one is likely to be good at others.

Similarly, hypothesis 2 which stated that there is no significant relationship between students' attitudes towards mathematics and their academic achievement in Physics in secondary schools, was rejected. This implies that there is significant relationship between students' attitudes towards mathematics and their academic achievement in Physics in Abaji senior secondary schools.

Furthermore, hypothesis 3 which stated that there is no significant relationship between students' mathematical ability and their degree of readiness to learn physics in secondary schools in Abaji was rejected. This implies that there is significant relationship between students' mathematical ability and their degree of readiness to learn physics in senior secondary schools.

With the findings of Adelad, (2011) that the language of physics is mathematics. The educational implication is that mastering of the basic mathematics skills by the physics students is among the most important factors for success in physics in secondary school. Hence, there is the need for coordination between the curricula of physics and mathematics at secondary school level. This will remove the difficulty of application of mathematics in physics.

Summary of the Findings

These hypotheses were formulated and tested using Pearson Product Moment Correlation. A descriptive research design was employed using random sampling to select respondents. Based on the analysis carried out during this research work, there was significant relationship between students' background knowledge of mathematics and their academic achievement in Physics in secondary schools in Abaji.There was significant relationship between students' attitudes towards mathematics and their academic achievement in Physics in Abaji secondary schools.There was significant relationship between students' mathematical ability and their degree of readiness to learn physics in senior secondary schools in Abaji Area Council of FCT, Abuja.

Conclusion

No doubt, offering of Mathematics is an advantage in understanding Physics and other science subjects. Mathematics is the language of science and it unites all the science subject. There is no science subject where, at least, elementary knowledge of mathematics is not required. Therefore, offering mathematics provides Physics students with the opportunities to be exposed to advanced topics in Physics which can enhance performance in biology, chemistry and physics. If the effect of mathematics can be very important at this level, no doubt this knowledge will provide a good

foundation for students in tertiary institution, especially for those who will later study mathematics and engineering. Based on the results of this study, the mathematics skills proved potent at predicting Physics student academic performance in Physics in schools. It can be concluded that students who do well in mathematics are expected to do well in Physics courses.

Recommendations

The following recommendations were made:

1. All Physics students should be encouraged to offer mathematics courses as this will enhance their performance in Physics.
2. Teachers of mathematics should teach the subject effectively so that students will understand and apply the knowledge in other areas.
3. Adequate mathematics Education should be given to the prospective Physics students through collaboration between Mathematics and Physics curricula.
4. Government should invest more into Mathematics and, since physics is the bedrock of technology and without technology a country cannot be said to have advanced.

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Biology Practical Activities as Medium for Improving Academic Achievement of Senior Secondary School Students in Bwari Area Council of Federal Capital Territory

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Abstract
This paper investigated Biology practical activities as medium for improving academic achievements of senior secondary school in Bwari Area Council of Federal Capital Territory. The study adopted pretest posttest non-randomized quasi experimental design. Four research questions and two hypotheses guided the study. One hundred and twenty (120) senior secondary school biology students were sampled from the population of 900 SS II students. Four schools were sampled out of 20 Government Secondary Schools in Bwari Area Council of FCT – Abuja. Instrument for data collection was Biology Achievement Test (BAT) consisting of 21 multiple choice test items was constructed. The instrument was validated by three expert one in measurement and evaluation and two from biology education. The reliability test was done using kurder – Richardson (K – R20) which gave a reliability index of 0.74. The research questions were answered using mean and standard deviation while the hypothesis were tested using t – test. The findings of the study showed that showed that students taught biology using practical activities performed better than their counterparts using conventional method. The result also showed that gender has significant difference on students' performance when taught with practical activities. The researcher therefore recommended that teachers should employed practical activities in teaching biology to enhance students' performance.

Keywords: Biology practical, academic Achievement, Biology students.

Introduction
Science is the bedrock of civilization and development of any nation. Nigeria as one, has made various efforts towards the realization of science, technology and mathematics (STM) educational objectives. Some governmental agencies like Department for International Development (DFID) and academic bodies such as Nigerian Educational Research Development Council (NERDC) and Science Teachers Association of Nigeria (STAN) are working conscientiously to realize the objectives of science education in Nigeria to enable the students acquire scientific literacy. Scientific literacy is the ability of individuals to be well informed and consequently live satisfactorily and conveniently in a techno-scientific culture. This implies an ability to think critically, solve socio-scientific problems and take part in collective decision making and communicate effectively in a socio-techno-science culture (Mbajiorgu, 2014).

Biology as a branch of science is the study of plants and animals. The knowledge of biology as a subject by secondary school students makes them well informed and motivated to assume roles in which the practical and theoretical aspects are used in unraveling some basic problems of life (Ude, 2011). But biology curriculum contains a lot of abstract concepts like photosynthesis, osmoregulation, genetics and osmosis. These causes frequent problems in conceptual instruction in biology lessons. The Chief Examiners' Report of WAEC and NECO 2013, 2014 and 2015 indicate poor performance of students in the sciences, biology inclusive. This calls for urgent

attention if we are to meet up with the challenging and rapidly growing wealth of scientific knowledge and sustainable development goals (SDG).

There is urgent need for innovations in our method of instruction. There should be a renewal of biology curriculum which will base on constructivist learning approach. Constructivism argued that knowledge can be obtained by individuals' active interaction and meaning can be formed based upon their experiences (Ibe, 2012). Students should therefore set up work and observe the concepts in biology lessons on their own through practical activities in the laboratory. Students tend to understand better when they have practical experiences, when they are involved in experiments; they tend to understand better and come to develop interest in biology as a course (Watts 2013).

Sam (2015) asserted that practical activities can be regarded as a strategy that could be adopted to make the task of a teacher (teaching) more real to the students as opposed to abstract or theoretical presentation of facts, principles and concepts of subject matter using varieties of instructional materials/equipment to drive lesson home. The use of practical activities (approach) to the teaching of biology should be compulsory for biology teachers so as to produce students who can acquire the necessary knowledge, skills and scientific competence needed to meet the scientific and technological demands of the society.

Nzewi (2016) and Aina (2018) observed that the laboratory is an indispensable organ of the school if effective teaching and learning of science subjects are to be achieved and laboratory is a room or building or a special period of time equipped and set apart for practical or experimental studies to take place" .Ude and Onah (2017) said, "it is an instructional facility used by the teacher to help students learn about science and how scientists investigate the world around them. It provides learners with opportunities to design and execute investigation, engage in scientific reasoning, manipulate equipment, generate record and analyze data and then discuss results. This implies that science teaching and learning cannot be completely done in a secondary school where there is no equipped laboratory. This is the problem with government schools in rural areas. Practical activities help learners to understand more because the way human nature is, things done by self is difficult to be forgotten because the picture of the incident is always registered in the brain.

According to Ibe (2012), the American Association for the Achievement of Science (AAAS) developed a programmed known as 'Science a Process Approach (SAPA).This programmed was designed to improve children's skills in the process of science. The experimental approach provides the opportunity for students to seek information using experimental procedures. It calls for careful observation and interpretation of data and has the qualities of questioning, investigating and confronting the unknown. It is for the above reasons that the researchers decided to investigate the effect of practical activities on the academic achievement of senior secondary school biology students.

The incorporation of biology practical activities has been identified as the foundation of a good scientific programme which allows students in the school to have experience which are consistent with the goals of scientific literacy. Practical biology constitutes a major part in biology education and not taught properly, the education of students in other sciences might be affected negatively. Hence practical activities are very important for biology education but some obstacles like time,

money, stress and availability of equipment militate against its effective and efficient use in secondary schools in Bwari Area Council of Federal Capital Territory. Students taught biology theoretically without the practical aspect tend to lack scientific inquiry skills and invariably perform poorly in both internal and external examinations

The following research questions guided the study:

1. What is the difference in the mean and standard deviation scores of students taught biology using practical activities and manual (non-practical activities)?
2. What is the difference in the mean and standard deviation of male and female students taught biology using practical activities?

Research Hypotheses

Two null hypotheses tested at 0.05 level of significance guided the study:

H_{O1} There is no significant difference between the mean achievement scores of students taught biology with practical activities and those taught using manual.

H_{02} There is no significant difference between the mean academic achievement scores of boys and girls taught biology using practicals activities.

Research Methodology

The study adopted a quasi-experimental design of non-randomized pretest – posttest, consisting of two schools used for the control group and two schools for experimental group. The population of the study consists of 900 students in 20 public secondary schools in Bwari Area Council of Federal Capital Territory. Purposive random sampling was employed to select 4 schools from Kubwa, Bwari, Mpape and Shere. 30 respondents from each of the selected schools make up a total of 120 respondents. The instrument for data collection was Biology Achievement Test (BAT) developed by the researcher based on the biology topic taught, food tests in food nutrients, selected from SS2 biology curriculum. This instrument was subjected to face and content validation by two experts in science education and measurement and evaluation. The reliability of the instrument BAT was determined using Kuder-Richardson (K-20). A reliability coefficient of 0.74 was obtained. Data was analyzed using mean and standard deviation for the research questions and ANOVA for testing the null hypothesis.

Results

Research Question I: What is the difference in the mean and standard deviation scores of students taught biology using practical activities and manual (non-practical activities)?

Table I: Mean and standard deviation of biology students' scores of students taught biology using practical activities and non-practical activities.

		Pre-test		**Post-test**		
Group	No	X	SD	X	SD	Mean
Experimental Group	60	9.69	2.48	17.20	1.60	7.51
Control	60	9.88	2.05	16.59	1.88	6.71

Group	
Total	120

Table I shows that the pretest and posttest of the experimental group mean score are 9.69 and 17.20; and standard deviation scores of 2.48 and 1.60 respectively. However, the control group has pretest and posttest mean scores of 9.88 and 16.59 with standard deviation scores of 2.05 and 1.88 respectively. The mean gain for the experimental group is 7.51 while that of control group is 6.71 indicating superiority of the experimental group over the control group. This shows that use of practical's as a method of teaching biology help students develop scientific skills for problem solving.

Research Question 2: What is the difference in the mean and standard deviation of male and female students taught biology using practical activities?

Table 2: Mean and standard deviation scores of male and female students taught biology using practical activities.

		Pre-test		Post-test		
Gender	N	X	SD	X	SD	Mean
Male	60	9.13	1.73	14.86	1.55	5.73
Female	60	8.36	2.08	17.18	2.30	8.82
Total	120					

Table 2 shows that the pretest and posttest mean scores of the male are 9.13 and 14.86 with standard deviation of 1.73 and 1.55 respectively. The female has the pretest and posttest mean scores of 8.36and 17.18, and standard deviation of 2.08 and 2.30 respectively. The mean gain for the male is 5.73 while that of the female is 8.82. This shows that female students perform better in practical work than their male counterparts.

Hypothesis One:

Ho_1: There is no significant difference between the mean achievement scores of students taught biology with practical activities and those taught using manual.

Table 3: Analysis of variance (ANOVA) for the mean achievement score of students taught biology with practical activities and those taught using manual.

Source of Variance	Sum of Squares (SS)	Degree of Freedom (DF)	Mean Square	F-Ratio
Between groups	153.60	2	76.8	2.13
Within group	18060.02	120	36.12	
Total	18213.62	198		

Table three showed the ANOVA table for the achievement scores of students taught with practical activities and those taught using manual. The calculated f-ratio is 2.13 and f-critical value for the 2-degree of freedom is 3.00. Since, the f-ratio calculated value (2.13) is less than the f-critical (3.00). Therefore, the null hypothesis of no significant difference between those taught with

practical activities and those taught using manual was not rejected. This meant that the difference among the means of those taught with practical activities and those taught using manual is not statistically significant.

Hypothesis Two:

Ho_2: There is no significant difference between the mean academic achievement scores of male and female students taught biology using practical activities.

Table Four: Analysis of variance (ANOVA) for the mean and academic achievement scores of male and female students taught biology using practical activities.

Source of Variance	Sum of Squares (SS)	Degree of Freedom (DF)	Mean Square	F-Ratio
Between groups	133.50	2	67.08	3.13
Within group	17071.09	120	34.21	
Total	18033.62	198		

The table showed the ANOVA table for the mean academic achievement scores of male and female students taught biology using practical activities. The calculated f-ratio was 3.13 and f-critical value for the 2-degree of freedom was 2.90. Since, the f-ratio calculated (3.13) is higher than f-critical value (2.90). The null hypothesis of no significant difference between the male and female students taught biology using practical activities was rejected. This implied that the difference among the means of those male and female students taught biology using practical activities is statistically significant.

Discussions

Students in the experimental group that is those taught biological concepts using practical activities performed better than the control group (those taught without practical activity method). The active involvement of students in practical activities may have helped in enhancing and facilitating students' academic achievement in biology. The result also revealed that there is great difference between the experimental and control group in development of scientific skills for problem solving. This is in line with National Academy of Sciences (2010) which recommended that practical work was found to achieve higher than the non-practical in biology. The result of the null hypotheses from the ANOVA of the experimental group and control group with t-calculated 5.36 and t-critical 0.361 indicates that there is significant difference between the two groups. This is in line with Kibirige&Tsamago (2013) who recommended the use of practical method in fostering students' acquisition of science process skills.

In gender disparity, the study revealed that girls performed better than boys when taught using practical activities because the t-test used for the null hypothesis testing indicated that there is significant difference between the mean scores of boys and girls; and t-calculated (3.277) greater than t-critical (0.361 at 28 degree of freedom.

Conclusion

The results of the study indicated that significant difference exist between experimental and control group which suggests that students in the experimental group performed better than those taught

without practical activities. It was also found out that female students achieved higher than the male students in biology practical activities.

Recommendations

Science students should be exposed to practical activities to enhance their academic achievement. Teachers should encourage students to develop interest in practical activities by engaging them in practical's and providing instructional materials that will challenge them to be involved actively and collaboratively during practical activities. Biology teachers should also train the science students on the use and proper handling of instructional materials to facilitate the process of transmitting knowledge, ideas and skills in biology practical activities. Government should equip laboratories while principals should provide biology teachers with fund for consumables. They should also sponsor biology teachers for STAN workshops/conferences.

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Gender Issues and STEM Education in 21st Century

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Abstract
The history of genderin education and the workforce has shifted over the past decades. Women have made gains in representation, equitable pay, and recognition through awards, grants, and publications. Despite overall change, differences persist in the fields of science, technology, engineering, and mathematics (STEM). This Viewpoints article on gender issues and STEM offers aprimary perspective by addressing what STEM is, importance of STEM, what gender and gender issues are, gender issues in STEM, causes of gender issues in STEM and how the issues may be solved. This paper also talks and creativity on stem briefly. The moral issues surrounding equal access aside understanding and addressing the complex issues surrounding gender in STEM are important because of the possible benefits to STEM and society that will be realized only when full participation of all capable and qualified individuals is guaranteed. There is also need to integrate creativity into STEM

Keywords: STEM, Gender, and 21st-century

Introduction
Science, Technology, Engineering, and Mathematics (STEM) is a curriculum based on the idea of educating students in four specific disciplines-Science, Technology, Engineering and Mathematics. In an interdisciplinary and applied approach. Rather than teach the four disciplines as separate and discrete subjects, STEM integrates them into a cohesive learning paradigm based on real-world applications.The acronym STEM was created after many strong similarities and connections between science, technology, engineering, and mathematics were acknowledged (Bequette&Bequette, 2012).STEM incorporates professional and technical support occupations in the areas of life and physical sciences, computer science and mathematics, and engineering.STEM education goes beyond school subjects. It gives a skill set that governs the way we think and behave. Merging science, technology, engineering, and mathematics, STEM education helps us to solve the challenges the world faces today. STEM education gives people skills that make them more employable and ready to meet the current labor demand. It encompasses the whole range of experiences and skills. Each STEM component brings a valuable contribution to a well-rounded education. Science gives learners an in-depth understanding of the world around us. It helps them to become better at research and critical thinking. Technology prepares young people to work in an environment full of high-tech innovations. Engineering allows students to enhance problem-solving skills and apply knowledge in new projects. Mathematics enables people to analyze information, eliminate errors, and make conscious decisions when designing solutions. STEM education links these disciplines into a cohesive system.Thus, it prepares professionals who can transform society with innovation and sustainable solutions.

STEM education prepares the world for the future. It is based on teamwork and collaboration of professionals from different disciplines. As a STEM student, you do not need to be an expert in each particular subject. You rather acquire a mindset that enables you to become a part of the

highly qualified workforce, which functions in collaboration. Teamwork brings a significant increase in productivity, work satisfaction, and profitability. There is a high demand for STEM skills in society. STEM education enables people to make informed decisions within the discussed subject areas. Moreover, STEM awareness is necessary for any job as most industries are more or less connected to science and technology: from an essay writing service and college to a paper company. Thus, such education will allow children to grow into active citizens who can speak up in STEM discussions with sound knowledge of the subject.STEM subjects are focused on providing solutions to the concerns society has today. Human history had seen years of thoughtless exhaustion of natural resources. Such a lack of environmental education led to numerous challenges. These issues affect the health and well-being of all living organisms on our planet. Our environment needs protection. Thus, sustainability became one of the most urgent aspects studied by STEM disciplines.

The world we live in is changing, and we must keep pace with it. STEM education changes society by offering learners a new mindset and skills valued in any profession. They allow young people to be flexible, look for patterns, find connections, and evaluate information. Besides, STEM education raises social awareness. It communicates global issues to the general public. Therefore, STEM opportunities move us to a knowledge-based economy and enhanced sustainability literacy. What separates STEM from the traditional science and math education is the blended learning environment and showing students how the scientific method can be applied to everyday life. It teaches students computational thinking and focuses on the real world applications of problem solving. As mentioned before, STEM education begins while students are very young. Much of the STEM curriculum is aimed toward attracting underrepresented populations. Female students, for example, are significantly less likely to pursue a college major or career. Though this is nothing new, the gap is increasing at a significant rate. Male students are also more likely to pursue engineering and technology fields, while female students prefer science fields, like biology, chemistry, and marine biology. Overall, male students are three times more likely to be interested in pursuing a STEM career.

Many current curricula in going beyond traditional goals, increasingly foster creativity in science classrooms, declaring creativity a core skill of the 21st century. For enhancing creativity in science classrooms, the subject Arts is considered to offer a potential way from STEM(science, technology, and engineering, mathematics)to STEAM (STEM with Arts). Creativity can be define as the formation of new and useful ways to solve a problem. (Sternberg & Kaufmann, 2010). Creativity is the use of imaginations or original ideas to create something, similar to inventiveness, imagination, innovation, originality, individuality, artistry, expressiveness, inspiration, vision, resourcefulness, ingenuity, enterprise.Also, creativity is a phenomenon whereby something somehow new and somehow valuable is formed.STEM and creativity, links science and technology subjects with creative processes. This method are meant to encourage students to seek interdisciplinary, creative ways to solve problems, and to support them in seeking innovative ideas and alternative approaches for addressing complex issues.Biology which is the study of life, also need critical thinking to enhance the understanding of the concept and linking it with STEM.STEM provide the skills and competencies required toSupport creativity productivity and expression of the innermost self. It is important because it contribute to the development of the country.Even as STEM subjects and skills are becoming more essential in today's World, gender disparities are prevalent in these fields.

In recent years much work have been done to help inspire girls and women also many organization many have organized skill acquisition and funds are been given out as loans to pay at their convenience and free funds were also given to study and inspire them in STEM and biology fields.It can put major constraint in individual life of women and contribute to transmitting gender in equalities across the generation. From an economic perspective,various studies have been shown that combined and diverse themes in organizations in which women and men introduce new skills attitude and perspectives to the work place are beneficial for innovation and the development of organizations.

Gender Issues

Gender according to World health Organization refers to the characteristics of women, men, girls and boys that are socially constructed. This includes norms, behaviors and roles associated with being a woman, man, girl or boy, as well as relationships with each other.Gender issues include all aspects and concerns related women's and men's lives and situation in society, to the way they interrelated, their differences in access to and use of resources, their activities, and how they react to changes, interventions and policies (Eige2014).Gender issues include Gender inequality and discrimination faced by women and girls. These barriers include restrictions on mobility; lack of access to decision-making power; lower literacy rates; discriminatory attitudes of communities etc.

Gender Issues in Stem

Most researchhave shown that mathematics and science are perceived as male domains, and scientists as predominantly male. Most especially in Nigeria educational system or should I say culture/beliefs that biological sciences is mostly for females.Girls and women remain substantially underrepresented in mathematics, science and technology in schools.Most of the books found around us and in the libraries most of the authors are male, they publish fewer articles, there is extensive yet fragmented, evidence of gender difference suggesting that women are underrepresented in most scientific disciplines and publish fewer articles throughout their carrier and they acquire fewer citation.

Gender difference also exist in STEM disciplines for example more boys go for engineering, medicine, ICT manufacturing industries, etc. while girls go for biology courses, educational courses and Art related courses such as journalism, mass communication, etc.Girls show more interest in STEM at their tender age but once they are married and begin to have kids and other marital issues their interest decreases. Most men have higher interest in STEM and mostly to go further in biology courses. During my undergraduate days at Ahmadu Bello University, zaria most of thedoctors and professors were men.Ladies vacate stem courses mostly at the university level, in secondary schools most of them only offered the subjects because it was made compulsory for them.Elementary school teachers are mostly predominant females, and many are anxious in teaching biology which can lead to lower achievement in biology.

Some of the Causes of Gender Issue in STEM

Gender issues which include Gender inequality are initiated by the following reasons. Some dedicated and committed women according to Francisca (2019) lack confidence in themselves. Also lack of opportunities and encouragement from those around them.Rachel (2020) pointed out a number of reasons for women's and girls' low levels of engagement in STEM,stereotypes within schools and families of boys being better at science and mathematics or more likely to succeed in

STEM-based jobs;perceptions that heavily male-dominated STEM careers are not suitable for women; andcontinued attitudes in some cultures that investing in education is more important for boys than girls. Moreover some of the topics which are difficult in biology are been skipped and some male teachers skip them too.

Difficulty in learning biology

Biology is a subject that is difficult to learn because of its abstract nature. The difficulty affects student achievement. In addition, the difficulty makes students less motivated to learn the subject. As a result, it is hard for them to achieve a good result of their studies.Biology covers some topics that are considered difficult to learn. According to Cimer(2012), there are five topics that are the most difficult, which are: matter cycles, endocrinesystem and hormone, aerobic respiration, cell division, and geneticsfound for the learning difficulty. Cimer (2012) explained that the nature of the topic, teachers'style of teaching, students' learning habit, students' negative feelings and attitudes towards the topics and lack of resources were the main cause of students' concern to study biology. Anyimprovement that is related to learning habit, teaching style and attitude will help students tolearn biology. For example, cell division process consists of two different processes. Therefore,teaching the subject requires appropriate method. The use of supportingmaterials, like model, graph, and video and laboratory activities can be used to overcome thesedifficulties, although it did not necessarily mean that it increased students' creativity.

How to Resolve Gender Issues In Stem

In recent years much work have been done to help inspire girls and women also many organization have organized skill acquisition and funds are been given out as loans to pay at their convenience and free funds were also given to study and inspire them in STEM and biology fields. Also, some of the leaders in Niger state and other states also give their indigenes scholarships and some annual funds which inspires the youth.

More STEM courses facilities should be introduced in our state universities to encourage the ladies to further more in STEM curses. After marriage most women find it hard to return back to school but once they have the STEM at their door step it encourages them and they find it easier. According to Francisca(2019), strategies that could be employed to attract more women in STEM include;Encouraging women in STEM to engage in international and national collaborative scientific research particularly with more advanced countries.Involving female scientists in Nigeria in the development of STEM policies.Encouraging young girls to develop an interest in STEM and empowering women through ICT.Exploring online engagement to strengthen participation and awareness.Sponsoring Ideas to foster creativity in learning biology

Creativity in STEM

Creativity is a highly-desired skill in our world of rapid change and ever-increasing social, emotional, and intellectual demands. Content knowledge is not enough to be successful today; one also needs to determine how to use knowledge in novel and efficient ways.Educators have recognized the value of creativity and, consequently, have included it in the 21st century skills list.The parable that the arts are creative and the sciences are quantitative forms the way we approach education. And that can be a problem because the skills that come with creativity are necessary in STEM (science, technology, engineering, and math) fields too. It's not that we didn't

already value creativity, but understanding it as a core competency in science is a new idea for some of us. Alison (2020).

The acronym STEM was created after many strong similarities and connections between science, technology, engineering, and mathematics were acknowledged (Bequette&Bequette, 2012) and became the base for the interdisciplinary approach to teaching STEM subjects (Kubat&Guray, 2018). Interdisciplinary approaches allow teachers to create learning opportunities that mimic real life situations that are often complex and ill-defined. This pedagogical tactic has been shown to foster creativity in students (Kubat&Guray, 2018; Roberts, 2015). An interdisciplinary approach to teaching STEM subjects also provides students with increased motivation because authentic learning opportunities are meaningful and have a clear purpose to which students can relate. Interdisciplinary projects promote the use of problem finding, problem solving, analysis, synthesis, and other 21st century skills including creativity (Kubat&Guray, 2018)**.**

Based on research on creativity in learning biology, it was found out that there is a needto integrate different finding of research across different subjects (Dunbar, 1997; Lawson, 2001). De Haan (2009) put emphasis on integrating material across subject areas. It wassupported by both Dunbar (1997) and Lawson (2001) that suggested analogy as a way to connectdifferent ideas to enhance creativity among students of biology.

Another suggestion for enhancing creativity was proposed by Mumford (2010) and Dunbar (1997), regarding unexpected finding of a research activity. Those unexpected finding,like any result of experimentthat is different from what was expected, may lead to a newalternative for a certain problem. It will be a new thing that can be useful in certain situation. Itcan be applied in educational setting, as it can help student to find out a solution.

1. Creativity needs to be taught to students, in order to learn biology better. Torrance (1972)pointed out that creativity involves skills, beside motivation. Therefore, the skills have to betaught to students, so the students can think creatively.
2. Images of female mathematicians or scientist shouldbe shown or added throughout classroom materials and assigning individual or group work that summarizes women achievement in this subject and can also shift perceptions about who belongs.
3. We will advise Nigeria to nurture and empower people of all gender to pursue STEM in order to literally make the world a better place. Women who pursue STEM bring unique talent since they love glitters and other enticing things.
4. Secondary school students should be connected to a role model and STEM activities to inspire them.

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What is STEM Education?By Elaine J. Hom February 11, 2014

Assessment of Secondary School Science Teachers Pedagogical and Content Knowledge (TPACK) in Minna Niger State

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Abstract
An assessment of the levels of pedagogical knowledge (PK), content knowledge (CK) and pedagogical content knowledge (PCK) of science teachers in Minna Niger state. The research design is descriptive statistics. The researcher's developed a five-point Likert scale questionnaire which had fifteen constructs each on PK, CK and PCK. All science teachers in Minna form the population. The sample size for the study were two hundred science teachers. The data collected were analyzed using the mean and standard deviation. An average mean of 3.0 was used as the benchmark; teachers who scored below the average mean had low PK, CK and PCK, and teachers who scored above the average mean had high PK, CK and PCK. The results showed that grand means of 3.54 was gotten for PK, 3.50 for CK and 2.50 for PCK indicating that teachers had high PK and CK while the level of their PCK was low. It was recommended that teachers should be given capacity training on pedagogical content knowledge (PCK), among others.

Keywords; *Teachers' Pedagogical and content knowledge, Content Knowledge, Pedagogical Knowledge, and Science teachers.*

Introduction
Teaching any subject is a highly complex cognitive activity in which the teacher must apply knowledge from multiple domains. Teachers with differentiated and integrated knowledge may have a greater ability than those whose knowledge is limited and fragmented. Teaching is a process of delivering knowledge between teachers and students. This process involves planning, implementation, evaluation, and feedbacks (Shahabuddin et al) in Jacob 2020. It requires thorough planning in order to produce effective teaching which will consequently lead to effective learning in the classroom. In any profession, there is a specialized professional knowledge that makes it unique and distinct with striking features entirely different from other professions. One of the characteristics of good teachers is that they possess a substantial amount of specialized knowledge for teachers known as Teachers' pedagogical content knowledge.

TPACK is a structure which aims to define the knowledge that teachers need while they are integrating it in their teaching. With the use of it they deal with the sophisticated and fixed nature of teacher knowledge Koyuncuoglu (2021). Lee Shulman (1986) who proposed the concept of PCK, describes it as teachers' understanding of "the most useful forms of representation of the most powerful analogies, illustrations, examples, explanations, and demonstrations. In a word, the ways of representing and formulating the subject that makes it comprehensible to others. Teachers of a specific subject should possess special understandings and abilities that integrate their knowledge of the subject's content and student learning of this content. This special knowledge, called Pedagogical Content Knowledge (PCK), distinguishes the science knowledge of teachers from that of scientists. Pedagogical content knowledge, defined by Shulman as the special amalgam of content and pedagogy that is uniquely the providence of teachers and their own special

form of professional understanding. Another important idea is that teaching science based on the methods advocated by current reforms is fundamentally different from how most teachers learned science themselves yet research indicates that teachers unfortunately, tend to teach the way they have been taught. The above arguments suggest that preparation of science teachers should be a purposeful intellectual endeavor that needs to be carried out by professionals who possess strong expertise in the content area and can apply it to learning of science and simultaneously have skills and experience in implementing the reformed way of teaching in a classroom.

Pedagogy can be defined as the art of teaching. • Pedagogical knowledge involves being able to convey knowledge and skills in ways that students can understand, remember and apply. • Pedagogical skills can generally be divided into classroom management skills and content-related skills. Pedagogical content knowledge plays an important role in the teaching and learning process because it involves teacher's competences in delivering the conceptual approach, relational understanding and adaptive reasoning of the subject matter (Kathirveloo *et al.,* 2014). Content knowledge is the "knowledge about actual subject matter that is to be learned or taught" (Mishra & Koehler, 2006). Teachers must know about the content they are going to teach and how the nature of knowledge is different for various content areas. Our own content knowledge affects how we interpret the content goals we are expected to reach with our students. It affects the way we hear and respond to our students and their questions. It affects our ability to explain clearly and to ask good questions.

Pedagogical content knowledge is special amalgam of content and pedagogy that is uniquely the province of teachers and their own special form of professional understanding. Key elements in shulmans' conception for PCK are knowledge of representations of the specific content and instructional strategies on the one hand and understanding of learning difficulties and students' conceptions of specific content on the other. Content knowledge is defined as the concepts, principles, relationships, processes, and applications a student should know within a given subject matter. It includes knowledge of concepts, theories, ideas, knowledge of proofs and evidences as well as practices and approaches to develop this knowledge. Pedagogy is knowledge of teaching, instruction and training. It includes the educational purposes, the methods of teaching and learning, knowledge about techniques or methods used in the classroom, the nature of the target audience, and strategies for assessing students' knowledge.

Amidst growing concerns in the education industry regarding the quality of teachers and how it affects the process of teaching and learning. The success or failure in the process of teaching a particular concept lies in the pedagogical approach adopted by the teacher, without which the teaching would appear to the students as abstract. For a teacher to function effectively he/she has to have good skills in communication, collaboration, proper knowledge of classroom management, proper knowledge of subject matter and effective teaching methods (Jacob *et al* 2020). However, there have been a major problem of low PCK among science teachers and how it translates into increasingly sophisticated methods for engaging diverse students in mastering challenging subject content and basic skills, lack of science teachers mastery of content, lack of inept knowledge of the lessons presented to students, science teachers not being able to carry out learning objectives, teachers inability to apply adequate teaching methods to attract students interest, inability of teachers to differentiate cognitive and learning intelligence among students so as to enable them prepare contents that that are not too high for the students to learn in one lesson, inability of

teachers to prepare a proper daily lesson plan in a correct context according to syllabus and to carry out the curriculum in a given time there by leading to students' understanding difficulties in science especially in the aspect of Science. In view of the afore mentioned challenges faced by teachers in teaching and learning, this study aims at assessing Secondary School Teachers Pedagogical and Content Knowledge in Minna, Niger state. This will help in the quest to identify teachers with low PCK and derive possible ways in which they can be improved which will in turn improve the quality of teaching in the state.

Aim and Objectives

The aim of this current study is to Assess Secondary School Science Teachers' pedagogical and content knowledge in Minna Niger State.This aim would be fulfilled through the following specific objectives to:

4. Identify science teachers' level of Pedagogical Knowledge (PK),
5. Determine science teachers' level of Content Knowledge (CK),
6. Examine science teachers' level of Pedagogical and Content Knowledge (PCK).

Research Questions

5. What is the level of science teachers' Pedagogical Knowledge (PK)?
6. What is the level of science teachers' level of Content Knowledge (CK)?
7. What is the level of science teachers' Pedagogical and Content Knowledge (PCK)?

Methodology

This research was conducted by using a descriptive survey research design. The population of the study comprises of all science teachers in the selected public senior secondary schools in Minna, Niger State. The sample size is two (200) hundred science teachers randomly selected from 10 public secondary schools. A researcher developed instrument which consists of five-point Likert-type questionnaire on pedagogical knowledge (PK), content knowledge (CK) and pedagogical and content knowledge (PCK). The questionnaire was validated by two science education experts from Federal University of Technology and College of Education Minna, Niger state. The instrument was pilot tested and yielded the reliability coefficient of 0.76, 0.70 and 0.82 for PK, CK and PCK, respectively. Data collected were analysed using mean and standard deviation.

Results

Research Question one: What is the level of science teachers' Pedagogical Knowledge (PK)? To answer this research question, mean and Standard deviation was used and the analysis presented in Table 1

Table 1 Mean and Standard Deviation of science Teachers' Level of Pedagogical Knowledge (PK)

S/No		N	Mean	Std. Deviation	Remarks
1	Classroom management helps to create and maintain appropriate behaviour of students in classroom settings	200	3.50	1.33	High
2	Classroom management helps to increase stud academic engagement	200	3.47	1.36	High

3	Classroom management helps to enhance social behaviour	200	2.35	1.12	Low
4	Classroom management helps topromote active learning and student involvement.	200	3.47	1.35	High
5	Classroom management helps to identify important student behaviours for success	200	2.43	1.20	Low
6	Classroom management helps in preventing discipline problems.	200	1.40	1.40	Low
7	Classroom management establishes and sustains an orderly environment in the classroom.	200	3.49	1.30	High
8	Classroom management Increases meaningful academic learning and facilitates social and emotional growth among students.	200	3.55	1.32	High
9	Classroom management decreases negative behaviours and increases time spent on academic engagement	200	3.44	1.36	High
10	Chaotic classroom environment contribute to high teacher stress and burnout rates.	200	1.53	1.11	Low
11	Educational goals are statements that describe the skills that you should possess upon completion of a course or program.	200	3.49	1.30	High
12	Educational goals are statements that also describe competencies you should have gained upon completion of a course or program	200	2.50	1.12	Low
13	Educational goals are statements that describe the qualities that you should possess upon completion of a course or program	200	3.46	1.36	High
14	Educational goals involves identifying objectives and creating a plan for achieving them	200	3.55	1.29	High
15	Educational goals involves choosing attainable short-term goals and creating a plan to achieve those goals	200	3.52	1.39	High

Grand mean	**3.50**

Table 1 reveals the mean and standard deviation of teachers' level of Pedagogical Knowledge. The average mean of 3.00 and above was used as the benchmark for **'High'** and the mean of less than 3.00 is considered **'Low**.' Consequently, fifteen (15) items were listed, all of the items had mean scores which were between 1.40 and 3.55. Ten items were above the benchmark of 3.0 which indicates that the majority of science teachers in this population have high pedagogical knowledge while five items were below the 3.0 benchmark which indicates that a minority of science teachers in this population have low pedagogical knowledge. A grand mean of 3.50 which indicates that science teachers' pedagogical knowledge is high in this population.

Research Question Two: What is the level of science teachers' Content Knowledge (CK)? To answer this research question, mean and Standard deviation was used and the analysis presented in Table 2

Table 2: Mean and Standard Deviation of science teachers' level of Content Knowledge (CK)

S/NO		N	Mean	Std. Deviation	Decision
1	I know what content of my area of specialization is science is to be addressed in each session of the secondary school curriculum	20	3.54	1.16	High
2	I have sufficient repertoire of strategies for teaching Science subjects	200	3.31	1.70	High
3	It is true that Science concepts are related	200	3.43	1.11	High
4	Teachers should be able to diagnose and eliminate students difficulties and misconceptions in Science	200	3.44	1.19	High
5	Teachers should be able to apply Science concepts and laws to Natural laws and phenomena	200	2.24	0.88	Low
6	Science subject teachers should know how to design experiments for teaching and learning purposes as well as research	200	2.08	0.86	Low
7	It is important for teachers to gain mastery of essential concepts of school Science.	200	3.19	1.14	High
8	Teachers should be able to link Science concepts together	200	3.57	1.13	High
9	Teachers should be able to think about the content of secondary school Science subjects like subject matter experts	200	2.00	0.90	Low

10	Teachers should be able to develop a deeper understanding of the content of secondary school Science subjects.	200	3.43	1.11	High
11	An atom is defined as the basic unit of a chemical element	200	3.50	1.33	High
12	Molecules represent the basic unit of a chemical compound	200	3.47	1.36	High
13	The periodic table is a list or arrangement of all known chemical elements.	200	2.35	0.42	Low
14	A chemical reaction is a process in which one set of chemical compounds are transformed into another	200	3.47	1.35	High
15	A molecule is said to be chiral when its mirror image is not super imposable to the molecule itself	200	2.43	0.38	Low
	Grand mean		**3.54**		

Table 2 reveals the mean and standard deviation of teachers' level of Content Knowledge. The average mean of 3.00 and above was used as the benchmark for **'High'** and the mean of less than 3.00 is considered **'Low**.' Consequently, fifteen (15) items were listed, all of the items had mean scores which were between 1.35 and 3.57. Ten items were above the benchmark of 3.0 which indicates that majority of science teachers in this population have high content knowledge while five items were below the 3.0 benchmark which indicates that only a minority of science teachers in this population have low content knowledge. A grand mean of 3.54 which indicates that science teachers' content knowledge is high in this population.

Research Question Three: What is science teachers' level of Pedagogical and Content Knowledge (PCK)? To answer this research question, mean and Standard deviation was used and the analysis presented in Table 3

Table 3 Mean and Standard Deviation of Science Teachers' Level of Pedagogical and Content Knowledge (PCK)

S/No		N	Mean	Std. Deviation	Remarks
1	Technology should be integrated into Science classes	200	2.50	1.33	Low
2	Students should be helped to reflect on their Science learning strategies	200	2.47	1.36	Low
3	Students should be guided to discuss effectively during group work	200	2.35	1.12	Low

4	Cooperative learning helps learners to build their confidence	200	3.47	1.55	High
5	Allocation of tasks based on students abilities helps to carry all students along	200	2.43	1.38	Low
6	Problem solving skills can be improved by inquiry based instructions	200	1.40	1.12	Low
7	Bringing the 'abstract' concept of Science to life by visual and practical learning is very important	200	2.49	1.10	Low
8	It is important to break down larger tasks into achievable steps	200	3.56	1.32	High
9	The use of media establishes a direct connection with the digital world that learners inhabit	200	2.44	1.16	Low
10	A combination of discipline and reward helps to build an atmosphere of mutual respect	200	1.53	1.21	Low
11	General questions during learning encourages active class participation	200	3.49	1.40	High
12	Assignments should be given upon completion of every lesson	200	2.50	1.13	Low
13	Practical is an essential part of the Science curriculum	200	2.46	1.16	Low
14	Practical is an essential part of the Science curriculum	200	2.55	1.19	Low
15	Multiple choice questions allow assessment of full specification and rapid marking	200	2.52	1.17	Low
	Grand mean 2.50				

Table 3 reveals the mean and standard deviation of teachers' level of Pedagogical and Content Knowledge (PCK). The average mean of 3.00 and above was used as the benchmark for **'High'** and the mean of less than 3.00 is considered **'Low**.' Consequently, fifteen (15) items were listed; all of the items had mean scores which were between 1.40 and 3.56. Ten items were below the benchmark of 3.0 which indicates that majority of cience teachers of this population have low pedagogical and content knowledge while three items were above the 3.0 benchmark which indicates that only a minority of science teachers in this population have high pedagogical and content knowledge. A grand mean of 2.50 which indicates that science teachers' pedagogical knowledge is low in this population.

Discussion of results

The finding of the study indicates that Science teachers in the said population have high Pedagogical Knowledge (PK). This result corroborates Ogunboyede (2014) in Odumosu (2018) who indicates that effective classroom teaching enhances students' performance. The implication is that science teachers have high content knowledge and this will translate to students having relatively good performance in science subjects. The findings also show that science teachers in this population have high content knowledge. This result corroborates the findings of (Festus, 2008) in Odumosu (2018) who reported high content knowledge among secondary school teachers. This implies that if students are taught by teachers of high content knowledge they could perform better. Collaborating this assertion are Olfos, Goldrine and Estrella (2014) and Popoola (2002) who found a strong correlation between teachers' pedagogical content knowledge and students' understanding in learning. The study is also in consonant with the works of Ishola and Udofia (2017); Ogar (2006) in Odumosu (2018) who affirmed that teachers' mastery of the subject matter is a component that determines the extent of students learning and achievement. The finding of this study also show that teachers in this population have low pedagogical and content knowledge. This corroborates with the findings of Mohamed *et al* (2021) indicating that teachers' face serious challenges in the implementation of PCK in classroom practices. There is, therefore, a need for more in-service training on raising teachers' PCK levels, which will eventually lead to improved teaching and learning.

Conclusion

The quality of chemistry teachers especially at the senior secondary education level cannot be compromised. The teachers at this level must have both the massage and the medium, because the shallow knowledge of teachers in chemistry content will not give the desired results. Given the findings of this study, it is logical to conclude that the teachers in this population have high pedagogical and content knowledge but have low pedagogical and content knowledge. If our goal is to encourage teachers to develop their PK, CK and PCK particularly in Science, it can only happen if teachers are exposed to proper training, conferences and workshops which will in turn improve the quality of teaching and learning.

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Chemistry Teachers' Self-Awareness as Correlates of Classroom Management Practices in Kwara State Senior Secondary Schools

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Abstract
The study investigated self-awareness as correlates of classroom management practices in Kwara State Senior Secondary Schools. *The study was guided by one research question with a corresponding hypothesis. The study adopted a correlational research design. The population of the study was 274 Chemistry Teachers. Simple random sampling technique was adopted in selecting 159 Chemistry Teachers. The research instruments used was adapted questionnaires with 5-point scale. Inferential statistics of linear regression was used to test the hypothesis at a 0.05 level of significance. Result of the hypothesis tested, revealed that there was significant relationship between chemistry teachers' self-awareness and classroom management practices. The study recommended that chemistry teachers should adopt a good measure to strengthen their self-awareness skills during teaching and learning processes.*

Keywords: Self-awareness, Classroom management practices.

Introduction
It is not a secret that teaching is one of the most emotionally charged and exhausting occupations. A teacher must be mindful of how lack of self-awareness will hinder the teaching and learning process in order to achieve its targets. For many centuries now, education has become a vital tool for human and capital growth, as well as the survival of every community. The state of growth and development in any society is laid on the contribution of quality education(Amalu & Okon, 2018). The quality of education given in schools should be of great concern to all stakeholders with the declining performance of students in both the West African School Certificate (WAEC) and Nationals Examination Council Examinations (NECO), coupled with continued decline in the number of Credit passes in Science subjects especially in Chemistry (James, 2018). The continuous decline in Chemistry performances raises issues of quality education among stakeholders in education and members of the public in Kwara State. The most essential activity in a typical school environment is the ability to organize classroom activities and manage the behaviour of students. Teachers have the responsibility of organizing classroom activities and managing student's behaviours in school. This means that teachers are the major implementers of school curriculum and as an individual or group of individuals; teachers hold a very important position in educational sector. They need certain classroom management skills and self-awareness to enable them manages students' behaviour and ensures the maintenance of high standard in schools since effective teaching and learning cannot be achieved in a mismanaged classroom. Hence self-awareness is a necessity for teaching and learning to take place effectively.

Self-awareness is the ability to understand one's feelings, attitudes and behaviours. Increasing self-awareness also has important implications for academic performance and classroom management.

Several studies show practising mindfulness is an effective and efficient technique for improving cognitive function resulting in increased test performance, memory and reading comprehension (Abraham *et al.,* 2017). Self-awareness is to inform ones' self of interest to identify feelings and how it affects performance. Teachers' self-awareness is the key to respond to student's strengths and weaknesses. Udoudo (2014) describe self-awareness as the foundational building block of an individual's emotional intelligence as individuals high in emotional awareness recognize how feelings affect one's performance. Andrei *et al.* (2016) agreed that emotional health is fundamental to effective teaching and that the most critical element of a teachers' success is an understanding of how to teach. He added that teachers' who are self-aware and intrinsically motivated would have very high classroom management practices which enhances student performance.

The poor performance of Chemistry examination in West African Examination (WAEC) and National Examination Council (NECO) has continued to be a major concern for the Government of Kwara State and other education stakeholders within the State (James, 2018). The low grades scored by most Chemistry students in their Senior Secondary School Certificate Examinations (WAEC and NECO) jeopardise their chances for admission into higher institutions of learning, particularly Nigerian Universities. In an effort to reverse the trend, the Kwara State government adopted a number of interventions such as Seminars, Conferences, and Workshops targeting students, teachers and the overall teaching and learning environment. However, Teachers' self-awareness could have both positive and negative influence on students in the sense that if teachers' self-awareness is positively utilized by classroom teachers, it will result to high academic performance of the students but if it is negatively utilized by classroom teachers it leads to low academic performance of the students (Amalu, 2018). The attitude of teachers affects the students' performance. The teachers' unprofessional attitude towards their students inhibits students' participation in classroom activities and hence jeopardized their performances in the classroom. The way a teacher manages the classroom will change the thinking of the students towards learning. The expectations and objectives of secondary education are normally accomplished in the classroom using a well-planned curriculum through effective classroom management skills.This being the case, one may ask whether the expectations and objectives of secondary school education in Nigeria are guided by unskilled teachers and mismanaged classrooms. To this end, this aroused the interest for the research to investigate chemistry teachers' self-awareness as correlates of classroom management practices in Kwara State senior secondary schools.

Aim and Objective of the Study

The aim of this study was to investigate chemistry teachers' self-awareness as correlates of Classroom Management Practices in Kwara State Senior Secondary Schools. The objective of this study is to determine the:

5. Relationship between Chemistry Teachers' Self-awareness and Classroom Management Practices in Kwara State Senior Secondary Schools.

Research Question One: What is the relationship between Chemistry Teachers' Self-awareness and Classroom Management Practices in Kwara State Senior Secondary Schools

Research Hypothesis

A null hypothesis was formulated to guide the study and was tested at a 0.05 level of significance;

HO1: There is no significant relationship between Chemistry Teachers' Self-awareness and Classroom Management Practices in Kwara State Senior Secondary Schools

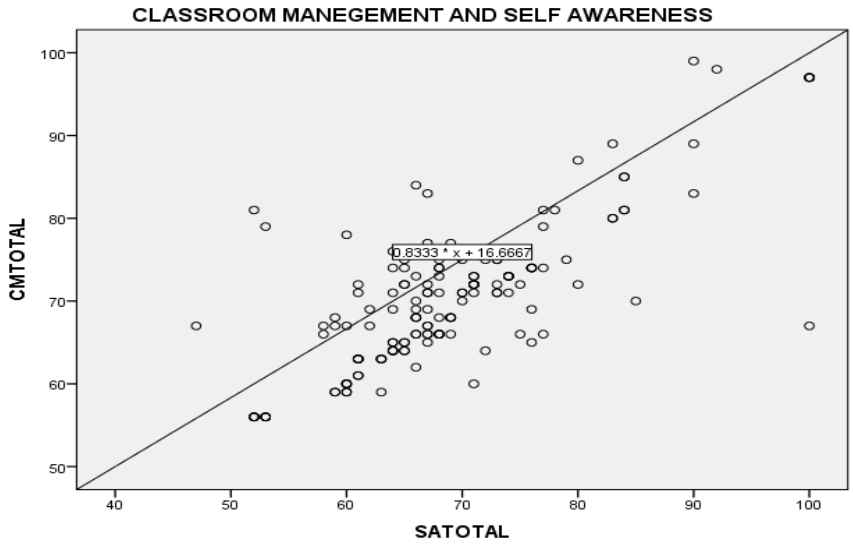
Methodology

The research design used for this study are descriptive survey research design using correlational approach. The correlational design is considered appropriate because correlational research is used to determine the extent to which two or more variables are related among a single group of people.

Results

Research Question One:

What is the relationship between chemistry teachers' self-awareness and classroom management practices in Kwara State Senior Secondary Schools? This research question was answered using a scatter plot, as shown in figure 1



CM (Classroom Management)
SA (Self-Awareness)

Figure 1: Scatter plot relationships between Classroom Management Practices and Teacher's Self-awareness.

Figure 1: is a scatter plot of the relationships between classroom management practices and teachers' self-awareness. The scatter plot indicates that there is a positive relationship between the two constructs, as indicated by the trend line. This finding is supported by the mean and standard deviation of the two constructs as shown in table 1

Table 1: Mean and Standard Deviation of Self-awareness and Teachers' Classroom management Practices

Variable	N	$\bar{x}$	SD	Mean difference
Classroom Management	159	70.81	8.816	1.73
Self-awareness	159	69.08	9.950	

Table 1 shows the mean and standard deviation of self-awareness and teachers' classroom management practices. The findings show a computed mean score of 70.81 and Standard Deviation of 8.816 for classroom management practices and a Mean score of 69.08 with a Standard Deviation of 9.950 for self-awareness. This gives a Mean difference of 1.73 between classroom management practices and teacher's self-awareness. This implies that the relationship between the variables is positive because the mean difference is not very large. The smaller the mean difference the stronger is the relationship.

Hypothesis One: There is no significant relationship between chemistry teachers' self-awareness and classroom management practices in Kwara State Senior Secondary Schools. This formulated hypothesis was tested using linear regression, and the summary of the results is presented in Table 2a

Table 2a: Linear Regression Model Summary on the Relationship between Chemistry Teachers' Self-awareness and Classroom Management Practices

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.759[a]	.575	.573	5.763

7. Predictors: (Constant), Self-awareness

Table 2a shows the regression model summary for the independent variable (chemistry teachers' self-awareness) and the dependent variable (classroom management practices). The result shows r (1,157) =. 759, r^2 = .575. The r^2 of 0.575 indicates that only 58.0% of the total variation in chemistry teachers' classroom management practices can be attributed to the teachers' self-awareness. The regression coefficient is presented in Table 2b

Table 2b: Linear Regression Coefficient on the relationship between Chemistry Teachers Self-awareness and Classroom Management Practices

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
1	Constant	24.381	3.216		7.582	.000
	Self-awareness	.672	.046	.759	14.585	.000

a. Dependent Variable: Classroom Management Practices

Table 2b shows the regression coefficient of teachers' self-awareness and classroom management practices. The result shows teachers self-awareness is a significant predictor of Classroom Management Practices (B = .759, t = 14.585, p (0.00) < 0.05. The findings indicate that the standard Beta coefficient for teachers' self-awareness is positive and statistically significant. Therefore, the hypothesis is rejected. The regression coefficient indicates that for any increase in one units of teachers' Self-awareness will cause an increase of 0.672 units of teachers' classroom management practices (when all other factors are constant) in Kwara State senior secondary schools.

Conclusion

The study disclosed that self-awareness have impact on classroom management practices of a chemistry teacher. This supports the findings of Kashani *et al.* (2012) who examined the role self-awareness in the classroom management practices of high school students. The findings

revealed that self-awareness plays a major role in dealing with teachers' classroom management practices. Hence, classroom teachers' should be aware of how their self-awareness influences their performance in the classroom so as to achieve the targeted goals and objectives of teaching and learning processes.

Recommendations

The paper recommended that:

4. The paper recommended that chemistry teachers should adopt a good measure to strengthen their emotional intelligence during teaching and learning processes.
5. The stakeholders as a matter of urgency should organise orientation to both new and old chemistry teachers on how to develop a better self-awareness skills during teaching and learning processes.
6. Workshops, conferences and seminars should be organized periodically to familiarize chemistry teachers with recent research findings that would lead to effective and meaningful teaching and learning
7. Curriculum planners should incorporate contents related to emotional intelligence into the curriculum in order to improved academic performance of students' in chemistry.

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Evaluation of the Implementation of Automotive Mechatronic Programme in Vocational Enterprise Institutions in Federal Capital Territory -Abuja and Kaduna State

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Abstract

The study was designed to evaluate the implementation of automotive mechatronic programme of the vocational enterprise institutions in Federal Capital Territory Abuja and Kaduna State Nigeria. three research questions and three hypotheses guided the study. A descriptive survey research design was employed for the study. The study was conducted in three VEIs offering automotive mechatronic programme in FCT Abuja and Kaduna State. A total of 90 respondents comprising of 14 administrators 32 instructors and 44 technical staff drawn from the three NBTE accredited Vocational Enterprise Institutions offering Automotive Mechatronic Programme in FCT Abuja and Kaduna State was used as the total population for the study. A structured questionnaire titled: Automotive Mechatronic Programme Evaluation Implementation Questionnaire (AMPEIQ) developed by the researcher and validated by three experts from Industrial and Technology Education department, Federal University of Technology, minna was used for data collected for the study. The reliability coefficient of the instrument was 0.7 through Cronbach Apha statistics. Statistical Package for Social Science (SPSS Version 23) was used for the data analysis. Mean, standard deviation, frequency and percentage were the statistical tools used for answering research questions while ANOVA statistics was used to analyze the null hypotheses formulated for the study at 0.05 level of significant. The findings of the study revealed among others that: achievement of the objectives of the automotive mechatronic programme of the VEIs in FCT Abuja and Kaduna State were extemerily low, the available training equipment/facilities were rarely often used and most teaching methods needed for effective implementation of automotive mechatronic programmewere rarely often used. Based on the findings it was recommended that: The VEIs in FCT Abuja and Kaduna State should adhere with the NBTE minimum requirement of training equipment/facilities for the implementation of the automotive mechatronic programmes, the available training equipment/facilities in the VEIs in FCT Abuja and Kaduna State should be effectively utilized for the implementation of the automotive mechatronic programmes, the automotive mechatronic instructors/technical staff of the VEIs in FCT Abuja and Kaduna State should adopt wide range of teaching methods in teaching automotive mechatronic. National Board for Technical Education (NBTE) and the Vocational Enterprise Institutions (VEIs) should make more efforts in enlighten the public about the programmes of the VEIs and they relevancy to the nation economic development.

Introduction

The Federal Government of Nigeria ability of realizing the vision of having one of the largest economies in the world by the year 2020 tremendously dependent on her ability to transform its youthful population into highly skilled and competent citizens capable of addressing the needs of the growing economy, technological advancement and competing favorably globally. A large part of the responsibility for preparing such citizens rests on higher education institutions, but which are constrained by several challenges including: lack of capacity to accommodate increasing number of applicants; low participation of the private sector in skills training and development;

and mismatch between the training provided and needs of employers; National Board for Technical Education, (NBTE 2007). These challenges according to NBTE 2007 pose serious threats to the attainment of the 2020 vision of the Federal Government of Nigeria. To address these challenges, the Government approved the establishment of the Vocational Enterprise Institutions (VEIs) with the major aim of widening access to Technical and Vocational Education and Training (TVET) to serve the needs of the industry and self-empowerment of the nation's citizens through VEIs.

Vocational Enterprise Institutions (VEIs) are institutions set up to provide an alternative route to higher education, as part of the on-going reform of the Vocational and Technical Education sector. NBTE (2007) noted that VEIs are institutions which are to provide competency based-skills in vocational, technical or professional education and training at post-basic and post-secondary levels to equip the youth as well as working class adults with vocational skills and knowledge to meet the increasing demand for skilled manpower in the various sectors of the nation's economy. The goals of VEIs according to Federal Republic of Nigeria (FRN 2013) include among other:- Train Post-Basic Education and Senior Secondary students who are desirous of obtaining some specific skills, knowledge and appropriate certification to pursue a chosen trade or career; Educate Post-Basic Education and Senior Secondary students to think creatively and transform knowledge through technological process into wealth and a broader economic base; Provide technologically based skill training that ensures that students understand how their expertise fits into improving the society and fulfilling national goals. A number of programmes were introduced to aid in the attainment of these loadable goals. According to FRN (2013) these programmes include: Welding and Sheet Metal Work, Agricultural, Electrical Wiring – domestic and industrial, Plumbing, Painting, Bricklaying, Motor-vehicle Mechanic Work, Panel Beating Work, Auto-Electrical, Vulcanizing, as well as Automotive Mechatronic trade.

Automotive mechatronic could be described as a system of mechanical components with electronically based decision making (control circuitry). It involves the design and manufacturing of intelligent products or systems involving hybrid mechanical and electronic functions of the modern vehicles. Tanuja *et al*(2016), identified the elements of mechatronic in the modern automobile to includes: sensors, hydraulic and pneumatic (actuators), mechanical couplings, electric motors, power electronic, assembly gear, control panels, computer hard and software to manage complexity, uncertainty and communication in modern mechatronic vehicles. The skill areas of automotive mechatronic programme at VIEs level in Nigeria according to NBTE (2009) include: VCS111-Introduction to computer, VAM109-Battery maintenance, VAM104-Coventional coil ignition system maintenance, VAM108-Auto electrical system maintenance, VAM203-Autompotive sensor technology, VAM205-Autompotive lighting system, VAM205-Transistorize ignition system maintenance, VAM204-Altrnator and starter motor maintenance, VAM208-Fuel injection system maintenance, VAM206-Electric power steering system, VAM305-Automatic transmission maintenance, VAM302-Vehicle communication system, VAM304-Electric wheel alignment, VAM306-Eletric diesel engine maintenance, VAM307-Electrnic ignition system and VAM309-Elctronic vehicle diagnosis. This Mechatronics Programme is inflexible modular form, and is structured to have three parts that is NVC Part I, NVC Part II, and NVC Part III respectively.

NBTE clearly spelt out the components of automotive mechatronic programme at VEIs level to include 40hours per week, with 6hours allocated for core theory courses, 2hours for general

education, 32hours for practical activities with three months Supervised Industrial Work Experience (SIWES) to achieve the above laudable objectives. However, these objectives appear not to have been achieved as many graduates of this programme from VEIs are unable to set up their own workshop and thus unemployed (Jalali, 2016). The foregoing clearly revealed that implementation which is seen as a process of executing a policy so that a concept become reality or practical transformation rather than the design process of institutional plan seems to have been defeated. Hence, there is need for the programme to attain its stated objectives.

Objectives are generally referring to an outcome statement that captures specifically what knowledge, skills, attitudes trainees should be able to exhibit following instruction. Olaitan (2003) explained that objectives are statement of the expected or desired learning outcomes from a particular learning activities. A well-articulated objectives according to International Bureau of Education (UNESCO-IBE) should be concise and understandable to the instructors, trainees, and guidance; be feasible for instructors and trainees to achieve, encompasses previous learning and required trainees to integrate and thus apply certain knowledge, skills and attitudes. Hence, the attainment of the objectives of automotive mechatronic programme at VEIs requires that the available training facilities/equipment needed to be effectively utilized.

Effective utilization of training facilities/equipment is the process of using procured and accessible facilities, tools, components equipment and appliances to make teaching and learning process easier, interesting and rewarding. Josephine et *al* (2016) opined that non-effective use of training facilities creates negative feeling in the trainees. It has thus, become in evitable to show concern with the use of equipment and facilities being made available to the VEIs centers across the country as continuous non used of available training facilities lead to material wastages. However, automotive mechatronic instructors at the VEIs must adopt right teaching methods that will accommodate effective utilization of the training facilities/equipment for impacting the needed practical skills to the trainees.

Teaching method refers to the ways and means which an instructor adopts to guide the trainees teaching and learning activities in order to accomplish the desired goals. Nneji (1997) opined that teaching method itself could be seen as the manner in which the contents are presented to the learner. There are many teaching methods and techniques available to the instructors, these methods/techniques are designed for communicating with trainees and the choice of which is affected by many components such as content, time, ability of pupils, group size as well as the instructor personal preference, (Theresa, 2016). Effective teaching and learning takes place when the instructors knows which method or technique to use in a particular situation to meet specific goals. Yinusa (2014) explained that the following methods are appropriate when the acquisition of practical skills are needed; these methods according to Yinusa include demonstration, project, field – trip, enquiry, close circuittelevision (electronics learning) and problem solving.It is against this backdrop that the researcher intends to evaluate the implementation of Automotive Mechatronic programme in the Vocational Enterprise Institutions in Federal Capital Territory Abuja and Kaduna State.

Statement of the Problem

The programme of automotive mechatronic at VEIs in Nigeria was designed to provide solutions to the service maintenance problems of highly technology motor vehicles through the production

of competent craftsmen who will be enterprising and self-reliant. Accordingly, the implementation of this automotive mechatronic programme at VEIs required adequate provisions of training facilities/equipment, effective utilization of these facilities/equipment for imparting practical skills aspect of automotive mechatronic to the trainees among others; as this will go a long way to assist the trainees to upon completion of the program have acquired practical skills that will enable them secured paid employment or set up their own workshop and become self-employed and be able to employ others.

However, it has been observed that the implementation of this programme at VEIs seems to have been defeated as evidences from the literature showed that graduates of automotive mechatronic programme from VEIs are graduating without pre-requisite skills as a results of these they are ill equipped and unemployable. Jelani (2016) noted that it is difficult to find skilled automotive mechatronic graduates that could hardly undertake the maintenance and repairs of modern mechatronic vehicles and even the few available ones undertake the maintenance and repairs of these vehicles on trial and error bases. Jelani further attributed the forgoing situation to the lack of adequate training facilities/equipment as well as ineffective use of the existing ones, as well as the use of irrelevant teaching techniques by the training instructors. This study is therefore sought to evaluate the implementation of automotive mechatronic programme in Vocational Enterprise Institutions in Federal Capital Territory, Abuja and Kaduna State.

Aim and Objectives of the Study

The aim of the study was to evaluate the implementation of automotive mechatronic programme of vocational enterprise institutions (VEIs) in Federal Capital Territory, Abuja and Kaduna State, Nigeria. Specifically, the study sought to determine:

1. The extent to which objectives of the automotive mechatronic programme of the Vocational Enterprise Institutions (VEIs) in FCT Abuja and Kaduna State are achieved;

2. The extent to which the training equipment/facilities are effectively utilize for the implementation of automotive mechatronic programme of the Vocational Enterprise Institutions (VEIs) in FCT Abuja and Kaduna State;

3. The teaching methods used for teaching automotive mechatronic by the instructors and technical staff of the Vocational Enterprise Institutions (VEIs) in FCT Abuja and Kaduna State;

Research Questions

The following research questions guided the study:

1. To what extent are the objectives of the automotive mechatronic programme of the Vocational Enterprise Institutions (VEIs) in FCT Abuja and Kaduna State are achieved?

2. To what extent are the training equipment/facilities put to effective use for the implementation of automotive mechatronic programme of the Vocational Enterprise Institutions (VEIs) in FCT Abuja and Kaduna State?

3. What are the teaching methods used in teaching automotive mechatronic by the instructors and technical staff of the Vocational Enterprise Institutions (VEIs) in FCT Abuja and Kaduna State?

Hypotheses

The following null hypotheses were formulated and was tested at 0.05 level of significant:

Ho_1: There is no significance difference in the mean responses of the administrators, automotive mechatronic instructors and technical staff as regards the extent to which the objectives of the automotive mechatronic programme are achieved at VEIs in Abuja and Kaduna State.

Ho_2: There is no significance difference in the mean responses of the administrators, automotive mechatronic instructors and the technical staff as regards the extent to which thetraining equipment/facilities are put to effective use for the implementation of the automotive mechatronic programme at VEIs in Abuja and Kaduna State.

Ho_3: There is no significance difference in the mean responses of the administrators, automotive mechatronic instructors and the technical staff as regards the teaching methods used in teaching automotive mechatronic by the instructors and technical staff of VEIs in Abuja and Kaduna State.

Research Methodology

A descriptive survey research design was adopted for the study. The study was conducted in three NBTE accredited VEIs offering Automotive Mechatronic Programme in FCT Abuja and Kaduna State. The targeted population for the study was 90 respondents, comprising of 14 administrators, 32 instructors and 44 technical staff. Since the population is not too large, the entire population was used for the study. Hence, no sampling technique was employed. A structured questionnaire validated by three experts from Federal University of Technology Minna was used for the study, reliability coefficient of 0.7 was obtained using Cronbach Alfa. Statistical package for social sciences was used for data analysis (SPSS version 21). Mean and Standard deviation were used to answer the research questions. Analysis of Variance (ANOVA) was used to present null Hypotheses at 0.05 level of significance.

Research Question 1

To what extent are the objectives of the Automotive Mechatronic programme of the Vocational Enterprise Institutions in FCT Abuja and Kaduna State are achieved?

Table 1

Mean and standard deviation of responses of the respondents on the extent to which the objectives of the Automotive Mechatronic programme of the VEIs in FCT Abuja and Kaduna State are achieved.

S/N	ITEMS	$X_{A\ N=90}$	$SD_{A\ N=90}$	DECISION
1	Function as technicians in automotive and related establishments	2.33	0.50	Low Extent
2	Carry out necessary general tests procedures on modern vehicle	2.57	0.52	Moderately Extent
3	Carry out standard diagnosis on modern vehicle	2.40	0.65	Low Extent
4	Carry out faults rectification on modern vehicles	2.24	0.66	Low Extent

5	Demonstrate the use of different sophisticated diagnostic equipment for fault detection on various modern vehicles	2.26	0.65	Low Extent
6	Demonstrate the use of different sophisticated diagnostic equipment for fault rectification on various modern vehicles	2.21	0.71	Low Extent
7	Observe relevant safety in Automotive Mechatronics Engineering practice	2.61	0.53	Moderately Extent
8	Interpret wiring diagrams of modern vehicle	2.29	0.69	Low Extent
9	Interpret fault codes of modern vehicle	2.23	0.70	Low Extent
10	Interpret technical reference materials	2.22	0.68	Low Extent
	Grand Mean/SD	**2.34**	**0.63**	**Low Extent**

Key: X_A= Average mean of administrators, instructors and the technical staff, SD_A= Standard deviation of administrators, instructors and the technical staff.

The analysis in table 1 shows the responses of the respondents on the extent to which the objectives of automotive mechatronic programme of VEIs are achieved. The grand mean of 2.34 implies that the extent to which the objectives of automotive mechatronic programme of VEIs are being achieved were extently low. The standard deviation of the items ranges from 0.52 to 0.71, this further implies that the respondents were not too far from the mean and were too closed to one another in their responses.

Research Question 2

To what extent are the training equipment/facilities effectively utilize for the implementation of automotive mechatronic programme of the Vocational Enterprise Institutions in FCT Abuja and Kaduna State?

Table 2

Mean and standard deviation of responses of the respondents on the extent to which the training equipment/facilities are effectively utilize for the implementation of automotive mechatronic programme of the VEIs in FCT Abuja and Kaduna State

S/N	Items	$X_{A\ N=90}$	SD_A	DECISION
1	Digital Multimeter (DMM)	2.09	0.59	Rarely Often
2	Potentiometer	2.19	0.39	Rarely Often
3	Ohmmeter	2.72	0.45	Often
4	Oscilloscope	2.10	0.30	Rarely Often
5	Independent Power supply panel	2.27	0.72	Rarely Often
6	Personal Computers	2.61	0.53	Often
7	Printers	2.34	0.58	Rarely Often
8	Scanner	2.39	0.49	Rarely Often
9	Functional Generator (a.c.)	2.24	0.43	Rarely Often
10	Functional Generator (d.c.)	2.73	0.47	Often
11	Multimedia Data acquisition & Control board	1.90	0.65	Rarely Often
12	Lab View Software (data acquisition & process control)	1.98	0.69	Rarely Often
13	MATLAB software	2.02	0.54	Rarely Often
14	Bench link software (HP, LG, IBM, etc.)	1.94	0.63	Rarely Often
15	Engine analysis, Part sourcing & assembling techniques tools	2.46	0.50	Rarely Often
16	Training board (Auto-electric)	2.08	0.43	Rarely Often
17	Plug-in-cables	2.88	0.36	Often
18	Pneumatic training unit	2.29	0.57	Rarely Often
19	Hydraulic board	2.27	0.51	Rarely Often
20	Bearing and Precision assembly kit	2.36	0.48	Rarely Often
21	Automatic crane	2.54	0.52	Often

22	Digital alignment unit	2.41	0.54	Rarely Often
23	Fuel Injection testing unit	2.67	0.47	Often
24	Live vehicles various models	2.69	0.61	Often
25	Model diesel & petrol engines	2.31	0.65	Rarely Often
26	Manual transmission units	2.29	0.66	Rarely Often
27	Automatic transmission units	2.31	0.65	Rarely Often
28	Assorted motor parts models	2.86	0.51	Often
29	Digital wheel balancing machines	2.33	0.56	Rarely Often
30	Mobile cranes	2.39	0.49	Rarely Often
31	Vulcanizing units	2.09	0.43	Rarely Often
32	D.C. charging kits	2.02	0.54	Rarely Often
33	Welding machines (AC, DC, Rectifier etc.)	2.32	0.65	Rarely Often
34	Mobile tool boxes	2.19	0.56	Rarely Often
35	Bench vices	2.84	0.36	Often
36	Column drilling machine	2.04	0.54	Rarely Often
37	Student Lathes	2.10	0.48	Rarely Often
38	Power saw	2.19	0.47	Rarely Often
39	Floor grinding machine	2.10	0.30	Rarely Often
40	Table grinding machines	2.96	0.21	Often
41	Table drilling machine	2.96	0.26	Often
42	Measuring and marking out tables	2.97	0.24	Often
43	Work benches with a.c. plug-in facilities	2.16	0.36	Rarely Often
44	Hydraulic brake testing unit	2.16	0.36	Rarely Often
45	Hydraulic jacks	2.58	0.49	Often
46	Hydraulic stands	2.12	0.54	Often
47	Floor jacks (6 ton capacity)	2.94	0.23	Often
48	Cable stands (mobile and stationary)	2.22	0.42	Rarely Often
49	Headlight alignment unit	2.91	0.32	Often
50	Modern training facilities (multimedia & overhead projectors, mobile board, board fax) 1each	2.16	0.36	Rarely Often
51	Fuel pressure gauge	2.16	0.36	Rarely Often
52	Engine stand	2.70	0.46	Often
53	Diagnostic equipment	2.49	0.50	Rarely Often
54	Drawing table complete with drafting machine/stools	2.97	0.18	Often
55	Drawing set complete with pens for ink work	2.16	0.36	Rarely Often
56	450 set squares	2.97	0.18	Often
57	600 set squares	2.12	0.49	Rarely Often
58	Blue printing machine	2.00	0.50	Rarely Often
59	Adjustable set squares	2.92	0.27	Often
60	Desk sharpener	2.94	0.23	Often
61	Triangular scale rule (30 mm)	2.33	0.50	Rarely Often
62	Flat scale rule (300 mm)	2.12	0.49	Rarely Often
63	Blackboard ruler (1m)	2.94	0.23	Often
64	Blackboard Tee squares	2.94	0.23	Often
65	Blackboard set square (450 600)	2.93	0.25	Often
66	Blackboard compasses	2.94	0.23	Often
67	Blackboard protractor	2.97	0.18	Often
68	French curve set	2.92	0.30	Often
69	Letter stencils (3 mm, 6 mm, 7 mm and 10 mm)	2.19	0.39	Rarely Often
70	Rubber stencils (3 mm, 6 mm, 7 mm, and 10 mm)	2.06	0.55	Rarely Often
71	Erasing stencils	2.97	0.18	Often
72	Drawing rack/shelves for 30 students	2.29	0.57	Rarely Often
73	Personal computers	2.87	0.40	Often
74	Plotter	1.98	0.64	Rarely Often
75	Printer to handle A3 size	2.08	0.48	Rarely Often

76	Comparator (Mechanical)	2.47	0.58	Rarely Often
77	Universal measuring microscope	2.00	0.58	Rarely Often
78	Bench testing centers	2.92	0.31	Often
79	Angle gauge	2.12	0.42	Rarely Often
80	Set of slip gauge	2.76	0.48	Often
81	Sine bars with centers	2.16	0.36	Rarely Often
82	Engineers level	2.86	0.38	Often
83	Micrometers (assorted denomination)	2.41	0.50	Rarely Often
84	Vee blocks (assorted sizes)	2.64	0.48	Often
85	Magnetic vee block	1.98	0.45	Rarely Often
86	Vernier calipers	2.98	0.15	Often
87	Vernier height gauge	2.11	0.41	Rarely Often
88	Angle plate	2.11	0.46	Rarely Often
89	Limit gauges for holes, shafts, and threads	2.09	0.47	Rarely Often
90	Surface plate	2.59	0.60	Often
91	Marking out table	2.93	0.33	Often
92	Parallel strips	2.10	0.50	Rarely Often
93	Bevel protractor	2.07	0.49	Rarely Often
94	Dial gauges and magnetic stand	2.08	0.43	Rarely Often
95	Engineers' square	2.10	0.30	Rarely Often
96	Thread gauge	2.10	0.43	Rarely Often
97	Radius gauge	2.02	0.54	Rarely Often
98	Feeler gauge	2.88	0.33	Often
99	Steel rule	2.29	0.57	Rarely Often
100	Combination set	2.81	0.42	Often
	Grand Mean/SD	**2.42**	**0.44**	**Rarely Often**

Key: X_A= Average mean of administrators, instructors and the technical staff, SD_A= Standard deviation of administrators, instructors and the technical staff.

Table 2 present the mean responses of the respondents on the 100 items posed to determine the extent to which the training equipment/facilities are effectively utilize for the implementation of the automotive mechatronic programme of the VEIs. The grand mean of 2.42 implies that the majority of the training equipment/facilities meant for the implementation of the automotive mechatronic programme of the VEIs in FCT Abuja and Kaduna State were not being effectively utilized for the implementation of the automotive mechatronic programme. The standard deviation of the items ranges from 0.18 to 0.72, this further implies that the respondents were not too far from the mean and were too closed to one another in their responses.

Research Question 3

What are the teaching methods used in teaching Automotive Mechatronic by the instructors/technical staff of the Vocational Enterprise Institutions in FCT Abuja and Kaduna State?

Table 3

Mean and standard deviation of responses of the respondents on the teaching methods used in teaching Automotive Mechatronic by the instructors/technical staff of the Vocational Enterprise Institutions in FCT Abuja and Kaduna State.

S/N	ITEMS	$X_{A\ N=90}$	SD_A	DECISION
1	Lecture method	3.23	0.43	Often Used
2	Demonstration method	3.72	0.45	Most Often Used
3	Exhibition method	2.01	0.25	Rarely Often Used
4	Questioning method	3.42	0.49	Often Used
5	Discussion method	2.53	0.55	Often Used
6	Project method	2.32	0.60	Rarely Often Used
7	Field trip method	2.20	0.40	Rarely Often Used
8	Assignment method	3.00	0.00	Often Used
9	Experiment method	2.17	0.38	Rarely Often Used
10	Inquiry and problem solving method	2.09	0.51	Rarely Often Used
11	Just in time method	2.17	0.40	Rarely Often Used
12	Individualized instruction method	2.11	0.44	Rarely Often Used
13	Brainstorming method	2.08	0.48	Rarely Often Used
14	Game and simulation method	1.67	0.47	Rarely Often Used
15	Programmed instruction method	2.09	0.47	Rarely Often Used
16	System approach instruction method	2.03	0.53	Rarely Often Used
17	Close Circuit method (E-learning)	2.18	0.39	Rarely Often Used
18	Concept mapping method	1.93	0.54	Rarely Often Used
19	Metal learning	2.02	0.54	Rarely Often Used
20	Cognitive apprenticeship	2.11	0.44	Rarely Often Used
21	Coaching	2.38	0.49	Rarely Often Used
22	Monitoring	2.22	0.42	Rarely Often Used
23	Practical monitoring and supervising method	3.43	0.50	Often Used
24	Drill method	2.21	0.41	Rarely Often Used
	Grand Mean/SD	**2.39**	**0.44**	**Rarely Often Used**

Key: X_A= Average mean of administrators, instructors and the technical staff, SD_A= Standard deviation of administrators, instructors and the technical staff.

Table 3presents the mean responses of the respondents on the 24 items posted to determine the teaching methods used in teaching Automotive Mechatronic by the instructors/technical staff of the VEISwith a grand mean of 2.39 which implies that the respondents jointly agreed that 18 out of the 24 items posted are rarely often used, 5 are often used and 1 is most often used. This implies that many teaching methods were not being used by the instructors/technical staff in teaching automotive mechatronic in the VEIS. The standard deviation of the items ranges from 0.18 to 0.72, this further implies that the respondents were not too far from the mean and were too closed to one another in their responses.

Hypothesis

Ho_1: There is no significance difference in the mean responses of the administrators, automotive mechatronic instructors and technical staff as regards the extent to which the objectives of the automotive mechatronic programme are achieved at VEIs in Abuja and Kaduna State.

The result of the one-way analysis of variance of mean scores of the respondents on the extent to which the objectives of automotive mechatronic programme were being achieved with respect to the administrators, automotive mechatronic instructors and technical staff is presented in table 4.6.1. Levene's test of homogeneity of variance for data was 0.228. Since the value is greater than

the significant level of ($p<0.05$) the assumption of homogeneity of variance was met. Therefore, ANOVA could be employed for the analysis.

Table 4
ANOVA Analysis of differences in the responses of the respondents on the extent to which the objectives of the automotive mechatronic programme are achieved at VEIs in FCT Abuja and Kaduna State.

Differences	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	0.81	2	0.41	2.28	0.11
Within Groups	15.51	87	0.18		
Total	16.33	89			

Table 4 revealed that there was no significant differences ($p<0.05$) in the mean score of the respondents on the extent to which the objectives of the automotive mechatronic programme are achieved at VEIs in FCT Abuja and Kaduna State. The data is supported the hypothesis, F (2, 87) = 2.28, P= 0.11. The mean and standard deviation for administrators were 2.69 and 0.36 respectively. The mean and standard deviation for instructors were 2.41 and 0.36 respectively. The mean and standard deviation for technical staff were 2.44 and 0.48 respectively. Post-Hoc (Tukey HSD) was not conducted simply because there was no significant difference in the mean responses of the respondents.

Ho_2: There is no significance difference in the mean responses of the administrators, automotive mechatronic instructors and the technical staff as regards the extent to which the training equipment/facilities are put to effective use for the implementation of the automotive mechatronic programme at VEIs in Abuja and Kaduna State.

Table 5
ANOVA Analysis of differences in the responses of the respondents on the extent to which the training equipment/facilities are put to effective use for the implementation of the automotive mechatronic programme at VEIs in Abuja and Kaduna State.

Difference	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	0.08	2	0.04	0.32	0.73
Within Groups	10.56	87	0.12		
Total	10.64	89			

Table 5 revealed that there was no significant differences ($p<0.05$) in the mean score of the respondents on the extent to which the training equipment/facilities are put to effective use for the implementation of the automotive mechatronic programme at VEIs in Abuja and Kaduna State. The data is supported the hypothesis, F (2, 87) = 0.32, P= 0.73. The mean and standard deviation for administrators were 2.42 and 0.46 respectively. The mean and standard deviation for instructors were 2.33 and 0.37 respectively. The mean and standard deviation for technical staff were 2.37 and 0.29 respectively. Post-Hoc (Tukey HSD) was not conducted simply because there was no significant difference in the mean responses of the respondents.

Ho_3: There is no significance difference in the mean responses of the administrators, automotive mechatronic instructors and the technical staff as regards to the teaching methods used in teaching automotive mechatronic by the instructors and technical staff of VEIs in Abuja and Kaduna State.

Table 6
ANOVA Analysis of differences in the mean responses of the respondents as regards to the teaching methods used in teaching automotive mechatronic by the instructors and technical staff of VEIs in Abuja and Kaduna State.

Differences	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	0.38	2	0.19	1.62	0.20
Within Groups	10.11	87	0.12		
Total	10.49	89			

Table 6 revealed that there was no significant differences ($p<0.05$) in the mean score of the respondents as regards to the teaching methods used in teaching automotive mechatronic by the instructors and technical staff of VEIs in Abuja and Kaduna State. The data is supported the hypothesis, $F(2, 87) = 1.62$, $P= 0.20$. The mean and standard deviation for administrators were 2.50 and 0.36 respectively. The mean and standard deviation for instructors were 2.32 and 0.35 respectively. The mean and standard deviation for technical staff were 2.32 and 0.33 respectively. Post-Hoc (Tukey HSD) was not conducted simply because there was no significant difference in the mean responses of the respondents.

Findings of the Study
Based on the data collected from the respondents and the analysis using appropriate tools;
The following findings emerged from the study:

1. It was revealed that, 8 out of the 10 objectives of the automotive mechatronic programme of the VEIs in FCT Abuja and Kaduna State were achieved to a low extent while 2 to a moderate extent.
2. The result also show that, most of the available training equipment/facilities in the VEIs in FCT Abuja and Kaduna State are rarely often used for the implementation of automotive mechatronic programme. Only few are often used.
3. It was found out that, only few teaching methods are often used in teaching automotive mechatronic programme at the VEIs in FCT Abuja and Kaduna State which include Lecture method, Demonstration method, Questioning method, Discussion method and assignment method and the other teaching methods are rarely often used.

Discussion of Findings
The major findings of the study were discussed in the order of the research questions and hypotheses formulated for the study.

The findings in table 1 relating to research question 1 showed that, the extent to which the objectives of the automotive mechatronic programme of the VEIs in FCT Abuja and Kaduna State are being achieved were extremely low. The findings revealed that the trainees were not able to function as technicians in automotive and related establishments upon completion of the programme. This is in conformity with the view of Ogbuanya et al. (2018) who pointed out that there are evidences of the inability of the technical colleges such as VEIs to meet the set standard of the quality of education for some years now; leading to the situation where graduates of technical college such as VEIs now parade the streets with paper qualifications and lack the needed

saleable skills for gainful employment. This view became consistent with the findings of a study conducted by Research and Curriculum Development Department, Industrial Training Fund (RCDD, ITF, 2014), that, the Skills Acquisition Centres in Nigeria are not geared up towards achieving their goals at high extent; there is need for them to be repositioned to ensure that they perform above expectation, and in line with their set objectives and goals.

Findings in table 2 relating to research question 2 showed that, the majority of the training equipment/facilities for the implementation of automotive mechatronic programme of the VEIs in FCT Abuja and Kaduna State were underutilized. The findings revealed that most of the available training equipment/facilities for the implementation of automotive mechatronic programme of the VEIs in FCT Abuja and Kaduna State were rarely often used; this is indicated with a grand mean of 2.42. This implies that teaching and learning of automotive mechatronic can be very difficult to achieve without the effective utilization of the available training equipment/facilities in the VEIs. This coincides with the view of Offorma (2002) who stated that teaching is usually facilitated and is more effective through the active participation of the learners and utilization of appropriate resources (facilities/equipment). This is also in agreement with the view of Awobodu (2000) who noted that teacher utilization of relevant equipment, materials and tools in teaching and learning enhances students' achievement. This is because usefulness of any available equipment/facilities depend on what the teacher makes out of it, as they do not achieve any of the attributed values on their own.

The findings in table 3 relating to research question 3 showed that, only few teaching methods were used in teaching automotive mechatronic programme by the instructors/technical staff of the VEIs in FCT Abuja and Kaduna State. The findings revealed that most of the teaching methods listed were rarely often used in teaching automotive mechatronic programme. Only Lecture method, Demonstration method, Discussion method, Questioning method, Assignment method, practical monitoring and supervision method were often used; this is indicated by their mean. This is in conformity with the findings of a study conducted by Research and Curriculum Development Department, Industrial Training Fund (RCDD, ITF, 2014) that the Instructors at the skills acquisition centres in Nigeria employed a number of Training Methods which include Lectures, Discussion, Questioning, Practical and Demonstration. However, the findings contrast the view of Odu and Biose (2003) who stressed that teachers should be able to use wide range of teaching methods to carter for the interest of diverse learners. According to them, some learners may understand a lesson through a certain type of teaching method, while others may understand through different ones.

Conclusion

This study evaluate the implementation of automotive mechatronic programme of the vocational enterprise institutions in Federal Capital Territory Abuja and Kaduna State Nigeria. The findings of the study serve as the basis for making the following conclusion: That on completion of the automotive mechatronic programme of the VEIs in FCT Abuja and Kaduna State, the trainees can function as technicians in automotive and related establishment to a low extent, carry out standard diagnosis on modern vehicle to a low extent, carry out faults rectification on modern vehicles to a low extent. Furthermore,it was concluded that there is ineffective utilization of the training equipment/facilities for the implementation of automotive mechatronic programme of the VEIs in FCT Abuja and Kaduna State and that the automotive mechatronic instructors/technical staff do

not adopt wide range of teaching methods to enhance teaching and learning of automotive mechatronic.

Recommendations

Based on the above revelations from the key findings of this study, the following recommendations were made.

1. The available training equipment/facilities in the Vocational Enterprise Institutions should be properly utilized for the implementation of the automotive mechatronic programmes which will ensure trainees active participation and acquisition of skills
2. The automotive mechatronic instructors/technical staff of the Vocational Enterprise Institutions should adopt other teaching methods like Exhibition method, Project method, Field trip method, Experiment method, Inquiry and problem solving method, Just in time method.

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Perceptions of Undergraduate Students' on Academic Advisors Roles Towards Academic Success in Federal University of Technology, Minna

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Abstract
This study investigated Undergraduate Students' Perceptions of Academic Advisors Roles Towards Academic Success at The Federal University of Technology, Minna, Nigeria. Three research questions were raised. The study adopted a survey research design. The study population consisted of one thousand eight hundred and ninety-nine (1,899) undergraduate students. A total of one hundred and ninety (190) were drawn from the science and technology education school that participated in the study. A twenty-five (25) items Perception of Academic Advisors Role Questionnaire (PAARQ) was used for data collection.Specialists in science education validated the instrument, and its reliability was established using Cronbach Alpha Method and yielded an index of 0.85. The research questions were answered using descriptive statistics (Mean & Standard Deviation). The findings of the study undergraduate students possess a positive perception of the role of academic advisors towards academic success in the University. The role of academic advisors influences students' perception of their school learning environment, and academic advisors' gender affects the role of academic advisors in the University. Based on these findings, the study recommended that institutions should improve their current advising systems to provide students with the advising they need and deserve to be satisfied with their campus experience; school management should organize workshops, seminars and conferences on the issues related to the academic advising at a tertiary institution and both male and female academic advisors should be allocated to each academic level.

Keywords: Undergraduate Students, Perception, Academic Adviser and Academic Success

Background to the Study
In most developed countries, academic advisors are trained professionals who get their tertiary education in fields or courses related to a specific discipline or professional programmes associated with the prospective student in a university system. However, in Nigerian Universities, unlike in advanced countries of the world, academic advising is considered an additional task of the academic staff in the University. Therefore, in this type of academic advising, the lecturers of each department are engaged with the responsibility of academic advising (academic advisers). This academic adviser provides educational and career information services which play an active role in assisting students of all ages in responding to rapid changes and effectively participate in learning processes (Najwa, 2014). According to National Academic Advising (2006), academic advising synthesizes and contextualize students' educational experiences within the framework of their aspirations, abilities and lives to extend learning beyond campus boundaries and timeframe.

Academic advising traces its origin from the earliest American colleges (Brian, 2003). A variety of approaches exist to the educational advising system. They depend on the goals of the advisor-students-interaction, thee principle model of academic advising include developmental advising which emphasized helping students explore, define academic career & life goal, developed

problem-solving and decision making skills through collaborative advising thereby improving the relationship between the Advisor and the students, and it is primarily on adult development theory and students development theory (Crookston, 2009). On the other hand, the prescriptive or traditional model focuses mainly on providing students with information directly related to their academic program and progress, like academic policies, program requirements, graduation requirements, and course selection (Jeschke, Johnson & Williams, 2001). The last one is intrusive (involvement or proactive) advising, which was first introduced by Glennon in 1975 and had a defining feature that contacts are initiated by the Advisor rather than the students (Schwebel, Walburn, Jocobson, Jerrolds, &Klyce 2008).

Academic advising is more successful when advisors hold face-to-face appointments with the advisees, particularly with the topics like futures classes and careers. In addition, participation in academic advising shows increases in students' satisfaction and mitigate students' feelings of isolation and expulsion from the institutions (Fowler &Boylon, 2010). Therefore, the academic Advisor should serve as a facilitator of communication and coordinator of learning experiences through the selection of courses, planning of career and review of academic progress of the students. He also serves as a referral agent to other necessary campus agencies.

Lynam and Cachia (2017) viewed academic success asaccomplishing the learning process, gaining subject knowledge and developing employability skills. It's also the achievement of summative assessment by learning output, achievement of knowledge through remarkable results,s and graduate ability to execute professional roles related to their degree. Naude, Nel, Tadi& Van der Watt (2016) stressed the need for tertiary institutions to promote a growth mindset in students and encourage motivation. Hence, responsibility is placed on educators to instruct and instil the development of abilities in learners through purposely included aspects of the curriculum. Also, a learning environment that will help achieve these goals should be put in place by the school management. As a result of the above benefit of academic advising, some universities have set goals on educational advising programs for the development and success of students. However, research has revealed that minimal studies have been carried out to determine the student's perceptions of the role of academic advisors.

There is a belief that there is a correlation between academic success in the school and the quality of guidance received or provided by the lecturer or instructor in the University. This reason has compelled universities to introduce academic advisors who are usually academic staff to guide students on matters of Academic work or exercises in the University. Therefore, this study was conducted to determine students' perceptions of the Academic Advisor's role as a predictor of academic success in thMinna'sederal University of Technology,

Aims and Objectives of the Study

The specific objectives of this study are set to:

8. Determine whether there is a relationship between students' perception of academic adviser's role and their academic success in the University.
9. Determine whether students' perception of Academic Advisers role influence their relationship with other students.
10. Determine whether students' perception of Academic Advisors role influence their relationship with the school learning environment

Research Questions

In line with the objectives of this study, the following research question is raised to guide the study:

1. What is the perception of undergraduate students on the role of Academic Advisors in the University?
2. What type of perception do students possess on the role of academic advisors on academic success base on their different departments in the University?
3. Does the role of Academic Advisors influence students' perception of their school learning environment?

Research Methodology

The study adopted a survey research design. It is quantitative research in which the researcher administers a survey to a sample or the entire population to describe the people's attitudes, opinions, behaviours, or characteristics. In this procedure, quantitative data are collected by the researcher using a questionnaire and the data is statistically analyzed to describe trends about responses to the questions to test the research questions. The total population of the students in the Federal University of Technology Minna is 21 617. Therefore, the study's target population is all the students in the School of Science and Technology Education (SSTE) in the University in the 2019/2020 academic session, which has 1,899 students. simple random sampling technique was used to select one hundred and ninety (190) undergraduate students from the School of Science and Technology Education, comprisedof students from Industrial Technology Education (ITE), Educational Technology. The students were selected using balloting.

Perception of Academic Advisors Role Questionnaire (PAARQ) was used as an instrument for data collection in this study. The researcher developed it; it contains two sections (Biographical information of the students and views on the academic advising activities). The first section consists of 4 item questions regarding biographical details of the participants. The second section consists of 25 items to evaluate multiple aspects of an advising-based relationship and students' communication with the Advisor on a 5-point Likert Scale. The maximum score is 100, the minimum score is 25, and the average score is 60. A score above 60 signified positive perception and thus acceptance region. A score below 60 indicated no perception and therefore rejection region. The instrument's reliability was established using internal consistency reliability and calculated using Cronbach's Alpha method, and the reliability index was 0.85. The survey data from students were firstly summarized through descriptive statistics. Then, means ($\sum$) and standard deviation (*SD*) were used to answer the research questions.

Research Question 1: What is the perception of undergraduate students of the role of Academic Advisory in the University?

Table 1: Mean and Standard Deviation of Perception Scores of Undergraduate Students on the Academic Advisors in the University

S/N	ITEM	N	$Mean$	$S.D$	Remark
1.	Academic Advisors should be a good listener and patient with students to be able to advise them adequately	190	3.47	1.81	Positive
2.	Academic Advisor should assist student's in the selection of courses related to their area of specialization at the beginning of every session	190	3.64	1.74	Positive
3.	Academic Advisors can help/assist you towards achieving academic success/excellence in the University	190	3.16	1.74	Positive
4.	Advising gives you accurate information about the degree program you're prospecting	190	3.70	1.87	Positive
5.	Academic Advisor can help increase your work rate and ensure development towards academic success	190	3.58	1.86	Positive
	Grand Mean		**3.51**	**1.80**	

The result presented in Table 1 above revealed that the entire respondents (Science Education, Education Technology and Industrial Technology Education Students) possess a positive perception of the role of Academic Advisory in the University. More so, the grand mean equals 3.51 indicates the general perception of the entire students to be positive, while the grand SD (1.80) $\leq \pm 2.0$ shows no significant difference in the students' response. Hence, the academic advisory has a substantial role in students' academic success in the University.

Research Question 2: What type of perception do students possess on the role of Academic Advisory on students' academic success based on their different departments in the University?

Table 1: Mean of Perception Scores of Undergraduate Students on the Academic Advisors in the University Base on Departments

S/N	ITEM	$\bar{X}_1$	$\bar{X}_2$	$\bar{X}_3$	$\bar{X}_T$	Remark
1.	Suggestions from my Academic Advisor influenced my thoughts and relationship with other students in the department and University	4.02	3.71	2.80	3.51	Positive
2.	Academic Advisors are ideally supposed to be enthusiastic, experienced, knowledgeable and highly accommodating	4.13	3.82	2.91	3.62	Positive
3.	Academic advising guides me on the types of friends to keep and how to relate appropriately with them on campus	3.92	3.61	2.77	3.43	Positive
4.	My Academic Advisor sees advising as a cooperative effort	3.86	3.55	2.80	3.40	Positive
5.	Academic advising has helped me to be open-minded among other students at the University	4.02	3.71	2.63	3.45	Positive
	Grand Mean	**3.99**	**3.68**	**2.78**	**3.48**	

The result presented in Table 2 above revealed that the respondents (Science Education and Education Technology) had a positive perception. In contrast, the entire Industrial Technology Education has a negative perception. More so, their respective grand mean $\bar{X}_1$ **=3.99** shows that Science Education possess a robust positive Perception, $\bar{X}_2$ **=3.68** shows that the Education

Technology Students possess a strong positive perception and $\bar{X}_3$ = 2.78 indicate a negative perception of the Industrial Technology Education students type of perception on the role of Academic Advisory on students' academic success based on their different departments in the University. Hence, the academic advisory has significant on students' academic success in the University.

Research Question 3: Does the role of Academic Advisors influence students' perception of their school learning environment?

Table 3: Mean Perception Scores of Undergraduate Students in the Role of Academic Advisors on their School Learning Environment

S/N	ITEM	$\bar{X}_1$	$\bar{X}_2$	$\bar{X}_3$	$\bar{X}_T$	Remark
1.	Academic Advisors should expose students to the basic infrastructures in the university (Library, school clinic)	4.02	3.71	2.54	3.42	Agreed
2.	My academic Advisor refers me to the appropriate personnel office when necessary	3.77	3.46	2.69	3.31	Agreed
3.	Academic advising has helped you to utilize the school facilities appropriately	3.57	3.26	2.57	3.13	Agreed
4.	Academic Advising gives you a referral to campus resources that address the academic problem	3.86	3.55	2.54	3.32	Agreed
5.	Academic advising has helped me to see the school environment as suitable for learning	3.81	3.50	2.89	3.40	Agreed

The result presented in Table 3 above revealed that the respondents (Science Education, Education Technology and Industrial Technology Education Students) agreed with all the items. This implies that the role of Academic Advisors influences students' perception of their school environment.

Research Question 4: Does gender influence the role of academic Advisors in the University?

Table4: Mean Perception Score of Undergraduate Students on the Influence of Gender on Academic Advisors' Role in The University Base on Departments

S/N	ITEM	$\bar{X}_1$	$\bar{X}_2$	$\bar{X}_3$	$\bar{X}_T$	Remark
1.	Male Academic Advisors are comparatively better than their female counterparts in the University	3.62	3.31	2.00	2.98	Agreed
2.	Female Academic Advisors are even better than their male counterparts in the University	4.18	3.87	2.51	3.52	Agreed
3.	Male Academic Advisors are easily accessible and respond to students request on time	3.53	3.22	2.34	3.03	Agreed
4.	Female Academic Advisors are even more easily accessible than their male counterparts	3.47	3.16	2.46	3.03	Agreed
5.	You easily interact and relate personal issues to the Academic Advisor irrespective of the gender	4.12	3.81	2.77	3.57	Agreed

The result presented in Table 4 above revealed that the respondents (Science Education, Education Technology and Industrial Technology Education Students) agreed with all the items. This implies that academic advisors' gender influences the role of academic Advisors in the University.

Summary of Findings

1. Undergraduate students possess a positive perception of the role of academic advisors towards academic success in the University
2. In all three departments, undergraduate students have a positive perception of the role of academic advisors on the students' academic success in the University
3. The role of academic advisors' influences students' perception of their school learning environment.
4. Academic advisors' gender influences the role of academic advisors in the University.

Discussion of the Findings

The finding shows that the respondents agreed with all the items. This implies that undergraduate students possess a positive perception of the role of academic advisors towards academic success in the University. The perceptions include; academic Advisor should assist students in selecting courses related to their area of specialization at the beginning of every session; Academic Advisor can help increase your work rate and ensure development towards academic success. These affirm that understanding the life themes that students are coping with at various stages of development, 'such as searching for identity and purpose may help advisors to focus their interventions with students on what should be taught during each encounter with students' rather than merely on what students' present as questions.'

The finding of this study revealed that, in all three departments, undergraduate students have a positive perception of the role of academic advisors on the students' academic success in the University. The perception includes; academic advisors are ideally supposed to be enthusiastic, experienced, knowledgeable and highly accommodating; academic advising guides me on the types of friends to keep and how to relate appropriately with them on campus. These are all in conjunction with the late 1950s and 1960s depicting that students expressed an interest in academic advising moving beyond a prescriptive scope; students' wanted advisors who took a greater interest in their needs and abilities along with advisors who were able to develop interpersonal relationships with them (Crookston, 2009).

It was also observed that the role of academic advisors' influences students' perception of their school learning environment. From the finding, the perceptions include; academic advisors should expose students to the basic infrastructures in the University (Library, school clinic), academic advising has helped you to utilize the school facilities appropriately, advising gives you a referral to campus resources that address the academic problem; Academic advising has enabled me to see the school environment as suitable for learning. This is in line with Lynam&Cachia, (2017) findings that, in developmental advising, the Advisor develops a stronger relationship with the advisee so that the Advisor and student together make decisions about their roles throughout the advising process.

It was also observed that academic advisors' gender influences the role of academic advisors in the University. Therefore, gender affects the function of academic advisors in the University. The perceptions include; male academic advisors are easily accessible and respond to students request on time; female academic advisors are even more easily accessible than their male counterparts; You easily interact and relate personal issues to the Academic Advisor irrespective of gender. This is following research carried out byKrist (2013), who examined multiple factors that determined

at-risk students specifically, race, gender, high school GPA, standardized test score, semesters living on campus, enrollment status, and socioeconomic status.

Conclusions

1. An excellent Academic Advisor gives students all the necessary assistance they may require, helps students increase their work rate, and gives them accurate information, thereby achieving academic success.
2. Academic Advisors are ideally supposed to be enthusiastic, experienced, knowledgeable and highly accommodating so that they influence students' thoughts, advise on the types of friends to keep and how to relate appropriately with them on campus
3. Academic Advisors expose students to the basic infrastructures in the University (Library and school clinic), referring them to the appropriate personnel and guides them on how to appropriately utilizes school facilities which will make the school environment suitable for learning.
4. Both male and female academic advisors are easily accessible and allow students to easily interact and relate personal issues to them.

Recommendations

1. With the support of past research and the results from this study, institutions should improve their current advising systems to provide students with the advising they need and deserve to be satisfied with their campus experience.
2. Academic advisors should be encouraging by the school management through allowances, giving an award and appreciation letter to the best academic adviser of the year.
3. School management should organize workshops, seminars and conferences on the issues related to the academic advisers at the tertiary institutions.
4. Academic Advisors should be good listeners, patient with students, and give students all necessary assistance they may require. They musthelp students increase their work rate and give them accurate information, thereby achieving academic success. In addition, academic advisors should expose students to the basic infrastructures in the university (Library, school clinic), referring them to the appropriate personnel and guides on how to appropriately utilizes school facilities which will make the school environment suitable for learning.
5. Both male and female academic advisors should be allocated to each academic level

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Application of Learning Styles inTechnical Education: Meta-Learning Perception

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Abstract
The idea of meta-learning describes the state of 'being aware of and taking control of one's own learning' while learning styles address the ways students perceive and process new information. This paper explores the perception in which meta-learning involving students' learning styles. An evolved conception is proposed in which meta-learning is a sub-concept within metacognition and self-regulation. It is professed as a kind of creativity that is best displayed by proactive self-regulators for whom deliberate self-regulated learning is a way of life. This perception of meta-learning is dependable with the 'awareness' and 'taking control of' elements of Biggs' original definition. The application of learning styles in conjunction with meta-learning concept is to help students of technical education to connect thinking about their own learning styles in order to achieve smooth learning processes.

Keywords: Technical Education, Learning Styles and Meta-Learning

Introduction
Knowledge acquisition is realized through education and learning. Learning plays an important role in man`s social progress, yet learning process is a complicated and multidimensional process. Psychologists and those involved in education have developed various methods of learning and teaching with regards to their own intellectual systems and proportional to the educational changes. It is expected that classroom learning be transferred into solving problems in real life situation. The inability of students to engage actively in the learning process (especially learning that require minds and hands like that of technical education) tends to dispose the students to constant rote learning and frustration leading to poor academic performance (Eze, Ezenwafor & Obi, 2015).

Technical education is an integral part of education that is meant to produce semi-skilled, skilled and technical manpower necessary to restore, revitalize, energize, operate and sustain national economy and largely reduce unemployment in the word of science and technology (FGN, 2013). The United Nations Educational, Social, and Cultural Organization (UNESCO) and The International Labour Organization (ILO) (2002) recommended that Technical education system should be geared towards lifelong learning that can maximize the creative potentials and skills of the individual through effective learning styles. Active learning style is required to uplift the sensational aspect of students for smooth learning process. This cannot be achieved if appropriate learning styles through meta-learning are not employed during and after instructional strategies for technical education students.

The appropriate learning styles among technical education have generated to meta-learning that helps students to have understanding, aware and control of the learning processes that lead to skill

acquisitions. The term meta-learning is synonyms with thinking about learning styles that individual adopted for learning processes. Through meta-learning, technical trades such as building trades, electrical/electronic trades, automobile trades, woodwork trades, metalwork trades among others trades in technical college can allow students to plan, execute, monitor and evaluate the learning activities by themselves. Thus, meta-learning can enhance technical college students' learning styles in order to assist learners to have a deeper awareness of the content and context in their specialized trades.

Meta-learning is originally described by Maudsley (1979) as "the process by which learners become aware of and increasingly in control of habits of perception, inquiry, learning, and growth that they have internalized". Based on this definition, Eze, Ezenwafor and Molokwu (2015) regard meta-learning as a student-centered (self-regulated) approach to teaching and learning. Meta-learning is then important in understanding the interaction between the mechanism of learning and the concrete contexts in which that mechanism is applicable. The field of meta-learning is focused on the relation between tasks or domains and learning strategies that can be used to improve learning style of learners.

Maudsley's conceptual on meta-learning synthesized under headings and assumptions, structures, change process and facilitation. He enunciated five principles that facilitate meta-learning in which students (technical education students) must;

a. Have a theory, however primitive
b. Work in a safe and supportive social and physical environment
c. Discover their rules and assumptions
d. Reconnect with reality (information from the environment) and **e.** recognize themselves by changing their rules and assumptions. The design was later adopted by Biggs (1985) to describe the position of being aware of and taking control of one's own learning. According to Biggs, the concept is framed around the idea of being aware of and taking control of one's own learning. Implicit in this conception is that technical education students need to have knowledge of how they learn, have the motivation to be proactive in managing themselves and the capacity to regulate their learning styles.

Technical Education

Technical education is expected to create manpower that will assist to uplift Science and Technology to the next level to solve human problem. A level of understanding of learning that can be possessed to solve human problem requires technical students to know how to learns, can learn and develop their learning styles to achieve smooth learning process. Technical education is an aspect of education that exposes the learner to acquisition of demonstrable skills that could be transformed into economic benefits (Akerele, 2007). However, UNESCO and ILO 2002 sees technical education as a comprehensive term which encompasses the study of technologies and related sciences, and the acquisition of practical skills, attitudes, understanding and knowledge related to occupations in various sectors of economic and social life.

According to Man (2005) technical education is the systematic and orderly transmission of knowledge, skills and values to develop a workforce that is able to enhance productivity and sustain competitiveness in the global economy. The Federal Republic of Nigeria (FRN, 2004) affirmed the goals of vocational technical education as to;

1. Provide trained manpower in the applied sciences, technology and business particularly at craft and advanced craft levels.
2. Provide the technical knowledge and vocational skills necessary for agricultural, commercial and economic development.
3. Give training and impart necessary skills to individuals who shall be self-reliant economically. These can only be achieved if students of technical education are engaged with right learning styles that involve meta-learning skills.

Learning Styles in Technical Education

Just as teachers develop preferences for particular methods, students develop preferences for particular way of learning which is called learning styles. Teachers and students, probably have preferred ways of perceiving and processing new information. These preferred ways can be called learning styles. Educators cannot dismiss the fact that individuals have preferred ways of learning throughout different stages of learning.

Learning styles address the ways students perceive and process information. Perceiving relates to the way students notice the learning and the way the reality of learning is. Processing relates to the way students internalize an experience and make it their own. Some students prefer to perceive the learning through ***concrete experience***. These students of technical education perceive by sensing and feeling, and prefer to use intuition to solve the problems of a given task showed. They function well in unstructured situations. Other students prefer ***abstract conceptualization***. They like to think things through, analyze and intellectualize. They function well in structured situations. Some students prefer to process new information by ***active experimentation***. They like to roll up their sleeve and immerse themselves in the task. They look for practical ways of applying what they learn. They embrace risk-taking and are results oriented. Other students process through ***reflective observation***. They like to watch and ponder the situation. They likely see tasks from several points of view. These students value patience and judgment. Concrete experience, abstract conceptualization, active experimentation and reflective observation are four general learning styles.

Theories of Learning Styles and Categories of Learning Styles

There are numerous theories of learning styles and categories of learning styles associated with the theories. Rita Dunn and Kenneth Dunn's learning styles inventory focuses on the environmental, emotional, sociological, physiological and psychological aspects of learning in which all students must find themselves in one or two aspects. Howard Gardner's theory of Multiple Intelligences derives nine learning styles from his nine intelligences. Their learning styles are derived from combinations of these aspects.

Global or Feeling*:* prefer to have big pictures of tasks presented first. Learn most effectively when a meaningful context is provided.

Analytic or Thinking: prefer to have small steps build to whole. Learn most effectively when pieces are provided first.

Verbal: rely on words and labels. Prefer to have definitions over images.

Imaginal or Intuitive: prefer to have images (concrete or abstract), metaphors, symbols and diagrams. Difficult concepts are best explained through images.

Concrete or Sensing: prefer concrete examples, followed by concepts or principles.
Abstract or Intuitive: prefer concepts of principles prior to concrete examples.

Haptic, Trial and Feedback or Judging: prefer doing tasks and hands-on applications followed by feedback. Prefer to make errors and build on trials and errors.

Reflective or Perceptive: prefer to think through and reflect on tasks prior to trials. More dependent on time to respond than on external feedback.

Relational: prefer to link new material to what is already known, or unfamiliar tasks to familiar tasks. These students need time to discuss what is being learned prior to executing the tasks.

Generally, the following nine learning styles, in pairs, are considered to be the most common. Of course, most of students' function by accommodating combinations of a range of learning styles. The most common test of learning style is the 126 items Myers-Briggs Type Indicator(MBTI), Form G. The MBTI provides data on four sets of preferences. These preferences result in 16 learning styles, resulting from combinations of Introversion versus Extraversion, Thinking versus Feeling, Sensing versus Intuition and Judging versus Perceptive.

Thinking students value fairness. They place great weight on objective criteria in decision making and judge situations on logic and reason. Data on *Star Trek* had an extreme preference for thinking. ***Feeling*** students value harmony. They focus on emotions and needs as they make decisions or arrive at judgments. They tend to be good at conversation, persuasion and facilitating differences among group members. The character played by Whoopi Goldberg on *Star Trek* demonstrated an extreme preference for feeling. Some students choose to rely on their five senses and prefer taking in information through a "sixth" sense. **Sensing** students are detail oriented and want facts and explanations. **Intuitive** students, on the other hand, seek out patterns and relationships among pieces of information. They trust hunches and their intuition and look for the "big picture." Some of students prefer to postpone action and seek more information. **Judging** students are decisive, plan out their decision and are self-regimented. They focus on completing the task, only want to know the essentials, and speak or act quickly, often too quickly. Deadlines and clearly defined roles are extremely important. They prefer to "just do it!" **Perceptive** students are curious, flexible and relatively spontaneous. They start many tasks, have to know the details about each task and often find it hard to complete a task.

Another learning style theory is that of Bernice McCarthy's learning style theory which is based on right brain, left-brain neurological science. Bernice McCarthy expanded on Kolb's learning cycle, and defined her four general learning styles as Imaginative, Analytic, Commons Sense and Dynamic in which technical education students can find themselves: *"imaginative learners prefer to experience and reflect, analytic learners prefer to conceptualize and reflect, commons Sense learners prefer to experiment and conceptualize and dynamic learners prefer to experiment and experience".*

McCarthy stresses that students should accommodate all four of these learners in our activities or lessons.

Most learning styles, including McCarthy's, are based of perceptual modality preferences. Perceptual modality refers to the way we perceive or take in the world. The notion of sense modalities is based on the Perceptual Learning Styles theory of French, Gilley and Cherry. Perceptual learning styles refer to the means by which learners extract information from their surroundings through the senses. Each individual has a preferred sense for accessing knowledge—they use different "pathways" specific to them. Initially, knowledge is stored in short-term memory. Repeated exposure, experience and application promote retention in long-term memory.

Perceptual Learning Styles refer to the pathways we use to access and reinforce knowledge. According to this theory, there are seven pathways or learning styles at work in the average classroom: These seven pathways or learning styles can be adopted and adapted for students of technical education:

1. ***Print****:* refers to seeing printed or written words.
2. ***Aural****:* refers to listening.
3. ***Interactive****:* refers to verbalization.
4. ***Visual****:* refers to seeing visual depictions such as pictures, graphs.
5. ***Haptic****:* refers to the sense of touch or grasp.
6. ***Kinesthetic****:* refers to whole body movement.
7. ***Olfactory****:* refers to sense of smell and taste.

For example, dynamic and common sense learners tend to be haptic, kinesthetic or enactive. They prefer to learn by physical contact and the "mind's hand." Imaginative learners tend to be visual or iconic. They prefer to learn by figural and spatial thinking or the "mind's eye." Analytic learners tend to be auditory or symbolic. They learn through verbal thinking or the "mind's ear."
Meta-learning Perceptions

We all permeate words with different meanings. The conception and propositions of meta-learning is perceived as: a collection of learning methods that people utilize to help them learn; learning about learning; personal knowledge of learning; metacognition in action; meta-learning embraces more than cognition; it embraces the affective, cognitive mind, body, emotions/feelings; consciousness/awareness of own learning practices and study strategies; awareness of own approaches to learning; imagining possible ways of learning. **Norman (2004) reveals a number of things about the way meta-learning is perceived. For** example:

- The strong connection of meta-learning to metacognition, self-awareness, self-identity as a learner and reflection as a process for achieving this self-awareness as a learner.
- Meta-learning as a product (knowledge), a thought process (a way of thinking to create routes to new learning), an attitude or habit (a way of engaging in learning and life more generally perhaps), a behavioural process (active regulation of behaviours in ways that will enhance learning).
- A way of growing knowledge about learning by imagining and thinking about the future, the present and the past.

According to Davenport and Prusak (2000) meta-learning definition depends on the perception of individuals and it usages. Using conception of Davenport and Prusak generated from participants in email discussion, meta-learning defines as:

- A collection of learning methods that people utilize to help them learn
- Higher levels of learning
- Learning about learning
- Personal knowledge of learning
- Being aware of and taking control of one's own learning
- Changing perceptions of learning
- Knowledge about how other people learn in order to help me learn (selfish or selfless knowledge depending on purpose)
- Metacognition
- Metacognitive skills
- Applied metacognition
- Metacognition in action
- Metaleaming embraces more than cognition, it embraces the affective, cognitive, connative and also embodiment... mind, body, emotions/feelings
- Consciousness/awareness of own learning practices and study strategies
- Awareness of own approaches to learning
- Awareness of what works or doesn't work
- The advisory function to self about how to learn in a particular situation
- Learning through reflection, reflective skills, different forms of reflection
- Taking the learning context into account
- Recognizing own motivations for learning
- Knowledge of self as a learner in a context
- A sense of identity in the learning process
- A sense of engagement with learning processes
- Regulating own behaviours in order to learn better/more deeply
- Helping people to be more effective learners
- A route to further metacognition
- The ability to stand back and see the bigger picture for learning
- Capacity to think about processes for learning
- Imagining possible ways of learning
- Imagining the future
- Ability to connect and use different sorts of knowledge creatively

Meta-learning as Metacognition

Flavell (1979) defines metacognition in terms of 'higher order thinking to actively control the cognitive processes engaged in thinking and acquiring knowing' (learning). It involves thinking about thinking and it must therefore include thinking about learning.

> *Is the whole concept of meta not that of 'thinking about'? So metacognition is thinking, to good purpose, about how the processes of cognition work, and in particular, about how they can work for users. Meta-learning is thinking about how one's learn, and can learn and develop more effectively.*

Activities such as planning how to approach a given task, monitoring, understanding and learning needs, and evaluating progress towards completion of the task or modifying the task as additional factors emerge, are metacognitive in nature. Wenden (1998) described 'metacognitive knowledge' as the 'facts learners acquire about their own cognitive processes as they are applied and used to gain knowledge and acquire skills in varied situations: People consciously or unconsciously use this knowledge to create metacognitive strategies, strategies about learning rather than learning strategies themselves. These strategies include, for example:

11. Planning—deciding what to do and how to do it (pre-planning) and modifying plans while you are doing it (planning in action).
12. Directed and Selective attention—deciding in advance to work on the general aspects of a task and deciding in advance to concentrate on certain things.
13. Self-monitoring—checking one's performance when engaging in a task.
14. Self-evaluation—appraising one's own performance in relation to self or external criteria or standards.
15. Self-reinforcement—rewarding oneself for success.

According to Flavell (1979), metacognition consists of both metacognitive knowledge and metacognitive experiences of regulation. Metacognitive knowledge refers to acquired knowledge about cognitive processes; knowledge that can then be used to control cognitive processes. Knowledge is considered to be metacognitive (rather than cognitive) if it is actively used in a strategic manner to ensure a goal is met. Flavell distinguishes between knowledge of person variables, task variables and strategy variables. *Knowledge of person variables:* refers to knowledge about how human beings learn and process information, as well as individual knowledge of one's own learning processes. *Knowledge of task variables*: includes knowledge about the nature of particular tasks or more generalized knowledge about types of task as well as the processing demands that will be placed upon the individual. *Knowledge about strategy* variables: include knowledge about both cognitive and metacognitive strategies, as well as conditional (contextual knowledge) about when and where it is appropriate to use such strategies.

The basic meta cognitive strategies in meta-learning according to (Dirkes, 1985; and Blakey & Spence, 1990) are connecting new information to existing (personal) knowledge, selecting thinking strategies intentionally and planning, monitoring and evaluating thinking processes. The idea of meta-learning sits fairly and squarely within metacognition: that part of metacognition that is devoted to the act of learning in relation to learning styles. There is a merit for students to trace their learning styles through metacognition. To do this, learning styles have to be connected to the process of thinking about learning that allow students to be aware and control their own learning.

Meta-learning and Self-regulation

Biggs' (1985) definition of meta-learning included the idea of 'taking control of one's own learning'. This requires learners to consciously regulate their thinking and behaviours in ways that will achieve desirable outcomes and results for a particular context. It is therefore important to consider the idea of self-regulation. Schunk and Zimmerman (1994, 1997, 1998), Zimmerman (2000) and Zimmerman and Schunk (2004) provide a well-developed scientific construction to explain the links between thinking, actions and the environment (problem situations and learning contexts) within which thinking and action occurs.

Some social cognitive researchers describe self-regulated learning in terms of self-determined processes and associated self-beliefs that initiate, change and sustain learning in specific contexts. These processes and beliefs are linked to three fundamental questions about students' self-regulated approach to learning.

> ***How*** *questions refer to students' use of metacognitive processes such as planning, organizing, self- instruction, self-monitoring and self-evaluating. Where questions pertain to behavioral processes such as selecting, structuring and creating learning environments that optimize growth. .High levels of motivation are necessary to self-regulate when short term goals must be subordinated to long term goals and ultimate gratification must be delayed. In summary, self-regulation refers to metacognitive, behavioral and motivational processes and beliefs used to attain personal learning goals in specific contexts. (Zimmerman, 2000).*

The processes and beliefs that underlie self-regulation are constantly adjusted in response to changes in three sources of control: personal, behavioral and environmental (Zimmerman, 2000). Each of these sources is also changing during learning and each source must be self-monitored and adjusted using feedback mechanisms constructed by the learner. Highly self-regulated people are strategically flexible, environmentally resourceful and perceptive of personal agency. A self-regulated system for learning can be represented as a continuous process that involves *forethought, performance* and *self-reflection* operating within a context specific environment that is structured by the learner to provide resources for learning.

Forethought involves thinking about the tasks, problems and contexts for learning. The model identifies two subordinate categories—task analysis and self-motivational beliefs.

Performance is the doing part of the process. It includes the capacities and attitudes to instruct self and seek help to learn, the self-management of tasks, the creation of processes for learning and the structuring of the environment in order to learn.

Self-reflection phase involves both self-judgments and self-reactions to those judgments. The two key self-judgment processes are self-evaluation and attributing causal significance to the results.

Zimmerman and Schunk (2004) draw the distinction between proactive and reactive self-regulators in terms of self-regulatory processes and beliefs. Reactive learners avoid forethought and attempt to regulate functioning during and after performance whereas proactive learners engage in forethought in order to improve the quality of subsequent phase functioning. It might also distinguish between learners with high levels of self-awareness and intentionality, and those with less well developed. The development of capacity for self-regulated learning have be seen as a process in which the technical educator can play an active and facilitative role to the way of growing knowledge about learning known as meta-learning.

Norton and Walters (2005) explained that meta-learning depends on the learner's conceptions of learning, epistemological beliefs, learning processes and academic skills which are summarized as learning approach that students can adopted and used as their learning styles. Through meta-learning students of technical education can plan, execute, monitor and evaluate the learning

activities to gain smooth learning process that can lead to academic success. Therefore, meta-learning can enhance technical education students to have a deeper awareness of the content and context of the learning process within their learning styles in their specialized trades

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Assessment of Extrinsic and Intrinsic Motivational Factors Among Science Teachers Attrition and Retention in Minna Metropolis Niger State

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Abstract
Teacher attrition and turnover is an educational wastage in terms of resources and manpower. The purpose of this study was to determine the assessment of extrinsic and intrinsic motivational factors on science teachers' attrition and retention in public secondary school in Minna metropolis Niger state. The study adopted the descriptive survey design and was guided by two research questions. The population of the study consistsof 1320 science teachers in Minna metropolis, Niger state. The sample for the study was 132 scienceteachers in Minna metropolis Niger state. Researcher designed a 5-point scale questionnaire which was validated by experts, tested for reliability and was used for data collection. Mean and standard deviations were used to answer the two research questions. The findings show among others that teacher attrition or teacher turnover takes place for a number of reasons which include low social recognition for teachers and lack of opportunities for professional development. Based on the findings, it was recommended that government should intensify programmes for teachers' development and capacity building. The society in general and employers of teachers in particular should do all that is needed to accord the teaching profession its rightful pride of place among professions.

Keywords: Attrition; Extrinsic and Intrinsic Motivation; Teacher Retention

Introduction
Education in the recent years has deteriorated all over the world which shows that the skills of teaching have greatly declined due to inadequate preparations on the part of the teachers and the stagnant compensation scheme by the educational institution management. This condition in the recent years for the teachers has led to inadequate compensation structure and very few growth opportunities. The role of employees in organizational (educational) success is undisputable and teachers "both in-role and extra-role" are critical for effective functioning of schools. Traditional approaches in educating teachers are criticized for disconnecting from the reality (Marshal, 2012). Teachers are the basic ingredients in the educational advancement of any nation, so the education system must be responsible and responsive enough to ensure the recruitment, training and retention of adequate, skilled and high performing teachers for the nation's educational goals to be achieved. However, teacher attrition especially at the secondary school level has become a major challenge to achieving the educational goals. Teacher attrition, also referred to as teacher turnover, is a phenomenon that is characterized by teachers leaving work in the classroom to take up and pursue other professional responsibilities inside or outside the educational system (Miller & Chait, 2018). It is the educational sector labour mobility by which, among other reasons, teachers seek professional 'greener pastures' which in turn leaves the school bereft of much needed teaching staff

Teacher plays pivotal roles in the development of any nation. No nation can successfully develop manpower base without the efforts of teachers. Teachers are the trainers of other professionals, needed for economic, technological, political, cultural, and social development of a nation. Specifically, they train the engineers, architects, quantity surveyors, who in turn help in ensuring the quality of infrastructure; the lawyers, judges, managers, who help to maintain law and order, as well as peace; the bankers, business administrators, insurance experts, who help to develop the economy; and the doctors, pharmacists nurses, just to mention a few, who in one way or the other help to protect the life of the citizens. Teacher also helps in promoting values in the society, maintain discipline among pupils or students in schools, the values, which are transferable to the same society (Grissmer,2013).

Teacher attrition is a major problem in Nigeria and the world at large. According to Efang (2019) teaching profession has the highest attrition rate of all professions. The introduction of educational programmes such as Universal Basic Education has brought about a large increase in enrolment at the primary and secondary levels of education, without a corresponding increase in teaching strength of schools. Teachers continue to retire, while others move to other jobs outside the education system for a variety of reasons. It becomes expedient to investigate the causes of teacher attrition. Teaching is often referred to as a noble profession but most people's assessment of the monetary and non-monetary benefits in the profession vis-à-vis other professions which compel prospective teachers' corp to seek alternative careers and as well teachers to leave the profession. This state of affair is worrisome and calls for urgent solution.

When teachers cite reasons for leaving their job, most involve non-salary-related dissatisfaction, teachers most frequently cite excessive workloads and high-stakes testing, disruptive student behavior, poor leadership and administration within schools, and views of teaching as a temporary profession. Most strategies identified in the research as cost effective and influential in convincing teachers to remain relate to improving teachers' work environment and providing professional development (Wilson *et al.*, 2015).

These high attrition rates mean students incessantly face inexperienced teachers and that schools face the higher economic costs of periodically hiring and training of new teachers. High turnover rates also disrupt the team-based, organizational structure and functioning of a school as well as interrupting the planning and implementation of a coherent, comprehensive, and unified curriculum (Guarino *et al.*, 2014). The advantages of having highly qualified science teachers are clear but it is not so clear what attracts and keeps highly qualified teaching staff and what drives them out of schools and the profession. The burning questions challenging educators from the federal to the local level today are:

a. What will increase the power of the teaching profession to recruit and retain well-prepared, experienced, accomplished, high-quality teachers?

b. What will create a stable, expert teaching force in all kinds of schools and districts?

Where teachers that are leaving a school are quitting the profession entirely, this causes additional damage to pupils/students' attainment at the systemic level. Teachers quickly become more effective, in terms of their ability to improve attainment, during their first few years on the job (Reeves, 2014).Performance of teachers mainly depend on the teacher's characteristic such as

knowledge base, sense of responsibilities and inquisitiveness which are intrinsic; the student characteristics such as opportunity to learn and academic work, the learning aspect such as involvement and success and the classroom phenomena such as environment and climate (Sanchez 2017). The requirement that schools staff all classrooms with "highly qualified teachers" has created challenges for many schools, particularly those in inner city and poor rural areas.

Statement of the Research Problem

The issue of teacher shortage has been a topical and recurring problem in Nigeria. It has been noticed that the number of available teachers in schools is far below the needed capacity for effective teaching. A report, by Teachers Registration Council of Nigeria (2018), indicates that, 250,000 teachers must be available in Nigeria annually, to tackle the acute shortage of teachers at the basic and secondary levels. The problem of acute shortage of teachers is being worsened by teacher attrition. There has been high-level teacher attrition in secondary schools in Nigeria (Ibukun,2014). Teacher attrition not only undermines the achievement of school objective, it also constitutes wastage of resources, occasioned by leaving costs, costs of replacement, training cost of replacements, and indirect cost of down time needed for new teachers to gain proficiency. Even though there are studies on teacher attrition and retention, those factors influencing it from deeper perspective, are few in literature, in spite of the negative effects of the menace in schools and the educational system generally. In the light of this shortcoming, this study is poised to add to the volume of researches on the assessment of extrinsic and intrinsic motivational factors among science teachers to attrition and retention in public secondary schools in Minna metropolis, Niger state.

Aim and Objectives of the Study

The aim of the study is to examine the assessment of extrinsic and intrinsic motivational factors among Science teachers to attrition and retention in public secondary schools in Minna metropolis, Niger state.

Research Questions

The following research questions were used to guide the study:

1. What are the extrinsic determinants of Science teachers to attrition in public secondary school in Minna metropolis, Niger state?
2. What are the intrinsic determinants of science teachers to attrition in public secondary school in Minna metropolis, Niger state?

Research Method

The study was a descriptive survey conducted in Minna metropolis Niger State. The population of the study was made up of 1320 science teachers in public secondary school in Bosso and Chachanga local government area. The sample for the study was 132 public secondary science teachers in Minna metropolis Niger state. This represented 10% of public secondary science teachers in Bosso and Chachanga local government area as part of Minna metropolis Niger state. The choice of 10% is in line with the recommendation made by Kunje (2012) that in a survey involving a population of few thousands, at least 5% of the population should be used as the sample size. Data were collected with an instrument adopted by the researchers. It has four (4) sections. Section A sought personal data from respondents and gave instructions on how to fill the questionnaire. Sections B, C and D contained items of the questionnaire. The response options

were Strongly Agree (SA), Agree (A), Neutral (N), Disagree (D) and Strongly Disagree (SD). This instrument was duly validated by two experts in science education department and one expert from educational technology department, federal university of technology Minna, Niger state. To ascertain the reliability of the instrument, the test-retest method was adopted using 20 copies of the questionnaire to collect data from 20 teachers in secondary schools in Gurara Local Government area of Niger state. Chronbach Alpha was used to test the reliability which yielded an average index of 0.73. Data collected was analysed using mean and standard deviations.

Results

Research Question 1: What are the extrinsic determinants of Science teachers to attrition in public secondary school in Minna metropolis, Niger state?

The descriptive statistics of Mean and Standard Deviation was used to answer this research question and the summary of the results is presented in Table1

Table1: Mean Response on the extrinsic determinants of Science teachers to attrition in public secondary school in Minna metropolis.

No	Items	N	x□	S.D	Decision
1	Teachers leave their job temporarily on secondment to other government establishment.	132	3.93	0.774	Agreed
2	Teachers leave the teaching profession to work in new areas not related to teaching	132	3.48	0.502	Agreed
3	High performing teachers leave when they are appointed into political offices	132	4.63	0.485	Agreed
4	Many science based teachers leave teaching to pursue other careers	132	3.96	0.795	Agreed
5	Some teachers remain in their job and do other business.	132	4.15	0.860	Agreed
6	Teachers leave their job due to inadequate instructional materials and facilities	132	3.51	1.052	Agreed
7	Student discipline referrals is a major reason why teachers seek new job offer in other organization	132	3.02	1.413	Agreed
8	Some teachers take teaching as a temporal job while awaiting other jobs	132	3.96	0.851	Agreed
9	Teaching job is the only alternative to my survival at the moment	132	4.05	0.809	Agreed
10	Principal behaviours and other organizational matter is a key factor for teachers seeking other job alternatives	132	3.97	0.791	Agreed
			3.87		

Decision Mean = 3.00

Table 1 reveals the Mean Response on the extrinsic determinants of Science teachers to attrition in public secondary school in Minna metropolis. All items produced high mean scores which were above bench mark of 3.0. Items with higher Mean rating includes item 3: High performing teachers leave when they are appointed into political offices ($\bar{x}$= 4.63, SD =0.485), item 5: Some teachers remain in their job and do other business. ($\bar{x}$= 4.15, SD =0.860). The table also reveals grand mean of 3.87which shows most Science teachers in public school attrition is as a result of extrinsic determinants.

Research question 2: What are the intrinsic determinants of science teachers to retention in public secondary school in Minna metropolis, Niger state?

Table 2: Mean Response on the intrinsic determinants of science teachers to retention in public secondary school in Minna metropolis.

No	Items	N	x□	S.D	Decision
1	Low salary	132	4.07	0.840	Agreed
2	Late payment of salary	132	4.07	0.764	Agreed
3	Lack of teachers participation in decision making Process	132	3.73	0.872	Agreed
4	Excessive workload	132	4.59	0.494	Agreed
5	Student discipline referral	132	4.05	0.785	Agreed
6	Inadequate access to rest and holiday	132	3.72	1.021	Agreed
7	Posting to rural and remote area/zones as primary place of assignment	132	4.55	0.584	Agreed
8	Other issues related to health and medical challenges	132	3.91	0.805	Agreed
9	Inadequate years of teaching experience	132	4.02	0.886	Agreed
10	Unequal work distribution or dual behavior of my supervisor in the school of teaching.	132	4.42	0.689	Agreed
			4.11		

Decision Mean = 3.00

Table 2 reveals the Mean Response on the intrinsic determinants of science teachers to retention in public secondary school in Minna metropolis. All items produced high mean scores which were above bench mark of 3.0. Items with higher Mean rating includes item 4: Excessive workload ($\bar{x}$= 4.59, SD = 0.494), item 7: Posting to rural and remote area/zones as primary place of assignment. ($\bar{x}$= 4.55, SD = 0.584). The grand mean proves that most Science teachers in public school retention can be as a result of intrinsic determinants also.

Discussion of Findings

Finding reveals that Science teachers in Minna metropolis public school attritions and retention is as a result of extrinsic determinants. In regard to references from Brown *et al*., 2018 & Kelly 2018 show that teachers attribute part of their decision to leave on administration behaviors, the

researchers further stated that the teachers' (a) Excessive pressure, (b) Corrupt administration practices, (c) Disrespect to teachers, and (d) Reduction of teacher moral which leads to Science teachers' attritions and retention in schools. The above mentioned are a result of extrinsic determinants.

Finding reveals the Mean Response on the intrinsic determinants of Science teachers to attrition and retention in public secondary school in Minna metropolis. Many teachers leave their job because of principal behavior and Teachers with higher educational qualifications tend to leave the teaching job more than their counterparts with lower qualifications. This finding is in agreement with the following researches: Brown *et al.*, (2018) and Kelly (2018) who found out that that teachers attribute part of their decision to leave on administration behaviors, the researchers further stated that the teachers' (a) Excessive pressure, (b) Corrupt administration practices, (c) Disrespect to teachers, and (d) Reduction of teacher moral which leads to Science teachers' attritions and retention in schools. The above mentioned can be attributed to lack of extrinsic determinants.

Conclusion

From the results of this study, it was concluded that teacher attrition is caused mainly by the low status accorded the teaching profession; poor work environment and poor remuneration, lack of opportunities for professional development, non-involvement of teachers in decision-making are some of the causes of high teacher turnover. The government and all concerned with education must stop paying lip service to the importance of education and take immediate steps to curtail teacher attrition.

Recommendations

Based on the findings, the following recommendations are made:

1. The government should make deliberate and sincere efforts to recruit and retain the best caliber of people into the teaching service by improving teachers' conditions of service and improving the social status of teachers.
2. Provision of accommodation, with amenities such as potable water, electricity and health services for rural schools will help entice new young teachers to accept postings to the rural areas.
3. Government should step up the recruitment of qualified teaching staff in vital core subjects that lack teachers in order to reduce excessive workloads for the limited number of existing teachers in these subjects.
4. Human capital development programmes through in-service training and study leave with pay must be emphasized to help teachers professionally actualize themselves.
5. Indigenes of places with peculiar circumstances (such as remote and inaccessible areas) that teachers reject postings / transfers should be recruited to teach in their local environments.

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SUB-THEME: Instructional Approaches in STEM and TVET

Application of Technical Vocational Education and Training in Science Technology Engineering Mathematics for the 21st Century Learning in North Central Nigeria

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Abstract

The study adopted descriptive survey as the research design using 30 items structured questionnaire as instrument to retrieve opinions and information from the respondents. Three research questions and two hypotheses were raised for the study. The population for data collection was (85) respondents involving TVET lecturers and instructors selected from two tertiary institutions in each State (Benue, Kogi, Kwara, Niger, Plateau, Nasarawa) of North Central State of Nigeria. no sampling technique was used for the study because of the small size of population. Mean and Standard Deviation were used to analysis the data collected and obtained from the research questions and t-test analysis was used to test the hypothesis.. A modified four points rating scale of Strongly Agreed= 4, Agreed= 3, Disagreed=2, and Strongly Disagreed=1 was used, at a decision of mean, cutoff point of 2.50 above with Standard Deviation of 0.50 was Agreed upon and any item with a mean below 2.50 with Standard Deviation below 0.50 was Disagree using SPSS Version 23. Among the recommendations are that, Lifelong learning should be given equal attention on skills development as other educational programs to enhance social, technological, economic needs of society also TVET lecturers/instructor should lay more emphasis on applying TVET and STEM contributes to skills development for the society's needs.

Keywords: TVET, STEM, lifelong learning, Skills and Tertiary institution

Introduction

Technical and vocational education and training (TVET) is an ideal platform for the acquisition of Science Technology Engineering Mathematics (STEM). TVET provides a strong foundation for, and serve as a delivery system for STEM competencies and skills for a broader range of students and learners irrespective of their status. Hadijah (2015) explained that TVET was often disregarded as a significant player in academic orientation. These statements are slowly put asideas many stakeholders arebecoming aware that TVET are the best providers of knowledgeable and skilled workers in the 21st century.The study will be of great benefits to Educational planners, TVET lecturers and instructors, students, Government and the society. The educational planners will use the research work to review the curriculum and the implementation to effect the corrections on lifelong learning and skill for a better performance during work and after retirement. TVET is an ideal vehicle to facilitate STEM because of its focus on innovation and problem solving, combining both paradigms in education and training seems to offer a breakthrough in how to prepare the workforce to be much more effective and productive in the present knowledge based economy.

Nevkar (2012) defined TVET as skill-based programme designed for specific vocation, TVET upgrades unskilled individual to semi-skilled and semi-skilled to skilled. Skilled individuals are known to be intelligent consumers of modern technologies, creative and innovative. Yaduma and Agada (2018) described TVET as the type of education which provides individuals with skills, knowledge and attitudes for effective employment in a specific occupation. This implies that TVET is designed to develop skills, abilities, understanding, attitudes and work habit, while TVET graduates are creators of jobs and self-reliant. This typifies that the pace at which a nation develops is dependent on the quality of teachers present there. Teachers are important in a nation for economic development as no nation can rise without good caliber of teachers. The responsibility of teachers is more extensive now than in the past and this might be as a result of the various scientific, technological, and economic challenges facing the nation. Therefore, there is every need to critically address the influence and explore challenges of TVET and STEM for lifelong learning in North-central Nigeria.

Science Technology Engineering Mathematics (STEM)

Educational initiative in North Central Nigeria is influence by teachers, students and other groups of learner with critical thinking skills that would make them creative, problem solvers, more marketable in the workforce and in lifelong learning. In light of the lingering job crisis and skills mismatch between labour market needs and training provided by Science Technology Engineering Mathematics (STEM), it has become widely recognized that STEM is an important part of national education systems and any skills development. Yilduim and Altun described STEM as an approach that brings disciplines together,provides effective and high-quality learning, integrate knowledge into daily life and encompasses high level thinking. STEM adequately prepare skilled workers through the provision of relevant skills development programmes and depends largely on the quality of its teachers and trainers for success. Kehdinga (2019) described STEM as an acronym for science, technology, engineering and mathematics and explained that attention has been placed on STEM as a result of the employment gap in STEM-field and the need to meet the demand of technological development of this present time. STEM education refers to the integrated teaching and learning of the subjects' of science, technology, engineering, and mathematics. STEM education is usually presented through hands-on and relevant real-world learning experiences. Kehdinga (2019) points out that STEM originally is to be called SMET which means science mathematic engineering and technology and was later changed to STEM in the 1990s by the National Science Foundation to promote and create awareness. The direction technological development is taking has created a need to prepare, sensitize, motivate and promote the study of STEM.

Lifelong Learning

Lifelong Learning is a voluntary decision to enroll in the learning of educational courses where most of the topics in the Lifelong Learning are chosen by the learners or on the learners' discretion. The Lifelong Learning is applicable to learners who have acquired a higher certificate or degree and entered a particular workforce. Lifelong learning is vital for everybody, no matter the age or level of education.Efforts are made by various authors to reach out with ideal definition of Lifelong learning. Lekoko, and Modise (2011), describe Lifelong learning as a form of self-initiated

education that is focused on personal development. Slowey and Schuetze (2012) defined lifelong learning in terms of its contribution to the development of skills and competencies and active citizenship, which advocated for a universal and comprehensive approach to lifelong learning through four pillars: learning to know, to do, to be and to live together. UNESCO (2012) in a report described Lifelong learning as education from early childhood to retirement for the knowledge of economy and it is as crucial in transition and developing economies as it is in the developed world. Lifelong learning has no standardized definition, but has generally been taken to refer to the learning that occurs outside of a formal educational institute, such as a school, university or corporate training.

Lifelong learning aims is for continuity and growth to higher education, where learners, Children, youth and adults learn to survive and preserve their own health, work, produce and develop full physical, intellectual and emotional potential. Lifelong learning ensures that communication with each other orally, in writing or through other means is achieved or participation in local and the broader society activities,protect nature, engage in personal, social change and development are successful.

According to Igor (2015) Lifelong learning applies to all kinds of experiences that help people to become wiser, more enlightened and full members of society. Therefore this learning brings about awareness of their rights and obligations; awareness of differences and respect to the following different areas (age, gender, culture, language, religion, ideology); Marjan (2011) explained that lifelong learning comprises all phases of learning, from pre-school to post-retirement, and covers the whole spectrum of formal, non-formal and informal learning. This means that it ensures that participant can learn how to dialogue, to argue and to negotiate as well as to deal with conflict, source for and to pass out information, direct change and adapt to change for learners as they will take advantage of all education and learning opportunities and means to enjoy learning and get a decent living during work and after retirement.

Statement of the Problem

Educational system today is based on the social, technological and economic needs of a society. The knowledge acquired in formal education is becoming more insufficient for present social, technological and economic needs of our modern society. In a quest to easy these challenges, learning in a society that demands teamwork, problem solving, motivation for lifelong learning and cannot be acquired in an educational setting in which teachers dictate facts to learners who seek to learn in order to be able to repeat what was taught. Therefore, the problem of this study hinges on application of technical and vocational education and training (TVET) and science technology engineering mathematics (STEM) for lifelong learning and skills in north central Nigeria in the 21st century. How TVET teachers apply TVET and STEM for the societies lifelong learning and skill as to enjoy and get a decent living during work and after retirement by creation of literate societies, valuing of local knowledge, talent and wisdom. The promotion of these learning through formal and non-formal education, and taking the best advantage of the lifelong professional work. However, the influence of TVET teachers using TEVT and STEM for lifelong learning is to enable learning system to cut across larger segments of the population and people

with diverse learning needs rather than age related. Where it success also depends greatly on the traditional institutional settings, new curricula and new teaching methods.

Objective of this Study

The objective of this study is to examine Influence of TVET lecturers and instructor using STEM for lifelong learning in tertiary institution in North Central State of Nigeria in the 21st century; the specific objectives of this study are to;

1) Identify the role of TVET and STEM on lifelong learning in North Central Nigeria
2) Effect of TVET and STEM for lifelong learning in North Central Nigeria
3) Identify the contributions of TVET and STEM to lifelong learning in North Central Nigeria.

Research Questions:

The following research questions guided the study:

1) What are the roles of TVET and STEM on lifelong learning in North Central Nigeria?
2) What are the effects of TVET and STEM on lifelong learning in North Central Nigeria?
3) What are the contributions of TVET and STEM to lifelong learning in North Central Nigeria?

Research Hypotheses

The hypotheses below was tested at 0.05 level of significance

Ho1: there is no significant difference between the mean response TVET lecturers and instructors on the role of TVET and STEM on lifelong learning in tertiary institutions in North Central Nigeria.

Ho2: there is significant difference between the mean response TVET lecturers and instructors on effect of TVET and STEM on lifelong learning in tertiary institutions in North Central Nigeria.

The Significance of the Study

TVET Lecturers and instructors will be saddled with responsibilities to implement the objectives, content and method of teaching lifelong learning and skill as to be able to adjust to rightful experience and skills. The learners/students who had acquired the skills and experience in the field of lifelong learning through TVET and STEM would be useful to themselves in terms of skills, innovations, reliance and jobs creation. Again the improvement on performance and provision of infrastructural facilities for the growth and other aligning activities related to lifelong learning courses for the students/learner to stand on their owns after graduation will be the sole responsibilities of the Government. While the beneficiaries of the products are the societies which would have a relief of the lifelong learning and skill by the TVET teachers and instructors

Methodology

The study adopted descriptive survey as research design using 30 items structured questionnaire as instrument to retrieve opinions and information from the respondents through a distributed Questionnaire titled Application of TVET and STEM for lifelong learning and skills

(ATVETASTEMLLLSQ) questionnaire. Three research questions and two hypotheses were raised for the study. The population for data collection was eighty 85 respondents involving 53 TVET lecturers and 32 instructors selected from two tertiary institutions in each state (Benue, Kogi, Kwara, Niger, Plateau, Nasarawa) of North Central State of Nigeria. There was no sampling technique used for the study because of the small size of population. The questionnaire was validated by three expects from Faculty of Vocational and Technology Education, Abubakar Tafawa Balewa University Bauchi, Nigeria. Test, retest was conducted twice at an interval of two weeks with 20 TVET lecturers and instructors from Abubakar Tafawa Balewa University Bauchi, Nigeria. The data generated from the study were analyzed using cronbach alpha to obtain 0.70 reliability coefficients indicating that the instrument is appropriate and reliable for the study as it was above 0.60 of reliability index. Mean and Standard Deviation were used to analysis the data collected and obtained from the research questions on modified four points rating scale of Strongly Agreed= 4, Agreed= 3, Disagreed=2, Strongly and Disagreed=1 at a decision of mean cutoff point of 2.50 above with Standard Deviation of 0.50 as Agreed and any item with below 2.50 with Standard Deviation of 0.49 Disagreed for the remarks while t-t analysis was used to test the hypothesis using SPSS Version 23.

Results Analysis

Research Question 1:- what are the roles of TVET and STEM on lifelong learning in North Central Nigeria?

Table 1: Mean and Standard deviation of TVET lecturers and instructors on the roles of TVET and STEM on lifelong learning in North Central Nigeria

S/N	ITEM			
	The roles of TVET lecturers/instructor using STEM for Lifelong Learning are:	**X**	**SD**	**Remarks**
1	Increasing prevalence of high-technology	2.55	0.55	**Agreed**
2	Coverage of all concepts lifelong learning	2.65	0.57	**Agreed**
3	Change in the course of a professional lifetime	2.75	0.58	**Agreed**
4	Deepening lifelong learning to the learned	2.50	0.55	**Agreed**
5	Providing learners for valuing learning	2.55	0.55	**Agreed**
6	Providing information on guidance and counseling	2.65	0.57	**Agreed**
7	Investing time and money in lifelong learning	2.75	0.58	**Agreed**
8	Bringing learners and learning opportunities together	2.60	0.56	**Agreed**
9	Ensuring acquisition of basic skills	2.65	0.57	**Agreed**

10	Introducing innovative pedagogy	2.52	0.56	**Agreed**
Grand Mean		**2.61**	**0.56**	**Agreed**

Key: *X=Mean, SD=Standard Deviation, SA= Strongly Agree A= Agree*

Table 1: the shows mean ratings of TVET lecturers and instructors from 2.50 to 2.75 with a corresponding standard deviation of 0.55 to 0.58. The result indicates that they agreed on items on1- 10asthe roles of TVET and STEM on lifelong learning and skill in tertiary institution in the North Central Nigeria

Research Question 2:- what are the effects of TVET and STEM on lifelong learning and skill in North Central Nigeria?

Mean ratings and Standard deviation response of TVET lecturers and instructors on the effect of TVET and STEM on lifelong learning in North Central Nigeria

S/N	Item	X	SD	Remarks
Effects of TVET and STEM on lifelong learning and skill				
11.	Upgrade job skills after acquisition	3.75	0.80	strongly Agreed
12.	Start a business during lifelong	3.53	0.52	strongly Agreed
13.	Working after retirement from service	3.65	0.67	strongly Agreed
14.	Learn about the subject of lifelong learning	2.65	0.57	Agreed
15.	Extend their knowledge towards TVET and STEM	2.75	0.58	Agreed
16.	Interact with new people	3.84	0.83	strongly Agreed
17.	Development of new skills	2.57	0.56	Agreed
18.	Develop self-confidence	2.50	0.55	Agreed
19.	Involved in the community services	3.80	0.83	strongly Agreed
20.	Develop personal skill towards TVET and STEM	2.57	0.56	Agree
Grand mean		**3.16**	**0.65**	**strongly Agreed**

Table 2: shows that items 11, 12, 13, 16 and19 mean ratings with a corresponding standard deviation ranging from 3.65 - 3.80 and 0.67 - 0.83 which is high, indicating that the effects of TVET and STEM on lifelong learning and skill in North Central Nigeria is strongly agreed upon, while items 14, 15, 17,18and 20 mean ratings with a corresponding standard deviation ranging from 2.75 - 2.50 and 0.58 - 0.55 is also within the acceptable mean rating. The result indicate that **lecturers/instructors** agreed on the effects of TVET and STEM on lifelong learning and skill in tertiary institution in North Central State of Nigeria

Research Question 3:- what are the contributions of TVET and STEM to lifelong learning in North Central Nigeria?

Mean ratings and Standard deviation response of TVET lecturers and instructors on contributions of TVET and STEM to lifelong learning in tertiary institution in North Central State of

S/N	Item	X	SD	Remarks
21.	helps Lifelong learning to develop natural abilities.	2.85	0.68	Agreed
22.	opens the mind for Lifelong learning and skill.	3.78	0.67	strongly Agreed
23.	Creates curiosity and hungry for Lifelong learning	3.54	0.77	strongly Agreed
24.	Increases learners wisdom for Lifelong Learning and skill	3.88	0.75	strongly Agreed
25.	TVET and STEM makes the world a better place	2.75	0.56	Agreed
26.	TVET and STEM helps to adapt any changes	3.90	0.76	strongly Agreed
27.	helps to find meaning in their living	3.68	0.66	strongly Agreed
28	contributors to society's development during Lifelong learning	3.87	0.68	strongly Agreed
29.	TVET and STEM helps in making new friends	3.87	0.68	strongly Agreed
30.	Lifelong learning establishes valuable relationship	2.75	0. 58	Agreed
Grand mean			**3.49**	**0.68 Agree**d

Table 3: shows that items 20, ,22,24,25,26,27 and 29 totaling 8 items whose mean ratings with a corresponding standard deviation ranging from 3.90 - 3.54 and 0.67 - 0.83 which is high. The result indicate that TVET lecturers and instructors strongly agree that TVET and STEM contribute to lifelong learning and skill in tertiary institutions in North Central Nigeria , while items 21,25and 30are 3 items whose mean ratings ranges from 2.85 - 2.75 with corresponding standard deviation and 0.68 - 0.58 isalso within the acceptable mean rating indicate that the TVET lecturers and instructors agree that TVET and STEM contribute to lifelong learning and skill in tertiary institutions in North Central Nigeria.

Testing of Hypothesis

Ho1: there is significant difference between the mean response TVET lecturers and instructors on the role of TVET and STEM on lifelong learning in tertiary institutions in North Central Nigeria

Table 4: Independent sample t-test of TVET lecturers and instructors on the role of TVET and STEM on lifelong learning and skills

N_1= 53, N_2=32, total = 85

	n	$\bar{x}_t$	SD	df	t-cal	t-cri	Decision
TVET Teachers	53	3.61	1.13				
				83	1.05	1.70	NS
Instructors	32	3.16	1.14				

Table 4 shows the test of hypothesis one using the mean of teachers and instructors on the identified practical tasks in Plumbing and Pipe Fittings where t-cal is 1.05 and t-crit is 1.70 at 0.05 level of significance with df 83. The result shows that t-calc is < t-crit. This indicates that there is no significant difference in mean response of TVET lecturers and instructors on the role of TVET and STEM on lifelong learning and skills. Therefore, the null hypothesis of no significant difference between the mean response of Independent sample t-test of TVET lecturers and instructors on the role of TVET and STEM on lifelong learning and skills was upheld.

Ho2: there is significant difference between the mean response TVET lecturers and instructors on effect of TVET and STEM on lifelong learning and skills in tertiary institutions in North Central Nigeria.

Table 5: Independent sample t-test of Teachers and Instructors on the on effect of TVET and STEM on lifelong learning and skills

N_1= 53, N_2=32, total = 85

	n	$\bar{x}_t$	SD	df	t-cal	t-cri	Decision
Teachers	53	3.49	1.13				
				83	1.05	1.70	NS
Instructors	32	3.31	1.14				

Table 4 shows the test of hypothesis one using the mean of teachers and instructors on the identified practical tasks in Plumbing and Pipe Fittings where t-cal is 1.13 and t-crit is 1.14 at 0.05 level of significance with df 83. The result shows that t-calc is < t-crit. This indicates that there is no significant difference in mean response of TVET lecturers and instructors on effect of TVET and STEM on lifelong learning and skills. Therefore, the null hypothesis of no significant difference between the mean response of Independent sample t-test of TVET lecturers and instructors on the on effect of TVET and STEM on lifelong learning and skills was upheld.

Discussion and findings

Table 1 the research work revealed that TVET lecturers and instructor play great roles in application of TVET and STEM for lifelong learning and skills in tertiary institution in North

Central Nigeria which is based on the social, technological and economic needs of a society; the knowledge acquired in formal education is not enough to sustain the learner during work and after retirement. Therefore the roles TVET lecturers and instructor plays in applying TVET and STEM in lifelong learning are identified. It points 10 out items and emphasized on its usefulness to lifelong learning and skills during learning and after retirement. Again, Table 2 the outcome of research study revealed that TVET lecturers and instructors agree on all the 10items as effect of TVET and STEM which has great effect on lifelong learning and skills. TVET lecturers and instructors strongly agreed and agree upon these items as the effect of TVET and STEM on Lifelong learning and skills. Table 3 the research study revealed the contributions of TVET and STEM to lifelong learning in tertiary institutions in North Central Nigeria. TVET lecturers and instructors strongly agreed on 10 items and emphases were placed on the contributions of TVET and STEM to lifelong learning and skills in tertiary institutions in North Central State of Nigeria.

Conclusion

The objective of this study is to examine application of technical and vocational education and training (TVET) and science technology engineering mathematics (STEM) for lifelong learning and skills in north central Nigeria in the 21st century. The role of TVET lecturers and instructor applying TVET and STEM for lifelong learning and skills were identified, effect of applying TVET and STEM for lifelong learning and skills were identified while contributions of TVET and STEM to lifelong learning in tertiary institutions in North Central Nigeria. Therefore TVET lecturers/instructor can be applying TVET and STEM for lifelong learning to enable learning system to cut across larger segments of the population and people with diverse social, technological, economic and learning needs.

Recommendations

The following recommendations were made with respect to the outcome of research work that:

1. Lifelong learning should be given equal attention on skills development as other educational programms for the social, technological, economic needs of society
2. TVET lecturers/instructor should lay more emphasis on applying TVET and STEM to enhance skills development for the society's needs.
3. TVET and STEM contributions to lifelong learning should be given more attention by TVET lecturers and instructor

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Strategies for Improving Students' Acquisition of Practical Skills in Electrical Installation and Maintenance Work Trade in Technical Colleges in Sokoto State

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Abstract
The study determine the Strategies for Improving Students' Acquisition of Practical Skills in Electrical Installation and Maintenance Work Trade in Technical Colleges in Sokoto State. Three research questions were formulated to guide the study. Data collection was by administration of 28 item questionnaire on a population of 224 persons comprising electrical installation teachers, all the SS II students and school administrators, of the four technical colleges in Sokoto State. The data was analyzed using average mean. The findings of the study include among others; Demonstration, assignment, drill and practice, and apprenticeship strategies as much appropriate for enhancing practical skills acquisition by students. It was found out in the study that there was no significant difference between the mean responses of trade teachers and students on supervisory strategies for students' practical skills acquisition in Electrical Installation and Maintenance Work Trade in technical colleges of Sokoto State. It was also discovered that there was no significant difference between the mean responses of trade teachers and school administrators on assessment strategies for students' practical skills acquisition in Electrical Installation and Maintenance Work Trade in technical colleges of Sokoto State. It was concluded that, teachers in Electrical Installation and Maintenance Work Trade used seven (7) out of eight (8) categories of practical teaching strategies; and ten (10) strategies for supervising students' practical activities in Electrical Installation and Maintenance Work Trade were much appropriate and enhanced acquisition of practical skills by students in the technical colleges. Based on the findings of the study the following recommendations were made; Teachers of Electrical Installation and Maintenance Work Trade should continue to adopt appropriate teaching strategies identified in the study for improving acquisition of practical skills by the students in technical colleges; and identified strategies for assessing practical skills of students in Electrical Installation and Maintenance Work Trade should be continuously used by teachers in technical colleges.

***KeyWords**: Acquisition of Practical Skills, Technical Vocational Education and Training, Technical College, Electrical Installation and Maintenance Works, Strategies.*

Introduction

The growth of any developing nation can be influenced by a well-articulated and organized Technical and Vocational Education and Training (TVET) programme because is a job orientated programme which serves as source income for whoever have it (Mohammed *et al*., 2018). The term 'Technical and Vocational Education and Training or TVET was officiated at the World Congress on TVET in 1999 in Seoul, Republic of Korea. The congress recognized the term TVET to be broad enough to incorporate other terms that had been used to describe similar educational and training activities including Workforce Education (WE), and Technical-Vocational Education (TVE)(UNESCO, 2019).The connection between TVET and the world of work will be reframed

in the post-COVID-19 era. More than ever before, there is an urgent need to build stronger links and promote collaboration with industry to ensure that TVET remains relevant and demand-driven. By focusing on anticipated futures and preparing for emerging trends, MTS-III enables TVET institutions to position themselves in these realities and swiftly adapt their strategies to respond (UNESCO-UNEVOC 2019). The goals of Technical and Vocational Education and Training (TVET) is for the acquisition of knowledge, attitude and practical skills for sustainable development. The training of vocational technical education students is based on the production of goods and services that are not only relevant to themselves but to the society. Federal Republic of Nigeria (2014) States the goals of technical and vocational education and training as to; a. Provide trained manpower in the applied sciences, technology and business particularly at craft, advance and technical level, b. Provide the technical knowledge and vocational skills necessary for agriculture, commercial and economic development; and c. Give training and impart the necessary skills to individual for self-reliance economically. It further explains that; in pursuant of the goals effective participation of students in practical works, the teacher student ratio shall be kept at 1:20.Technical colleges are among the TVET institutions.

Technical Colleges are post primary institutions where students are giving full vocational training that will enable them acquire relevant knowledge, skills and attitude for paid or self-employment in various occupations in the world of work. The programs at a technical college, or trade school, provide practical, specific skills that can offer the necessary education to begin a career upon completion of the program or necessary certification. Often, technical colleges focus on hands-on programs in allied health or mechanical trades including medical and dental assisting, welding, HVAC/R-MAR, and truck driving. These programs are typically taught by instructors who are industry professionals with years of experience working in the field they are teaching. Technical colleges usually do not require general education programs, and instead focus entirely on the skills needed for a specific career. Many industries require industry certifications, and trade schools prepare students with the necessary skills and knowledge to sit for the certification exams (Midwest Technical Institute, 2020). However, National Board for Technical Education (NBTE 2011) reported that the quality of academic programmes in technical colleges is regulated by its body of curriculum development, supervision and periodic accreditation visits while the National Business and Technical Examinations Board (NABTEB) is responsible for the examination and certification of the occupational trades leading to the award of National Technical Certificate (NTC) and Advanced National Technical Certificate (ANTC). Electrical/Electronic trade is one of the vocational trade training offered in Technical Colleges in Nigeria and classification of the trade in Technical Colleges according to NBTE (2012) includes: Appliance maintenance and repairs, Electrical installation and maintenance works, Instrument mechanics, and Radio, television (RTV) and maintenance works. The aim of Electrical/Electronic according to NBTE is to give training and impart the necessary skills leading to the production of craftsmen, master craftsmen and other skilled personnel who will be enterprising and self-reliant towards sustainable development. With center of attention on Electrical/Electronic (E/E) trade; Electrical/electronic trade is vital in the production of workforce with understanding in diverse skills in the design, development, production, management and utilization of trending electrical/electronic devices and circuits, as well as imparting basic knowledge and skills leading to the production of skilled craftsmen who will be enterprising, self-reliant and sufficiently competent to meet the demands in the world of work. In view of the National Board for Technical Education programme (NBTE, 2012) electrical/electronic offers trade in; Appliance maintenance and repairs, Electrical installation and maintenance works, Instrument mechanics, and Radio, television (RTV) and maintenance works.

Electrical installation and maintenance works as offered in technical colleges prepares an individual with job-satisfying requirements towards employment and self-reliance. Electrical installation and maintenance work provides technical training to meet the demands of electrical industry and the needs of the individual allowing the students to identify their career objectives (Eze 2015). Electrical installation and maintenance works curriculum is designed to prepare the students to acquire entry level knowledge and manipulative skills for employment in the electrical industry in Sokoto State, Nigeria. Students who undergo training in electrical installation and maintenance works trades as expected to get hold of skills for fineness in installation of electrical machines and equipment, maintain nerve of machines and equipment, winding of electrical machines, testing and inspection of electrical installations, repair of electrical machine and others.

Idoko (2014) explains acquisition of practical skills to involve the development of new skills, practice and performing a task, usually gained through training experience. According to Okwelle and Agwi (2018) practical skills acquisition could be referred to as an organized process of training which eventually leads to the effectiveness of an individual in a given trade.

However, students' acquisition of practical skills is necessary for the attainment of the above mentioned purposes which cannot be realized in a non-supportive school environment. In a similar perspective, Udofia*et al*. (2012) reported that wrong approach to teaching and evaluation of practical subjects in technical colleges rather than impart skills to students, produce students who are ill-equipped with practical skills, inadequate creative power and unable to secure employment. EIMW departments in technical colleges of Sokoto State are no exception to this problem of learning resources that hamper with career education. In the opinion of the researcher, students in EIMW departments receive ineffective instruction and become weak in practical skills due to wrong approach to teaching, supervising, and assessment of students. Inadequate supervision of practical activities also impedes acquisition of practical skills especially where practical projects are inspected at the end of the process whereas adequate supervision on the whole practical process has a major influence on the overall performance and efficiency of skills acquisition. It is therefore important to investigate strategies that will bring forth appreciable improvement in the acquisition of practical skills among the students of EIMW trade in the eight technical colleges of Sokoto State.

Statement of the Problem

Electrical Installation and Maintenance Work Trade, in technical colleges is designed to produce skilled craftsmen who will be able to perform basic functions in electrical installation and maintenance work both in private and public sector (Muhammed 2012). This calls for the necessity of acquiring high quality practical skills through the use of appropriate teaching and assessment strategies to be complemented with competent and experienced teachers, well-equipped workshops, adequate supply of teaching materials, adequate supervision of practical lessons and proper linkages between technical colleges and local industries Odo*et al*. (2012).

Unfortunately, practical skills acquisition in Nigerian technical colleges are battling with numerous problems among which are poor teaching strategies. The teaching of technical subjects has been too theoretical that many students prefer subjects in Arts and Social Sciences because there is no longer much emphasis on the learners' practical skills acquisition in technical colleges.

However, the researcher also observed that in spite of many years of teaching EIMW trade subjects in technical colleges of Sokoto State and in spite of the lucrative nature of the trade and low capital requirement for establishing a trade centre, not many graduates of the trade possessed adequate practical skills that will enable them to effectively fit into the world of work. This may be caused by poor acquisition of practical skills by the Students consequent upon obsolete and inefficient practical teaching materials, ineffective teaching and assessment strategies in EIMW trade in technical colleges of Sokoto State. Another important factor could be poor supervision of practical lessons in EIMW trade in technical colleges of Sokoto State. In view of the above therefore, there is need to carry out a study to determine strategies for improving students' acquisition of practical skills in electrical installation and maintenance work trade in technical colleges in Sokoto State. This could improve on the existing strategies associated with EIMW trade students' practical skills acquisition in technical colleges of Sokoto State.

Purpose of the Study

The main purpose of the study was to identify strategies for improving students' acquisition of practical skills in Electrical Installation and Maintenance Work (EIMW) trade in the technical colleges of Sokoto State. Specifically, the study determined:

1. The appropriate strategies for teaching practical skills in EIMW trade in technical colleges of Sokoto State.
2. The supervisory strategies for practical skills acquisition of students in Electrical Workshop in technical colleges of Sokoto State.
3. The strategies for assessing practical skills of students in EIMW trade in technical colleges of Sokoto State.

Research Questions

The study was guided by the following research questions:

1. What are the appropriate teaching strategies to be used for teaching practical skills in Electrical Installation and Maintenance Work (EIMW) trade in technical colleges of Sokoto State?
2. What are the strategies for supervising student's practical work activities in Electrical Installation and Maintenance Work trade in technical colleges of Sokoto State?
3. What are the strategies for assessing students' practical skills acquisition in EIMW trade in technical colleges of Sokoto State?

Hypotheses

The following null hypotheses were tested at 0.05 level of significance to guide the study.

H_{O1}: There is no significant difference between the mean responses of EIMW trade teachers and students on appropriate teaching strategies for teaching practical skills in EIMW.

H_{O2}: There is no significant difference between the mean responses of EIMW trade teachers and students on supervisory strategies for practical skills acquisition in EIMW.

H_{O3}: There is no significant difference between the mean responses of EIMW trade teachers and school administrators on the assessment strategies for practical skills acquisition in EIMW.

Methodology

The researchers adopted descriptive survey research design. The design is suitable for this study since data will be collected through questionnaire from school administrators, EIMW trade teachers and students on Strategies for Improving Students' Acquisition of Practical Skills in Electrical Installation and Maintenance Work trade in technical colleges of Sokoto State. This study covered four (4) Government Technical Colleges (GTCs) in Sokoto State where EIMW programmes have been duly accredited by the National Board for Techncical Education. The schools are: Government Technical college Farfaru, Government Technical college Runjin Sambo, Government Technical college Binji and Olusegun Obasanjo Technical college Bafarawa. The population of the study comprised 12 school administrators, 10 trade teachers and 233 SS 2 students of the four (4) government technical colleges. The whole population of 255 was manageable; hence there was no sample for the study.

Instrument for Data Collection

A structured questionnaire named Strategies for Improving Students' Acquisition of Practical Skills in Electrical Installation and Maintenance Work (EIMW) trade in the four technical colleges of Sokoto State was used to collect data for the study. The instrument contained 28 items and was divided into four sections lettered 'A', 'B', 'C' and 'D'. Section 'A' was on general information of the respondents. Section 'B' comprised 8 items which solicited responses from trade teachers and students on appropriateness of teaching strategies to be used for teaching practical skills. Section 'C' consisted of 10 items which also solicited responses from trade teachers and students on the supervisory strategies for improving acquisition of practical skills by students in EIMW trade. While the responses in Section 'D' having 10 items were obtained from school administrators and trade teachers because this section addressed strategies for assessing acquisition of practical skills by students in technical colleges. The questionnaire were designed based on 4-point scale with responses of: Strongly Agree, SA = 4; Agree, A = 3; Disagree, D = 2; and Strongly Disagree, SD = 1.

Validation of the Instrument

A draft of the instrument for data collection of this study was face validated by three experts. Two experts from Department of Industrial and Technology Education, Federal University of Technology Minna Niger State and one from Ministry of Science and Technology Sokoto state. The experts were requested to scrutinize each item of the questionnaire for clarity of statement. They also examined the appropriateness and suitability of all items on the instrument. The suggestions and corrections of the experts were used in modifying the instrument. The validated instrument was then used for data collection.

Reliability of the Instrument

Kurder Richardson (KR-21) formula was used to determine the reliability of the instrument. The choice of the KR-21 formula is to determine the internal consistency of items within the instrument. The reliability test of the validated instrument was obtained by administering the questionnaires on 15 teachers from electrical electronics trade who is not part of the population for the study.

Kurder Richardson (KR-21)

Formula is given by: $R_k - R21 = 1 - \frac{X\,(n - X)}{ns^2}$

WhereRk – R21= Kuder Richardson reliability coefficient

n = Numbers of items in the test
x = Means score of the test
s^2 = Test variance

Method of Data Collection

The questionnaire was administered to the respondents with the help of two research assistants. The research assistants were given instructions on how to administer the questionnaire. The copies of the questionnaire were collected by the research assistants and the researchers as soon as the respondents finished responding to the questionnaire.

Method of Data Analysis

Manual computation will be use to analyze the data. The research questions will be analyzed by using mean, grand mean and standard deviation. While t-test analysis will be used to test the null hypotheses at 0.05 level of significance. For testing the null hypotheses (Ho); if the calculated t-value was equal or greater than the t-table (t-critical), the null hypotheses were rejected. If the calculated t-value was less than the t-table (t-critical), the null hypotheses were accepted.

Results and Discussion

This part presents an analysis of the information gathered. The information gathered was utilized to provide answers to research questions and test the hypotheses planned for the study.

Table1: Mean Responses and Standard Deviations on Appropriate Teaching Strategies to be used for Teaching Practical Skills in EIMW Trade in Technical Colleges of Sokoto State

A researcher grouped the respondents into three namely (1) students (2) Teachers and (3) school administrator. He administered the same instrument on them and received the total of 224 (out of the total of 255) respondents, 202 students, 10 Teachers and 12 school administrator.

S/N	ITEMS	SA	A	D	SD
1	Guest lecture method.	5 (0)	15 (0)	32 (4)	150 (6)
2	Demonstration method	140 (7)	47 (3)	10 (0)	5 (0)
3	Field trip method	145 (7)	52 (2)	12 (1)	3 (0)
4	Project method	100 (5)	50 (3)	12 (1)	40 (1)
5	Assignment method	10 (1)	20 (1)	32 (2)	140 (6)
6	Guided discovery method	95 (5)	55 (2)	22 (2)	30 (1)
7	Drill and practice methods	160 (8)	30 (1)	8 (1)	4 (0)
8	Apprenticeship (local attachment) method	175 (9)	20 (1)	5 (0)	2 (0)
Percent (%)		51.05(52.5)%	17.77(16.25)	8.18(13.75)%	23 (17.5)%
Average		51.775%	17.01%	10.965%	20.25%
Remark				**SA**	

SA = Strongly Agreed, A = Agreed, D = Disagreed, SD = Strongly Disagreed

To answer this research question a structured questionnaire was used. The result is presented as shown in the table 1 That 51.05% of the students respondents strongly agreed on Appropriate Teaching Strategies were used for Teaching Practical Skills in EIMW Trade in Technical Colleges of Sokoto State. Likewise, 52.5% of the teacher's respondents also strongly agreed in that. Which averagely 51.77% of the both respondents strongly agreed on that. And 17.77% of the Students

agreed together with 16.25% of the Teachers also agreed. Which averagely 17.01% of the both respondents agreed on that. While 8.18% of the Students Disagreed together with 13.75% of the Teachers Also Disagreed. Which averagely 10.965% of the both respondents Disagreed on that. And 23% of the Students Strongly Disagreed together with 17.5% of the Teachers also Strongly Disagreed. Which averagely 20.25% of the both respondents Strongly Disagreed on that.

From the views of the respondents above, it can be concluded that there is Appropriate Teaching Strategies for Teaching Practical Skills in EIMW Trade in Technical Colleges of Sokoto State.

Table 2: Student's Respondent

X	F	$X - X = X_1$	$F X_1$	$F (X_1)^2$	RS	Mean	SD
4	830	1.031	830 (1.031)	$830 (1.031)^2$			
3	289	0.031	289 (0.031)	$289 (0.031)^2$			
2	133	-0.969	133 (-0.969)	$133 (-0.969)^2$	202	2.969	1.230
1	37	-1.969	374 (-1.969)	$374 (-1.969)^2$			
$N_1 = 1626$				**$\Sigma F (X_1)^2 = 2457.401$**			

Table 3: Teacher's Respondent

X	F	$X - X = X_2$	$F X_2$	$F (X_2)^2$	RT	Mean	SD
4	42	0.9626	42 (0.9626)	$42 (0.9626)^2$			
3	13	-0.0375	13 (-0.0375)	$13 (-0.0375)^2$			
2	11	-1.0375	11 (-1.0375)	$11 (-1.0375)^2$	10	3.0373	1.174
1	14	-2.0375	14 (-2.0375)	$14 (-2.0375)^2$			
$N_2 = 80$				$\Sigma F (X_2)^2 = 108.887$			

Table 4 Mean Responses and Standard Deviations on Supervisory Strategies for Students' Practical Work Activities in Electrical Installation and Maintenance Work Trade in Technical Colleges of Sokoto State

S/N	Items	SA	A	D	SD
9	Taking attendance.	10 (1)	22 (2)	160 (6)	10 (1)
10	Selection of tools and materials.	12 (2)	20 (1)	150 (5)	20 (2)
11	Students to be open minded and creative for applications of techniques to their challenges during practical session	150 (6)	32 (2)	15 (1)	5 (1)
12	The teachers must make sure each individual is provided with needed materials at the beginning of the practical	165 (6)	15 (3)	12 (1)	10 (0)
13	The teachers should make sure that each student is well dressed during the practical lesson	20 (1)	12 (2)	140 (6)	30 (1)
14	The teachers should interact with students and ask for their opinions where necessary during the practical exercise	170 (7)	22 (2)	6 (1)	4 (0)
15	The teachers should allow students for improvisation and make alternative where necessary during practical exercise	145 (6)	30 (3)	17 (0)	10 (1)

16	The workshop attendants should always encourage team work among students undertaking practical activities	155 (5)	22 (4)	15 (1)	10 (0)
17	Teachers must enforce safety rules and regulation with regards to use of workshop tools and equipment	140 (5)	30 (3)	21 (1)	11 (1)
18	The workshop attendants must ensure that each student participates in the process of practical projects	15 (1)	2 (1)	5 (2)	180 (6)
Percent (%)		51.96 (40) %	9.37 (23) %	23.33 (24) %	15.34(13)%
Average		45.98%	16.185%	23.665%	14.17%
Remark				**SA**	

SA = Strongly Agreed, A = Agreed, D = Disagreed, SD = Strongly Disagreed

To answer this research, question a structured questionnaire was used. The result is presented as shown in the table 4. that 51.96% of the students' respondents strongly agreed on Appropriate Supervisory Strategies for Students' Practical Work Activities in EIMW Trade in Technical Colleges of Sokoto State. Likewise, 40% of the teacher's respondents also strongly agreed in that. Which averagely 45.98% of the both respondents strongly agreed on that. And 9.37% of the Studens agreed together with 23% of the Teachers also agreed. Which averagely 16.185% of the both respondents agreed on that. While 23.33% of the Students Disagreed together with 24% of the Teachers Also Disagreed. Which averagely 23.665% of the both respondents Disagreed on that. And 15.34% of the Students Strongly Disagreed together with 13% of the Teachers also Strongly Disagreed. Which averagely 14.17% of the both respondents Strongly Disagreed on that.

From the views of the respondents above, it can be concluded that there is Appropriate Supervisory Strategies for Students' Practical Work Activities in EIMW Trade in Technical Colleges of Sokoto State.

Table 5: Student's Respondent

X	F	$X - X = X_1$	$F X_1$	$F (X_1)^2$	RS	Mean	SD
4	982	1.02	982 (1.02)	$982 (1.02)^2$			
3	177	0.02	177 (0.02)	$177 (0.02)^2$			
2	441	-0.98	441 (-0.98)	$441 (-0.98)^2$	202	2.980	1.169
1	290	-1.98	290 (-1.98)	$290 (-1.98)^2$			
N_1 = 1890				**$\Sigma F (X_1)^2$ = 2582.1962**			

Table 6: Teacher's Respondent

X	F	$X - X = X_2$	$F X_2$	$F (X_2)^2$	RT	Mean	SD
4	40	1.1	40 (1.1)	$42 (1.1)^2$			
3	23	0.1	23 (0.1)	$13 (0.1)^2$			
2	24	-0.9	24 (-0.9)	$11 (-0.9)^2$	10	2.9	1.078
1	13	-1.9	13 (-1.9)	$14 (-1.9)^2$			
N_2 = 100				**$\Sigma F (X_2)^2$ = 115**			

Table 7: The Mean Responses and Standard Deviations on Strategies for Assessing Students' Practical Skills Acquisition in Electrical Installation and Maintenance Work Trade in Technical Colleges of Sokoto State

S/N	Items	SA	A	D	SD
19	Assessing students' practical lesson using checklist assessment strategy	5 (4)	6 (5)	1 (0)	0 (1)
20	Allowing students to participate in assessment process	7 (5)	2 (4)	2 (1)	1 (0)
21	Using psycho-productive test to measure students' practical ability in the workshop	6 (3)	3 (5)	3 (1)	0 (1)
22	Using psycho-productive test to measure students' practical ability after instruction monthly	4 (4)	5 (6)	2 (1)	1 (0)
23	Giving different assignment to each student at the end of each lesson	3 (6)	7 (4)	1 (0)	1 (0)
24	Giving oral examinations to students at the end of each lesson	8 (5)	2 (4)	1 (1)	1 (0)
25	Measuring students' ability with standardized test every week	9 (4)	1 (5)	1 (0)	1 (1)
26	Giving project work to students every week	7 (3)	2 (6)	2 (1)	1 (0)
27	Administering written examinations to students every two weeks	8 (2)	1 (7)	2 (1)	1 (0)
28	Interviewing and rating each student immediately after practical work	6 (3)	5 (6)	1 (0)	0 (1)
Percent (%)		52.5(38.61)%	28.33(51.49)	13.33(5.94)%	5.83(3.96)%
Average		45.555%	39.91%	9.635%	4.895%
Remark				**SA**	

SA = Strongly Agreed, A = Agreed, D = Disagreed, SD = Strongly Disagreed

To answer this research, question a structured questionnaire was used. The result is presented as shown in the table7. that 52.5% of the Teachers' respondents strongly agreed on Appropriate Strategies for Assessing Students' Practical Skills Acquisition in EIMW Trade in Technical Colleges of Sokoto State. Likewise, 38.61% of the School Administrators respondents also strongly agreed in that. Which averagely 45.555% of the both respondents strongly agreed on that. And 28.33% of the Teachers agreed together with 51.49% of the School Administrators also agreed. Which averagely 39.91% of the both respondents agreed on that. While 13.33% of the Teachers Disagreed together with 5.94% of the School Administrators Also Disagreed. Which averagely 9.635% of the both respondents Disagreed on that. And 5.83% of the Teachers Strongly Disagreed together with 3.96% of the School Administrators also Strongly Disagreed. Which averagely 4.895% of the both respondents Strongly Disagreed on that.

From the views of the respondents above, it can be concluded that there is Appropriate Strategies for Assessing Students' Practical Skills Acquisition in EIMW Trade in Technical Colleges of Sokoto State.

Table 8 Teacher's Respondent

X	F	$X - X = X_1$	$F X_1$	$F (X_1)^2$	RT	Mean	SD
4	63	0.725	63 (0.725)	$63 (0.725)^2$			
3	34	-0.0275	34 (-0.0275)	$34 (-0.0275)^2$			
2	16	-1.275	16 (-1.275)	$16 (-1.275)^2$	10	3.275	0.907

1	7	-2.275	7 (-2.275)	7 $(-2.275)^2$
N_1 = 120				**Σ F $(X_1)^2$ = 97.92505**

Table 8 School Administrator's Respondent

X	F	X - X = X_2	F X_1	F $(X_2)^2$	RT	Mean	SD
4	39	0.752	39 (0.752)	39 $(0.752)^2$			
3	52	-0.248	52 (-0.248)	52 $(-0.248)^2$			
2	6	-1.248	6 (-1.248)	6 $(-1.248)^2$	12	3.248	0.740
1	4	-2.248	4 (-2.248)	4 $(-2.248)^2$			
N_2 = 101				**Σ F $(X_2)^2$ = 54.8119**			

Hypothesis 1

There is no significant difference between the mean responses of EIMW trade teachers and students on appropriate teaching strategies for teaching practical skills acquisition in EIMW trade in technical colleges of Sokoto State.

Table 9: Mean, Standard deviation and Z-test analysis on appropriate teaching strategies for teaching practical skills acquisition in EIMW trade.

Respondents	Mean	SD	Df	Zcal.	Ttab.	Remark
Students	2.969	1.230	210	-0.509	1.653	NS
Teachers	3.0375	1.178				

= Mean, SD= Standard Deviation, df = Degree of freedom, NS = No Significant difference

Data presented in Table 9 shows that the t_{cal} (0.509) was less than the t_{tab} value (1.653) at 0.05 level of significance and at 210 degree of freedom. Hence, the null hypothesis H_{O1} was accepted indicating that there is no significant difference between the mean response of trade teachers and students on appropriate teaching strategies for teaching practical skills in Electrical Installation and Maintenance Work trade in technical colleges of Sokoto State.

Hypothesis 2

There is no significant difference between the mean responses of EIMW trade teachers and students on supervisory strategies for practical skills acquisition in EIMW.

Table 10: Mean, Standard deviation and Z-test analysis on supervisory strategies for teaching practical skills acquisition in EIMW trade.

Respondents	Mean	SD	Df	Z-cal.	T-tab.	Remark
Students	2.980	1.169	210	0.720	1.653	NS
Teachers	2.9	1.078				

= Mean, SD= Standard Deviation, df = Degree of freedom, NS = No Significant difference

Data presented in Table 10 shows that the Z_{cal} (0.720) was less than the T_{tab}. value (1.653) at 0.05 level of significance and at 210 degree of freedom. Hence, the null hypothesis H_2 was accepted indicating that there is no significant difference between the mean responses of trade teachers and

students on appropriate teaching strategies for teaching practical skills in Electrical Installation and Maintenance Work trade in technical colleges of Sokoto State.

Hypothesis 3

There is no significant difference between the mean responses of EIMW trade teachers and school administrators on the assessment strategies for practical skills acquisition in EIMW.

Table 11: Mean, Standard deviation and Z-test analysis on the assessment strategies for teaching practical skills acquisition in EIMW trade.

Respondents	Mean	SD	Df	Zcal.	Ttab.	Remark
Teachers	3.275	0.907	20	0.221	1.725	NS
School Administrators	3.248	0.740				

= Mean, SD= Standard Deviation, df = Degree of freedom, NS = No Significant difference

Data presented in Table 11 shows that the Z-cal (0.221) was less than the T-tab. value (1.725) at 0.05 level of significance and at 210 degree of freedom. Hence, the null hypothesis H_{O3} was accepted indicating that there is no significant difference between the mean scores of trade teachers and students on appropriate teaching strategies for teaching practical skills in Electrical Installation and Maintenance Work trade in technical colleges of Sokoto State.

Findings of the Study

Based on the results obtained from the analyzed data, the findings of the study are summarized as follows:

1. Teaching strategies for teaching practical skills acquisition in Electrical Installation and Maintenance Work (EIMW) trade courses in technical colleges in Sokoto State include guest lecture, demonstration, assignment, project, and guided discovery methods.
2. Appropriate supervisory strategies discovered for supervising students practical activities include taking attendance by workshop attendance at the beginning of every practical lesson, guide the students in selection of tools and materials for every practical session, encouraging students by the teachers to be open minded and creative about the applications of techniques to their challenges during practical session, ensuring that each individual is provided with needed materials at the beginning of the practical.
3. Appropriate strategies for assessing students' practical lesson in EIMW trade in technical colleges in Sokoto State include using checklist assessment strategy, allowing students to participate in assessment process, using psycho-productive test to measure students' practical ability in the workshop, and giving different assignment to each student at the end of each lesson were discovered to be much appropriate for assessing students' practical skills acquisition in EIMW trade in technical colleges of Sokoto State.
4. It was found out that there was no significant difference between the mean responses of trade teachers and students on appropriate teaching strategies for teaching practical skills in Electrical Installation and Maintenance Work trade in technical colleges of Sokoto State.
5. It was discovered that there was no significant difference between the mean responses of trade teachers and students on supervisory strategies for students' practical skills acquisition in Electrical Installation and Maintenance Work trade in technical colleges of Sokoto State.

6. It was also found out that there was no significant difference between the mean responses of trade teachers and school administrators on assessment strategies for students' practical skills acquisition in Electrical Installation and Maintenance Work trade in technical colleges of Sokoto State

Conclusion

Based on the results of this study it can be concluded that appropriate strategies for teaching practical skills acquisition are used in Electrical Installation and Maintenance Work (EIMW) trade in technical colleges of Sokoto State. Appropriate strategies for supervising and assessing students' practical work in technical colleges of Sokoto State are also being used to improve acquisition of practical skills by the students. EIMW trade in technical colleges is all about teaching skills to students for employment and wealth creation. In order for the students to acquire practical skills, teachers are required to teach relevant skills to students by adopting appropriate teaching, supervisory, and assessment strategies.

Recommendations

Therefore, the study made the following recommendations:

1. Industries sited in communities where technical colleges are located should be made to contribute funds that will be used in the procurement of tools and equipment.
2. Technical colleges should be encouraged and assisted to undertake fund raising activities (appeal fund launchings), the funds of which should be judiciously used to procure tools and equipment for the workshops of the technical colleges.
3. Instead of setting up new technical colleges which is capital intensive, government needs to fund and equip existing technical colleges. This way, the standard of the technical colleges will improve greatly.

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Assessment of Technology Education Lecturers Competencies in the Application of ICT for Instructions in Tertiary Institutions in Niger State, Nigeria.

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Abstract

This study was carried out to assess technology education lecturers' competencies in the application of ICT for instructions in Tertiary institutions in Niger State. Two research questions guided the study. While two null hypotheses were formulated at 0.05 level of significance. Descriptive survey research design was adopted for the study. The entire population of 47 respondents of technology education lecturers in Niger State, Tertiary Institutions. A total of 23 items structured questionnaire were used to collect data from the respondents. The ICT competency level possess and required category had a 4 response options.47 copies of the questionnaire administered were retrieved and analyzed. Weighted mean and standard deviation were used to answer the research questions, while t-test was used to test the null hypotheses 1 and 2 respectively. The findings of the study among others revealed that the ICT applications instructions were required by technology education lecturers in Niger State. The findings on hypotheses revealed that there was no significant difference in the mean ratings of the lecturers and administrators oftechnology education in 8 out of 12 items in ICT competency level and all the items on ICT instructions required by technology education lecturers in Niger State. It was therefore recommended among others that once a while, in-service training should be organized for technology education lecturers till all becomes ICT competent, ICT should be a compulsory course in all technology education tertiary Institutions. There should be integration of ICT in technology education lecture room or curriculum.

Key work: ICT, Technology Education, Lecturers, Competency

Introduction

The unique power of education acts as a catalyst for wider development goal of any nation. The development goal can only be fully realized, if technology education is equitable beyond mere enrollment or completion rates but to meet the Sustainable Development Goals (SDGs). It is therefore vital that nations focus on the quality of teaching and learning in the classroom throughout the education lifecycle (Olafare, Lawrence, Fakorede, 2017). To meet up with the SDGs through the power of technology education is a serious financial investment which is currently beyond the reach of developing country like Nigeria but Creativity and innovative solutions such as those offered by Technical VocationalEducation and Training (TVET) can go a long way in bridging the gap.

Technical Vocational Education and Training (TVET) is an aspect of education which prepares itsrecipients with skills, knowledge and attitudes necessary for effective employment inrecognized occupation.TVET as a comprehensive term referring to those aspects of the educational process involving, in addition to general education, the study oftechnologies and related sciences and the acquisition of practical skills, attitudes, understandingand knowledge relating to occupations in

various sectors of economic and social life. Specifically Federal Government of Nigeria(2014), stated that the goals of TVET shallbe to; provide trained manpower in the applied sciences, technology and business particularly atcraft, advanced craft and technical level; provide the technical knowledge and vocational skills necessary for agricultural, commercial and economic development; and give training and impartthe necessary skills to individuals who shall be self-reliant economically. It is, therefore necessary to integrate ICTinto all aspect of the teaching and learning instruction in technology education.

ICT refers to a range of computer-based technologies such as the internet, email and multi-media. Thus, ICT literacy can be defined as the knowledge, skills and abilities in operating the range of technologies that are applied in the process of collecting, storing, editing, retrieving, and transferring of information in various forms (Olafare, et al. 2017), to meet personal, educational and labour market goals. This definition reflects the use of computers in education as learning tools to help students to gain a level of competence in applying information technology to every day problem-solving. Lecturers are at the heart of the education enterprise, and they must play a central role in leveraging technology, and in particular, using ICT devices in teaching and learning. The use of the World Wide Web as a reference library of information that is always growing, and a means of communication between lecturers and students and among groups of students through email or an online chat-room are some of the activities that aid the ICT-based approach to teaching. Mobile technology, such as the Smartphone, and Tablet have become popular worldwide with users in classrooms at all levels of technical education (Olafare, et al. 2017). Therefore, from the foregoing it becomes an imperative that for technology education to be effective in instructions, there is need for sound application of ICT.

The application of information and communication technology (ICT) in technology education according to Felix, (2007) is summaries into three broad categories: Pedagogy, Training and Continuing Education. The pedagogical applicability of the ICTs is concerned, essentially, with the more effective learning with the aid of the various components of ICTs. Almost all subjects ranging from technology education can be learnt with the help of computers (Justin, *et al.*, 2016). It should be emphasized that pedagogic application of ICTs, involves effective learning with the aid of computers and other information technologies, serving the purpose of learning aids, which plays complementary roles in teaching/learning situations, rather than supplements to the lecturer. In fact, the computer is regarded as add-on rather than a replacing device. The pedagogic uses of the computer necessitate the development, among technology education lecturers of skills, competencies and attitude related to effective use of information and communications technologies. The implications in terms of changes in the teaching strategy, instructional content, role of the lecturers and context of the curricula are obvious as well as inevitable.

Competence is the quality of being well qualified physically and intellectually. Diri, (2012)viewed competencyas the acquisition of knowledge, skills and abilities at a level of expertise sufficient for one to be able to perform in an appropriate work setting (within or outside academia). Competencies are the knowledge and skills required of a lecturerin order to teach in the school, which include high levels of knowledge, values, skills and personal dispositions, sensitivities and capabilities and the ability to put those combinations into practice in an appropriate way (Diri, 2012). Thesecontributions imply that "competence" does not just involve ability to know but also the ability to be able to put

into use what one knows in an appropriate way. For ICT to effectively achieve its prior objective in teaching/learning of technology education, it largely depends on the competence of the lecturers.

New technologies require teachers' competencies in their roles, pedagogies, and approaches for training. The successful integration of ICT into the classrooms will depend on the ability of the technology education lecturers to structure the learning environment,embrace new technology with new pedagogy, to develop socially active classrooms, encouraging cooperative interaction, collaborative learning, and group work. This requires a different set of classroom management skills to be developed(Justin, *et al.,* 2016). The readiness of technology education lecturersto use ICT in the classroom need to be examined properly. That is, their ICT skills and degrees of competencies for the use of ICT tools in the teaching/learning of technology education need to be examined properly. Therefore, this study sought to investigate technology education lecturers' competencies in the use ofICT in classroom instructions.

Statement of the Research Problem

The Federal Government of Nigeria and various agencies such as National UniversitiesCommission (NUC), National Commission for Colleges of Education (NCCE) amongothers agencies of the tertiary institutions, has invested on ICT usage in education toachieve the objectives of the country's ICT policy and for Nigerian lecturers to be partof the community of experts of ICT supported teaching. This is based on the fact thatInformation and Communication Technology (ICT) is now used as tools, tutor and tuteein technology education and other programme of education.

Despite these laudable efforts, in Niger State the ICT competencies of technology education lecturers in the application of ICT in the teaching and learning situation arestill not known. Evidence abound that the level of ICT application during instructionvaries among lecturers in the tertiary institutions due to some factors such as lecturer'sICT competencies and institutional type among others. This makes it paramount tocontinually seek for strategies that could enhance the application of ICT in instructionssince ICT competencies among lecturers have been viewed in literatures as a prerequisitein the application of ICT in instructions.

The technology education lecturers therefore, required ICT competency for improvement because any improvement on the competence of these technology education lecturers will help improve the quality of instructional delivery in future. This study is therefore design to assess technology education lecturers' competencies in the application of ICT for instructions in Tertiary institutions in Niger State, Nigeria.

Research Questions

The following research questions are raised to guide the study:

1. What is the competency level of technology education lecturers in the use of ICT in tertiary institutions in Niger State, Nigeria?
2. What are the ICT applications, technology education lecturers required for instructions in tertiary institutions in Niger State, Nigeria?

Research Hypotheses

The following null hypotheses are formulated and were tested at 0.05 level of significance

HO_1: There is no significant difference between the mean responses ofLecturers and Administrators oftechnology education as regard the competency level of technology education lecturers in the use of ICT in tertiary institutions in Niger State, Nigeria.

HO_2: There is no significant difference between the mean responses ofLecturers and Administrators of technology education as regard the ICT applications, technology education lecturers require for instructions in tertiary institutions in Niger State, Nigeria.

Methodology

A descriptive survey research design was adopted for this study. The method was viewed as proper in light of the fact that it includes gathering information identifying with the suppositions and frames ofmind of the subjects of the investigation. The study was conductedin two tertiary institutions Federal University of Technology Minna and College of Education, NigerState, Nigeria. Niger State has been experiencingincessant security challenges in the recent time hence making these technology education lecturers inaccessible of the teaching instruction by road necessitated the choice of Niger State as an area of the study. The targeted population for this study was 47 comprising of 33 technology education lecturers in Niger State (Department of Industrial and Technology Education,Federal University of Technology Minna and School of Technical Education, Niger State College of Education Minna).As well as 14 administrators in both FUT and COE Minna. There was no sampling since the population was small.

A structure questionnaire titled: information and communication technology application competency (ICTAC) developed by the researchers and validated by three experts was used for the data collected for the study. All sections of research questions were structured so that respondents expressed their opinion on a four-point rating scale of: Highly Possess (HP) = 3.50 – 4.00; Possess (P) = 2.50 – 3.49; Moderately Possess (MP) = 1.50 – 2.49 and Not Possess (NP) = 1.00 – 1.49 respectively for research question one (1). Whereas the rating scale for research question two (2) was: Highly Required (HR) = 3.50 – 4.00; Required (R) = 2.50 – 3.49; Moderately Required (MR) = 1.50 – 2.49 and Not Required (NR) = 1.00 – 1.49. mean and standard deviation were the statistical tools used to analyze the data for answering research questions; t-test was used to test the null hypotheses and 1 and 2 respectively at 0.05 level of significant.

Results

Research Question One

What is the competency level of technology education lecturers in the use of ICT in tertiary institutions in Niger State, Nigeria?

Table 1

Mean and standard deviation of respondents onthe competency level of technology education lecturers in the use of ICT in tertiary institutions N = 47

S/N	Items	$\bar{X}$	SD	Remark
1	Using the keyboard during teaching instruction	62	49	P
2	Using available hardware during teachingInstruction	32	45	NP
3	Using of different instructional software packages in technology education	05	48	NP
4	Using of different operating systems	64	50	P
5	Accessing the internet	65	49	HP
6	Using of e-mail	62	50	HP
7	Using key ICT skills in developing and presenting Information	55	48	P
8	Participating in online discussions like Zoom	63	48	HP
9	Hardware repairs	42	82	NP
10	Writing general programmes	38	57	NP
11	Solving common ICT problems relating to instruction in technology education	71	46	HP
12	Using ICT for teaching and learning technology programs	64	49	P
	Total grand mean and SD	**2.52**	**0.51**	

Note: *N= Number of Respondent, SD= Standard Deviation; P= possessed; NP= not Possessed*

Table 1 presents the mean responses of the respondents on the 12 items on the competency level of technology education lecturers in the use of ICT in tertiary institutions with grand mean of 2.52. four (4) out the 12 items had their mean values ranged from 3.50 – 4.00 indicating that the ICT competency level items were highly possessed by technology education lecturers in the use of ICT in tertiary institutions. similarly, 4 out of the 12 items had their mean values ranged from2.50 – 3.49indicating that the competency level items were possessed by technology education lecturers. However, the remaining 4 items have their mean values ranged from 1.00 – 1.49 indicating that the ICT competency level items not possess by technology education lectures in tertiary institutions in Niger State, Nigeria.

Research Question Two

What are the ICT applications, technology education lecturers require for instructions in tertiary institutions in Niger State, Nigeria?

Table 2
Mean and standard deviation of respondents on the ICT applications, technology education lecturers require for instructions in tertiary institutions N = 47

S/N	Items	$\overline{X}$	SD	Remark
1	Use of presentation application	32	48	R
2	Use of digitalized lesson notes	48	71	R
3	Lesson presentation using projectors (in classroom)	65	48	R
4	Use education software which are subject specific	64	50	HR
5	Finding information via internet through browsing.	65	49	HR
6	Ability to Using computer for database	85	59	R
7	Developing industrial technology websites	44	77	R
8	Ability to operate Software programs/hardware devices setup to protect computers.	82	89	HR
9	Writing general programmes	67	48	HR
10	Evaluating technology education topics using specificsoftware	61	57	R
11	Developing diverse technology websites	22	98	R
	Total of Mean and SD	**03**	**63**	

Note: *N= Number of Respondent; SD= Standard Deviation; R=Require; HR= Highly Required*

Table 2 presents the mean responses of the respondents on the 11ICT applications items, technology education lecturers require for instructionswith grand mean of 3.03. Four(4) out the 11 items had their mean values ranged from 3.50 – 4.00 indicating that the ICT applications technology education lecturers required for instructions were highly required by technology education lecturers in tertiary institution in Niger State. Similarly, 7 out of the 11 items had their mean values ranged from 2.50 – 3.49 indicating that the technology education lectures required ICT application in teaching instructions in tertiary institutions in Niger State, Nigeria.

Hypotheses

HO_1: There is no significant difference between the mean responses of technology education lecturers and administrators as regard the competency level of technology education lecturers in the use of ICT in tertiary institutions in Niger State, Nigeria (P<.05).

The result of independent sample t-test mean ratings of the respondents on the technology education lecturers and administrators as regard the competency level of technology education lecturers in the use of ICT in tertiary institutions is presented in table 3.

Table 3 t-test of mean rating of respondents on response of technology education lecturers and administrators as regard the competency level of technology education lecturers in the use of ICT in tertiary institutions N = 47

Groups	N	Df	$\overline{X}$	SD	t	P	Remark
Lecturers	39	45	3. 12	0. 46			
Administrators	8		2.59	0.83	-1.298	0.644	Highly required

Significant at P>0.05

Table 3 shows the analysis of independent sample t-test of mean achievement scores of technology education Administrators and Lecturers as regard the competency level of technology education lecturers in the use of ICT in tertiary institutions. It was reveals that the calculated t-value = -1.298, df = 45, p=0.644 indicating p> 0.05. Hence, hypothesis two was retained. This mean, there was no significant difference in the mean achievement scores of technology education administrators and lecturers as regard the competency level of technology education lecturers in the use of ICT in tertiary institutions.

HO2: There is no significant difference between the mean responses ofLecturers and administrators of technology education as regard the ICT applications, technology education lecturers require for instructions in tertiary institutions in Niger State, Nigeria(P<.05).

The result of administrators and technology education lecturers as regard the ICT applications, technology education lecturers require for instructions in tertiary institutions is presented in table 4.

Table 4
t-test of mean rating of respondents on response of technology education lecturers and administrators as regard the ICT applications, technology education lecturers require for instructions in tertiary institutions in Niger State, Nigeria.

Groups	N	Df	Mean	SD	t	P	Remark
Lecturers	39	45	3.38	0.40			
Administrators	8		2.89	0.81	-1.391	0.542	Highly required

Significant at P>0.05

Table 4 shows the analysis of independent sample t-test of mean achievement scores of technology education Administrators and Lecturers as regard the competency level of technology education lecturers in the use of ICT in tertiary institutions. It was reveals that the calculated t-value = -1.391, df = 45, p=0.542 indicating p> 0.05. Hence, hypothesis two was retained. This mean, there was no significant difference in the mean achievement scores of technology education administrators and lecturers as regard the ICT applications, technology education lecturers require for instructions in tertiary institutions

Discussion of Findings
The discussion of finding of the study was organized based on the research question answered and hypotheses tested and presented thus:

The table 1 reveal that one (1) ICT competency level item out of 12 washighly possess by technology education lecturers. Similarly, seven (7) ICT competency level items were possessed by technology education lecturers in tertiary institutions. However, the remaining 4 ICT competency level items were not possessed by technology education lecturers in tertiary institutions in Niger State, Nigeria. The null hypotheses of no significance difference were therefore upheld for the 12 items. This implies that there was no significance difference in the mean responses of administrators and technology education lecturers as regard the competency level of technology education lecturers in the use of ICT in tertiary institutions. The findings of

the study were also in conformity with the findings of Fakorede et al. (2017**)**on different instructional softwarepackages in technology education. Felix, (2007) review a literature in consonance with Fakorede et al, who opinion thatusing key ICT skills in developing and presenting information among others enhance the competency level of technology education lecturers for instruction in tertiary institution.

The table 2 reveals that the respondents agreed that five ICT application instruction required items were highly required bytechnology education lecturers in tertiary institutions. Sharma, (2017) summaries ICT instructions required by technology education lecturers in tertiary institutions which include;using digitalized lesson notes,presentationlesson using projectors (in classroom) and others.The null hypotheses of no significance difference were therefore upheld for the 11 items. This implies that there was no significance difference in the mean responses of administrators and technology education lecturers as regard the ICT applications, technology education lecturers require for instructions. The finding of Justin, *et al.,* (2016) was in conformity with that of ICT instruction required which include;finding information via internet through browsing**,**ability to operate Software programs/hardware devices setup to protect computers chosen among others.

Conclusion

The study was determined to assess technology education lecturers' competencies in the application of ICT for instructions in Tertiary institutions in Niger State, Nigeria. The finding of the studyserves as the basis for making the following conclusion: that technology education lecturers' competencies in the application of ICT are highly required for instructions in tertiary institutions in Niger State, Nigeria.

Recommendations

The following recommendations were made for implementation based on the findings of this study;

1. Once a while, in-service training should be organized for technology education lecturers till all becomes ICT competent.
2. ICT should be a compulsory course in all technology education tertiary Institutions.
3. ICT competency should also be made one of the compulsory requirements for technology educationlecturers'promotion.
4. To ensure the integration of ICT in technology education lecture room or in the technology education curriculum, every technology educationtertiary institution should include, as a most, elements for developing ICT competencies of lecturers and student.

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Availability and Utilization of Educational Resources for Effective Teaching of Electrical/Electronics' Technology at Minna Innovation Enterprise Institute of Niger State

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Abstract:
This study determined instructional resources available and utilization for teaching and learning of electrical/electronic technology of innovation enterprise institutes (IEIs) programmes in Niger State. A descriptive survey design was used. The study comprised a population of 161 respondents. Two research questions and three hypotheses guided the study. The instrument used for data collection was a structured questionnaire which was validated by experts. Mean was used to answer the research questions while z-test was used to test the hypotheses. The study found that human resources such as qualify teachers, workshop instructors and attendants for teaching and learning of electrical/electronic technology trade in innovation enterprise institutes (IEIs) programmes in Niger State were available. The study also found that material resources for teaching and learning of innovation enterprise institutes (IEIs) programmes in Niger State available but not very adequate. The study also found that most of the material resources were utilized for teaching and learning of electrical/electronic technology in Niger State. Based on the findings, it was recommended among others that human resources such as qualified electrical lecturers, instructors, technicians, and workshop attendants should be employed in electrical/electronic technology department of minna institute of technology and innovation in Niger State for effective implementation of electrical/electronic curriculum.

Keywords: Availability and Utilization, Educational Resources, Teaching, Electrical / Electronics' Technology, IEIs

Introduction

It is widely accepted that no social, economic, political, and educational sector can achieve expected outcomes without the necessary resources. Hence, students' academic performance cannot be achieved in electrical/electronic technology in innovation enterprise institutes (IEIs) programmes in Niger State without the utilization of instructional resources to expose students to some form of stimulation. Vocational and technology education programmes aim at imparting individual learners with practical skills, basic scientific knowledge, attitude and competence that enable them to work very effectively in industrial and self-reliance ventures. This can however be achieved through a systematic and well-organized training facilities. Training facilities in schools must be comparable to those in industries (Maaji,2013).Electrical and electronics trades' subjects taught Nigerian in innovation enterprise institutes (IEIs) include: Basic of communication, Algebra and elementary trigonometry, Introduction to ICT, electrical and electronics principles, electronics, electrical and electronics CAD, Circuit theory, electrical machine, electrical power system, telecommunication, electrical and electronics maintenance and repair, computer software

and hardware maintenance, electrical installation, electrical and electronics design and drafting, microcontroller technology, industrial and electronics control.(FGN, 2004; NBTE, 2012).Instructional resources in the teaching of electrical electronic are anything that assist teachers' effectiveness in promoting teaching and learning. Students learn faster and easier when given the chance to learn through more instructional resources than one. The use of instructional material provides the teachers with interesting and compelling platform for conveying information since they motivate learners to learn more. Resources could be described as anything that can be used for production or creation, which yields an output. It includes things in the learning environment that are used to enhance the achievement of learning objectives such as facilities, materials, finance, human beings, among others. Operationally, a resource refers to human beings, instructional materials, and instructional methods which provide information for teachers and students on instructional basis in teaching.

Teaching is an instructional process that involves the acquiring of knowledge through the utilization of resources. It therefore, follows that such resources may be both human and non-human provided they facilitate the acquisition and evaluation of knowledge, skills, attitude, morals and values (Esu&Inyang-Abia, 2004). According to Nigeria Board for Technical Education (NBTE, 2012), for Electrical/Electronic trade to achieve its stated objectives, resources for teaching and learning must be available. Oloyede (2003) categorized educational resources into human and material resources. In terms of human resources, the most important are the teachers and the students. Human resource indicators include staff strength, number of teachers, teachers' quality, qualification, and experience. Human resources exist within people and consist of a person's potential abilities as well as current attributes; these resources include energy, knowledge, education, talent, attribute, skills and any other characteristics which require cognitive, affective or psychomotor abilities. Human resources in Electrical/Electronic trades in Innovation Enterprise institutes can thus be school administrator, technical teachers, workshop attendant, artisans and other members of staff who are either directly or indirectly involved in improving or moulding creative ability, aptitude, value commitment of students in Electrical/Electronic Technology trades curricular. Human resources in electrical/electronic engineering/technology programme are qualified technical education teacher with at least a degree in technical education engineering or in Technical Education, higher national diploma in electrical/electronic technology. (NBTE, 2012). Ogbuanya, Nweke and Ugwoke (2017) posited that educational resources needed for effective delivery of electrical/electronics technology include workshop, wiring boards, meters, cold chisels, power hand drills, electric soldering iron, universal pipe bending machines, radio receivers, drill bit set, screw drivers (assorted), hydrometers, hammers, (assorted), steel rules (assorted), magnets (assorted), relays, switches (assorted), tubes (assorted), thermostats, conduit pipes, joint junction boxes, socket outlets, plugs (assorted), digital meters, analogue meters, oscilloscopes, function generators, inductors (assorted), lead sucker, side cutters, among others. According to Osuala (1999), the use of educational resources in teaching electrical/electronic technology subjects is vital because thus they attract the attention of the students in the class. Olagboye (2004) stated that material resources consist of instructional resources such as audio and visual aids, graphics, printed materials. These resources according to Wang (1993) effectively facilitates the conveying of intended messages for learners' understanding, retaining, and application of experiences gained to reach overall purpose of electrical/electronic technology. Infrastructural facilities are the relevant materials utilized by institutions to facilitate teaching and learning in electrical electronic technology trades. It is the physical framework of facilities through

which goods and services are provided to the public (Deepika, 2002). Ezeji (2015) explained that Electrical/Electronic technology trades requires a workshop setting with adequate teaching facilities as a unique learning situation in which the learner may experiment, test, construct, assemble and disassemble, repair, design, fabricate, create, imagine and study. It was further stressed that adequate workshop experiences are essential for effective training of Electrical/Electronic Technology in innovation enterprise institute.

Infrastructural facilities refer to non-human and non-financial resources. They include the school physical facilities such as the library, laboratories, school plant, workshops, land, building, furniture, equipment, machinery, vehicles, electricity and water supply. Deepika, (2002) identified playgrounds, furniture, instructional facilities, school physical environment (beautification of the school environment), classroom blocks, electrical/electronic workshops, store, drilling machines (portable) library, staff office, toilet, adequate power supply, bore hole and utilities which include extinguishers, workbench, and first aid box as requirements for effective electrical/electronic technology programme. Chukwuani (1989) stated that for teaching to be a pleasure material resources needed in a laboratory or workshop must be of adequate number. Filibus(2001) asserted that when tools and other equipment are inadequately provided, it can lead to the production of highly unskilled personnel who are unemployable and unproductive. Supporting this assertion, Osam (2013) stated that vocational and technical school facilities in Minna institute of technology and innovation are also inadequate and in poor condition.

Statement of the Problem

There has been every low performance from Electrical/Electronic technology graduates who are unable to meet up with the demand of industries in terms of effective and qualitative service delivery. Graduates from Minna institute of technology in electrical/electronic technology and other innovation enterprise institutes are not performing up to expectation. The NBTE Executive secretary during a meeting with the Federal Ministry of Education, and operators of IEIs, suggested the need to improve on the performance of electrical/electronic technology graduates from IEIs. The private and public sectors reported that the performance of electrical/electronic candidates from IEIs was extremely poor. It was further reported that 37% of the students passedwith lower grades while 63% had deficiencies in one competency or the other. In addition, it was gathered by the industries who are the employers of the manpower graduates, that there is high level of unqualified electrical/electronic candidates in the recent years. The electrical/electronic graduates from Minna institute of technology and innovation Niger State will remained unemployable when these graduates are not supplyed with adequate teaching and learning facilities.

Based on the above, there is need to assess the availability of instructional resources for teaching and learning of electrical/electronic technology in Minna institute of technology and innovation of Niger State.

Purpose of the Study

The purpose of the study was to assess the availability of instructional resources for teaching and learning of electrical/electronic technology in Minna institute of technology and innovation Niger State. Specifically, the study seeks to:

6. Determine the availability of human resources for teaching and learning of electrical/electronic technology in Minna institute of technology and innovation Niger State.
7. Ascertain the availability of material resources necessary for teaching and learning of electrical/electronic technology in Minna institute of technology and innovation Niger State.
8. Ascertain the utilization of instructional materials for teaching and learning of electrical/electronic technology in Minna institute of technology and innovation Niger State.

Research Questions

8. What are the human resources available for teaching and learning of electrical/electronic technology in Minna institute of technology and innovation Niger State?.
9. What are the material resources available for teaching and learning of electrical/electronic technology in Minna institute of technology and innovation Niger State?.
10. What is the utilization level of facilities available in workshop for teaching and learning of electrical/electronic technology in Minna institute of technology and innovation Niger State?.

Hypotheses

The following null hypotheses were formulated and tested at 0.05 level of significant.

8. There is no significant difference in the mean responses of teachers and students on human resources availability for teaching and learning of electrical/electronic technology in Minna institute of technology and innovation Niger State
9. There is no significant difference in the mean responses of teachers and students on infrastructural facilities available for teaching and learning of electrical/electronic technology in Minna institute of technology and innovation Niger State.

Methodology

The study was carried out in Minna institute of technology and innovation, is a tertiary institution situated in Niger State. A descriptive survey research design was used to seek the opinion of teachers and students. The target population was 161 electrical/electronic personnel (125 students and 36 staff). The entire population was studied because of the manageable size of the population. The instrument for data collection was the researchers' structured questionnaire designed in a 4-point rating scale. The reliability of instrument was established from 28 responses gotten from elsewhere using Pearson Product Moment Correlation (PPMC) coefficients method which yielded a reliability of 0.50-1.49 which is considered as Not use, from 1.50-2.49 regarded as rarely, from 2.50-3.49, considered as Often and 3.50-4.00 regarded as Very often. Data were analyzed using mean and standard deviation.

Result

Research Question 1: What are the human resources available for teaching and learning of electrical/electronic technology inMinna institute of technology and innovation Niger State?

Table I: Mean Response on Human Resources available for teaching and learning of electrical/electronic technology

S/N	Item statement	Required no Ratio	Avail Ratio	Remark
1	Lecturers	1:15	1:15	Adequate
2	Instructors	1:10	1:10	Adequate
3	Workshop technicians	1;15	1:30	Inadequat
4	Workshop attendances	1:15	1;30	Inadequat

Table 1 shows the human resources available for teaching and learning of electrical/electronic technology in Minna institute of technology and innovation Niger State The result revealed that all the items are available with mean value of no 1, 2, 3 and 4. (1:10 & 1:10), (1:15 & 1:15), (1:15 & 1:30), (1:15 & 1:30) for lecturers, instructors, workshop technician and workshop attendants respectively. The standard deviation values indicated that the respondents were close in their responses.

Research Questions 2: What are the material resources available for teaching and learning of electrical/electronic technology in Minna institute of technology and innovation Niger State?

Table II: Mean Response on Material Resources available for teaching and learning of electrical/electronic technology.

S/N	Item	Required no	Avail		Remark
1	Basic electricity kits	5	2	40%	Inadequate
2	Voltmeter	5	5	100%	Adequate
3	Ammeter	15	13	86.6%	Adequate
4	Millimeter	10	3	30%	Inadequate
5	Micrometer	15	6	40%	Inadequate
6	Potentiometer	10	7	70%	Adequate
7	Allen wrench	10	4	40%	Inadequate
8	Megametre	15	5	33.3%	Adequate
9	Wheatstone bridge	10	6	60%	Adequate
10	Pliers of various types	20	15	75%	Adequate
11	Wire Strippers	10	6	60%	Adequate
12	Hammer of various sizes	20	25	125%	Adequate
13	Tester of various sizes	20	17	85%	Adequate
14	Rheostat	15	2	13.3%	Inadequate
15	Fish tape	10	6	60%	Adequate
16	Electronic trainer unit	10	NIL	NIL	NIL
17	Experimental trainer	10	4	40%	Inadequate
18	Earth loop tester	10	3	30%	Inadequate
19	Motor generator	5	5	100%	Adequate

20	Techogenerator	5	3	70%	Adequate
21	Dc motors	10	6	60%	Adequate
22	Ac motors	10	6	60%	Adequate
23	Stabilizers	5	5	100%	Adequate
24	Transformers	10	7	70%	Adequate
25	Soldering Materials	10	4	40%	Adequate
26	De-soldering Pump	10	4	40%	Adequate
27	Oscilloscope/Signal Generator	15	13	86.6%	Adequate
28	Prototyping Tools	10	2	20%	Adequate
29	Power f meter	10	5	50%	Adequate
30	Inductive motor	10	8	80%	Adequate

Table 2 shows the material resources available for teaching and learning of electrical/electronic technology in Minna institute of technology and innovation Niger State. The result revealed that these resources were available at different extent base on the response of teachers and students. For teachers' responses, the result shows that item 2, 3, 6,8,9, 10, 11, 12, 13, 15, 17,19,20, 21,22, 23,24, 25,26, 27,28,29 and 30 were considered to be available and adequate .From the students' response, the result shows that item 1, 4, 5, 7, 14, 17 and 18, were considered to be available but inadequate. Whereas item no 16 is considered as NIL . Furthermore, the result revealed that material resources that fall below 50% is considered available but inadequate for teaching and learning of electrical/electronics technology in Minna institute of technology and innovation Niger State.

Research Question 3: What is the utilization level of facilities available in workshop for teaching and learning of electrical/electronic technology in Minna institute of technology and innovation Niger State?

Table III: Mean Response of Respondents on utilization of available Facilities for Teaching and learning of Electrical/Electronic technology.

S/N	Item	Mean	SD	REMARK
1	Basic electricity kits	2.50	0.11	Often
2	Voltmeter	3.78	0.78	Very often
3	Ammeter	3.67	0.77	Very often
4	Millimeter	3.67	0.77	Very often
5	Micrometer	3.87	0.75	Very often
6	Potentiometer	2.65	1.34	Often
7	Allen wrench	2.05	1.35	Rarely
8	Megametre	2.89	1.25	Often
9	Wheatstone bridge	1.54	1.67	Rarely
10	Pliers of varus sizes	3.65	0.77	Very often
11	Wire Strippers	2.98	1.27	Often
12	Hammer of various sizes	3.56	0.76	Very often

13	Tester of various sizes	3.65	0.77	Very often
14	Rheostat	2.45	1.45	Rarely
15	Fish tape	3.87	0.78	Very often
16	Electronic trainer unit	NIL	NIL	NIL
17	Experimental trainer	2.50	0.68	Often
18	Earth loop tester	2.65	1.56	Often
19	Motor generator	3.87	0.78	Very often
20	Techogenerator	1.23	2.00	Rarely
21	Dc motors	3.87	0.77	Very often
22	Ac motors	1.45	1.96	Rarely
23	Stabilizers	3.87	0.77	Very often
24	Transformers	3.78	0.76	Very often
25	Soldering Materials	3.90	0.67	Very often
26	De-soldering Pump	3.90	0.67	Very often
27	Oscilloscope/Signal Generator	2.50	1.76	Often
28	Prototyping Tools	1.43	1.55	Rarely
		0.99		Often
29	Power f meter	1.45		Rarely
30	Inductive motor			

Table 3 shows the utilization of facilities available for teaching and learning of electrical/electronic technology in Minna institute of technology and innovation Niger State. The result revealed that the following items are used very often 2(3.78 & 0.78), 3 (3.67 & 0.77),4 (3.67 &0.77), 5 (3.87 & 0.75), 10 (3.65 &0.77) ,12 (3.56 & 0.77),13 (3.65 & 0.77),15 (3.87 & 0.77),19 (3.78 & 0.78), 21 (3.87 & 0.78), 23 (3.87 & 0.78) ,24 (3.78 &0.76) and 25(3.90 & 0.69), 26 (3.90 & 0.69), facilities available and very often used for teaching and learning of electrical/electronic technology in Minna institute of technology and innovation Niger State. The result also revealed that equipped workshop 1(2.50 & 1.98),6 (2.65 & 1.95), 8(2.89 & 1.62), 11(2.98 & 1.43), 17(2.65 & 0.11), 18(2.65 & 1.46), 27(2.52 & 1.43) and 29(2.68 & 2.00) were often used for the teaching and learning of electrical/electronic technology in Minna institute of technology and innovation Niger State. Lastly the items no 7(2.05 & 1.35), 9 (1.54 & 1.67), 14(2.45 & 1.45), 20(1.23 & 1.55), 22(1.45 & 1.96), 28(1.43 & 1.46) and 30(2.23 & 1.43) were rarely used for teaching and learning of the teaching and learning of electrical/electronic technology in Minna institute of technology and innovation Niger State.

Test of Hypotheses

The following null hypotheses were formulated and tested at 0.05 level of significant.

Hypothesis 1: There is no significant difference in the mean response of teachers and students on human resources available for teaching and learning of electrical/electronic technology in Minna institute of technology and innovation Niger State.

Table IV: z-Test Analysis on Human Resources available for teaching and learning of electrical/electronic trades

GRUOP	N	X	SD	N	Df	A	Z-cal.	Z-crit.	Remark
TEACHER	36	2.7	0.7	36	159	0.05	1.32	1.96	Accepted
STUDENT	125	2.70	0.94	125					

The result in Table IV shows that the calculated value (z-cal) is 1.32 while the critical value (z crit) stands at 1.96. Since the calculated value (z-cal) is less than the critical value (z-crit), it therefore means that the null hypothesis of no significant difference in the responses of teachers and students on human resources available for teaching and learning of electrical/electronic technology in Minna institute of technology and innovation Niger State.

Hypothesis 2: There is no significant difference in the mean response of teachers and students on infrastructural facilities available for teaching and learning of electrical/electronic technology in Minna institute of technology and innovation Niger State

Table V: z-Test Analysis on Infrastructural Facilities available for teaching and learning of electrical/electronic trades

Group	N	X	SD	N	Df	A	Z-cal	Z-crit.	Remark
Teacher	36	2.60	0.84	36	159	0.05	-1.47	1.96	Accepted
Student	125	2.67	0.85	125					

Table V shows that the calculated value (z-cal) of -1.47 was less than the critical value (z-crit) which stood at 1.96. Hence, the null hypothesis of no significant difference in the response of teachers and students on infrastructural facilities available for teaching and learning of electrical/electronic technology in Minna institute of technology and innovation Niger State was accepted.

Discussion of Findings

Table 1 revealed that lecturers, instructors, workshop attendants and workshop technician were available human resources in Minna institute of technology and innovation for teaching and learning of electrical/electronic trades in Niger State. This finding corroborate with James and David (2019) who posited that human resources such as lecturers, instructors are found to be adequate and laboratory attendants and technicians were found to be inadequate in Minna institute of technology and innovation for teaching and learning processes in Technical and Vocational

Education and Training programmes. The finding is also in agreement with Akinfolarin, Ajayi, and Oloruntegbe (2012) who reported that teachers, instructors, technician and other required resources for teaching technical education were available.

From Table 2, the study revealed that material resources are available for teaching and learning of electrical/electronic trades in Minna institute of technology and innovation among others include Basic electricity, kits, ammeter, micrometer, ohmmeter,galvonometer, wattmeter ,CR oscilloscope, experimental trainer for DC and AC, rheostats, Earth loopier tester motor generator sets,ac generator, variable resistance, variable inductive moto,energy meter,power factor meter,clips on meter, digital phase meter, meggameter, multimeter, among. However, some needed materials resources for effective teaching and learning of electrical technology were either not available or inadequate, thus limiting students' skill development in electrical technology. These findings are in agreement with Osam (2013) and Okebukola (2005) who asserted that hand tools needed for the teaching and learning of electrical electronics trades are rarely available in the institute workshops.

Table 3 revealed the utilization level facilities as mentioned above were very often used compered to rarel in Minna institute of technology and innovation in Niger State. These findings are in agreement with Filibus (2001) who posited that the inadequacy of tools and other equipment provided in TVET institution led to the production of unskilled students who are unemployable and unproductive.

Conclusion

Based on the findings, the study hence deduced that human, material and infrastructural resources for the teaching and learning of electrical/electronic technology in Minna institute of technology and innovation are necessities that should be adequately provided for inculcating the required skills needed for students to become self-reliant after graduation. Therefore, these resources should be made available for utilization in Minna institute of technology and innovation in Niger State to facilitate positive learning outcome.

Recommendations

1. Infrastructural facilities like block of classrooms, workshops, toilet facilities should be constructed in the institution.
2. Innovation enterprise institutes should be enlisted among the tetfund benefiting institution in order to be able to access grant for scholarship and physical infrastructural development.
3. The need for the IEIs be giving special consideration and take off grants to enable them meet up with the required learning and teaching materials.
4. Federal government should as matter of urgency inculcate innovation diploma in the federal scheme of service.

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Teaching Method for Technical and Vocational Training Education: A View into Project-Based Learning in Nigeria

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Abstract
The need arising from speedy national development through skilled manpower causes paradigm shift in teaching and learning skill oriented programme like Technical Vocational Education and Training (TVET). Training in skill acquisition has come a long way but Nigeria is yet to achieve as expected. In the 21st century Nigeria needs holistic approach to TVET that will make youth actively engaging in real world exercises to make them develop critical thinking ability, collaborative and team work at the same time independent project accomplishment. The paper looked into what is obtainable in skill training pedagogy and the need for paradigm shift to Project-Based Learning (PBL), what advantages it carries over the present approach. The paper ends with call in shift in the teaching and learning in adopting project-based learning approach first by redesigning the curriculum to more project activities and provision of more practical materials by institutions. Similarly, industries and communities equally to assisting institutions in training the learners in skill acquisition. Lastly, authority should have political will of moving the nation forward by providing the viable atmosphere for the youth as future leaders in this country.

Keywords: TVET, Project-Based learning, Skill, Curriculum, National Development

Introduction
One of the key element of education or knowledge is that it isdynamic and policies related to it keep changing with time but progressively. Society or situation call for changes in curriculum content and teaching pedagogies either to modify current methodology or do away with it as it cannot deliver the expected result. Education is the key to all human changes needed for social cohesion. More precisely skill training qualifies one to fit into the society and equally contribute to development. In Nigerian context, the National Policy on Education (NPE) of the 2013 is the latest version in operation reflecting the 21st needs and aspirations of Nigerians. Innovation and technological advances are constantly changing and education systems which reflect this dynamism will be most capable of responding effectively to the current and changing needs of young people, society and indeed the labour market. These innovations warrant changes in the methodology of both teaching and learning. The 21st century teacher is in the forefront of creating and implementing the innovations. The assertions are shared with *Hallerman, Lewis, and Dresbach* (2019) that the teacher "inspiring creativity, encouraging collaboration**,** expecting and rewarding critical thinking**,** and teaching children not only how to communicate, but also the power of effective communication**.** These are skills students need to develop in order to thrive in todays and tomorrows dynamic workplace".

On this Akor*et al* (2016) forward "that is why it is important for schools to prepare and supply future worker with appropriate knowledge and skills to enhance their productivity and therefore promote economic growth". In the same veinAggarwal and Gasskov (2013) from the International Labour Organization (ILO) office agreed that

> Countries formulate skills development policies to engage all stakeholders in: setting a common vision of the skills system that a country aims to build; facilitating an alignment with national development framework and coherence with other policies; proposing coordinated and planned actions and reforms for improving outcome and impact of training (pp. 2, 2013).

Practically oriented field of study like Technical Vocational Education and Training (TET) is such nature. In order to catch up with speedy change in technology and skills needed for national development. Eze and Okarafor (2012) "the development of TVET as an educational panacea that would usher in the much needed technical aspect of human capital, potentially leading to an age of economic and technological development".Applying teaching pedagogy that speeds skill acquisition and critical thinking in a learning process brings about Project-Based Learning (PjBL) methodology, which actively spear not any learning content from the learner and the teacher active facilitator.

According to Renard (2017) PjBL is a learning method in which students identify a real-world problem and develop its solution. Students gain knowledge and skills by working for a longer period of time to investigate and respond to an engaging or complex question, problem or challenge. Students show what they learn as they go through the unit, interact with the lessons, collaborate with each other and assess themselves and each other. In the same perspective Bulk Institute for Education (BIE) (2020) defined PjBL as "a teaching method in which students learn by actively engaging in real-world and personally meaningful project. However, in any learning situation there is element of meaningfulness but could either be negative or positive. On this ground, BIE (2020) further clarifies that in Project Based Learning, the project is the vehicle for teaching the important knowledge and skills student need to learn.Students work on a project over an extended period of time – from a week up to a semester". As a result, students develop deep content knowledge as well as critical thinking, collaboration, creativity, and communication skills (BIE, 2020).

Technical and Vocational Education and Training and Skilled Manpower

It is not a waste of time to continue reminding ourselves what TVET entails or its importance in human development, economic growth, skill enhancement and social value. The more labour and market demand on skilled manpower are considered the more the perception on TVET deepened. This view corresponds with Pucel (1990) in Gyimah (2020) that "Technical and Vocational Education and Training has been assuming different meanings and purposes due to global demographic, social, technological, economic, and political developments". On this ground Boatenga (2012) in Gyimah (2020) posits that "these developments put pressure on governments and policymakers to keep expanding the purposes and expectations of Technical and Vocational Education and Training". TVET must respond appropriately to these changes in order to remain relevant in preparing individuals to be able to take advantage of the opportunities for the kind of workforce of 21st century world of work.

Technical and Vocational Education and Training is a practical-based learning system where the primary objective is acquire skills and be able to apply the skill in more advanced format. To meet this goal, students need to work more independently but under close guide and supervision by the teacher. They equally need to use higher-order thinking skills and learn to work as a team. With growing awareness on the added value of TVET, Atchoarena (2009) in Osidife (2017) observed that "the international dimensions of vocational education and training are becoming increasingly important—in a way similar to what has already happened with higher education and, indeed, employment systems and labour markets".

The paradigm shift from teacher-centered teaching to learner-centered teaching opens window to genuine or realistic method of instruction in TVET related fields. The adoption of any policy should be towards realizing the set goals and objectives. On this perspective, Okolocha (2012) in Raimi and Akhuemonkhan (2014) opines that TVET is well suited to help youths and adults become self-dependent and self-reliant, while for those working in the industry, TVET is helpful in the areas of skills enhancement, mitigation of high 'job turnover and risks of obsolescence.

Project-Based Learning Pedagogy

Changing learning procedure came with assessment of system or methodology in practice. As life moves from one stage to the next, aspirations are unfolded, demands by societies generate pressure on authorities for more effective and easier pedagogy for the young children. 21st century is characterized by technology. Schröder (2019) posits that "the rapid pace of development and change continues to increase. Advances in digitalization arechanging how we live and work, and opening up new dimensions to the understanding of learning". In this case, Stivers (2010) forwarded that "there is forty years of accumulated evidence that the instructional strategies and procedures that make up Project Based Learning are effective in building deep content understanding. Research also shows that PBL raises academic achievement and encourages student motivation to learn". PBL is an instructional approach built upon learning activities and real tasks that have brought challenges for students to solve collectively toward common goal. However, performance is assessed on an individual basis, takes into account the quality of the product produced, the depth of content understanding demonstrated, and the contribution made to the ongoing process of project realization, (Stivers, 2010). Similarly, according to George Lucas Educational Foundation (GLEF) (2007)

> The old-school model of passively learning facts and reciting them out of context is no longer sufficient to prepare students to survive in today's world. Solving highly complex problems requires that students have both fundamental skills (reading, writing, and math) and 21st century skills (teamwork, problem solving, research gathering, time management, information synthesizing, utilizing high tech tools). With this combination of skills, students become directors and managers of their learning process, guided and mentored by a skilled teacher (GLEF, 2007).

Project-based learning enables students to solve problems and address issues important to them, their communities, and the world. Through PBL, students learn how to interact with adults and organizations. They are exposed to real workplaces and jobs so they will develop career interests. Similarly, by bringing real-life context and technology to the curriculum through a PBL approach, students are encouraged to become independent workers, critical thinkers, and lifelong learners

(GLEF, 2007). Project-based learning encourages formative assessment. Additionally it has the following benefits, thus;

- It allows students to demonstrate their capabilities while working independently.
- It lets teachers have multiple assessment opportunities.
- It shows the student's ability to apply skills such as doing research.
- It develops a student's ability to work with other students, building teamwork and group skills.
- The teacher learns more about the student as a person.
- It helps the teachers communicate in meaningful ways with the student or a team. Being able to give meaningful feedback is very important. (GLEF, 2007)

Similarly, PjBL expands the horizon of the learner as forwarded by Thomas (2000) reported by Intel Corporation (2012) that PjBL "drives students to encounter (and struggle with) the central concepts and principles of a discipline" and central activities of a project involve enquiry and construction of new knowledge by the students"

Improving TVET Practical Delivery through Project-Based Learning

The key characteristic of TVET is practical dominance considering the primary objectives of skill acquisition, industrial knowledge, technological advancement, employment opportunities and carrier fulfilment among others. Since practical activities are non-compromising, TVET programme must go with needs and innovations of the 21st century industries. In Nigeria TVET relevance to industries is a lingering issue and yet to be addressed squarely. There exist gap between curriculum and industrial need which resulted to mismatch between training output and employment requirement by the industrial sector. Rufa'i, Abdullahi and Kagara (2013) observed that "various studies have queried the relevance of graduates and research results to the industry considering the low academic status and skill acquired byproduct from various TVE institutions. The training program is not addressing the growing needs of the industry and the society". One principal factor to the existence of this gap has to do observation made by Olurefemu and Ashaolu in Rufa'i*et al* 2013) that "the industries in Nigeria do not have much involvement in training, funding and curriculum development of our technological institutions, which are the trademark of industrialization in the developed nations".

In order to close up the gap Nigeria must follow the world by rekindling the awareness on the importance of globalization effect of TVET and the changing world economy, the economy that demands productive workforce for improving productivity and working conditions towards improving the quality and skills levels of their labour workforce. In nutshell the curriculum content and teaching methodology need holistic approach, an approach that will give required time and trainingskills needed to match with marketdemand. Esa and Rahmn (2014) reported similar ideafor Malaysia that "in 2010 alone, 5000 companies were involved in the training of 7800 community colleges students. While they are in industries, industries are expected to provide them with suitable tasks to prepare them for work as well as future learning".

Achieving Project-Based Learning in TVET

Keeping children engaged and motivated in school is challenging, even for the most experienced teachers. This is why teachers need suitable and effective method of controlling the students' attention within the four walls of the classroom. This is not obtainable without occupying the learners for substantial period of time. However, research shows that there are practices that will generally encourage students to be more engaged.The TVET learning content is characterized by practical activities that keeps learner practically engaged. As means of acquiring the expected skills there is a synergy with Project-Based learning pedagogy. While TVET constitute of 70 percent practical activities, PjBL consider engaging learner into independent activities that exposes learner into task "that allows students to gain knowledge by requiring them to work for an extended period of time to investigate a complex problem or question. Students are given the freedom and opportunity to explore real world problems and develop a deeper and more enriched understanding (Abdo, 2020). According to Kokatsaki *et al* (2016) in Aksela & Haateinen (2019) PjBL is characterizedby students' autonomy, constructive investigations, goal-setting, collaboration, communication and reflection within real-world practices. As a comprehensive approach to classroom teaching and learning designed to engage students in the investigation of real-world problems, Akselab & Haateinen (2019) believed PjBL adopt

> Drivingquestion designed by students and/or teachers should not be so constrained that the outcomes are predetermined, leaving students with little room to develop their own approaches to answering the question. Students' freedom to generate artifacts is critical, because it is through this process that students construct their knowledge (pp. 10, 2019).

These practices include moving away from rote learning and memorization to providing more challenging, complex work; having an interdisciplinary, rather than departmentalized focus; and encouraging cooperative learning. While Aksela & Haateinen (2019) observed that common barriers to implementing PBL effectively include teachers' resistance tostudent-driven learning because they often see this as giving up control of the class, they equally Han et al (2015) maintained that a common goal for PBL has been to help students acquire deeper content knowledge, skills as well as feelings of commitment and ownership of their learning. Similarly, both Katz(1994) and Challenge 2000 (1999) in Railsback, (2002) opine that most important, students find projects fun, motivating, and challenging because they play an active role in choosing the project and in the entire planning process. Their observation is the bases upon which all learning activities are achieved. However achieving the objectives, the curriculum needs to reflect the expected objectives. Substantial number of scholars have outlined the nature or the curriculum should encompassed for PBL. Condliffe *et al* (2017) reported views posed by scholars that "some PBL scholars set guidelines for the types of questions and topics that a student should encounter, as well as the relationship between the PBL approach and other curriculum and pedagogy featured in the course".These guidelines include

a. *Driving Question to Motivate Learning*: PBL unit/curriculum should be motivated by driving questions. Krajcik and Mamlok-Naaman (2006) explained: "a driving question is a well-designed question that students and teachers elaborate, explore, and answer throughout a project" (Condliffe *et al*, 2017)

b. *Target Significant Learning Goals*: Larmer and Mergendoller (2015a) stated that a well-designed PBL approach should teach "students the important content standards, concepts, and in-depth under-standings that are fundamental to school subject areas and academic disciplines." (Condliffe *et al*, 2017)

c. *Use Project to Promote Learning*: Parker and colleagues (2011, 2013) and Thomas (2000) explained that projects should be "central, not peripheral to the curriculum". What clearly distinguishes PBL from other instructional approaches is that projects are not the culmination of learning (as they often are in standard classrooms), but instead are the process through which learning takes place. (Condliffe *et al*, 2017)

d. *Dedicate Sufficient Time*: The design principles offered by Parker and colleagues (2011, 2013) and Thomas (2000) require that a PBL approach guide the curriculum and instruction of an entire course and not just appear in a single, time-limited unit. Ravitz (2010) specified that PBL instruction should "occur over an extended period"(Condliffe *et al*, 2017)

Equally the learner has a role to play in how PBL could achieved. Condliffe et *al* (2017) cited responses by scholars in this respect, thus:

a. *Promote Construction of Knowledge*: PBL has its roots in constructivist theories of learning. Sets the concept of PBL units involving students in the construction of knowledge, in-depth in-query, and/or the use of problem-solving and critical thinking skills. Thomas (2000) explicitly stated that a PBL approach must involve students in the "construction of knowledge". Darling-Hammond and colleagues (2008) explained that projects should have "multiple solutions and methods for reaching solutions and should lead students to confront and resolve conflicting ideas" (Condliffe *et al*, 2017)

b. *Cultivate Student Engagement*: Parker and colleagues described why fostering a "need to know," by defining a student's role in the project *before* the delivery of pertinent information or content, is essential for student learning. Krajcik and Shin (2014) noted that the driving question of a PBL approach supports students' engagement in project activities. (Condliffe *et al*, 2017)

c. *Use Scaffolds to Guide Student Learning*: Krajcik and Shin (2014) "While engaged in the practices of science, students are *scaffolded with learning technologies* that help them participate in activities normally beyond their ability". Teachers, peers, learning materials, and technology can all serve as scaffolds. The use of scaffolds to support student learning is an approach that has grown in popularity with the spread of Project-Based and design-based learning environments (Puntambekar and Hubscher, 2005). (Condliffe *et al*, 2017)

d. *Support Collaborative Learning*: Grant (2002) and Krajcik and Shin (2014) saw collaborative work as an essential element of PBL. Grant (2002) and Krajcik and Shin (2014) saw collaborative work as an essential element of PBL. According to Darling-Hammond (2008b) collaboration do support students' capacity to "engage in meaningful learning that will allow them to manage the fast-changing, knowledge-based society of the twenty-first century" (Condliffe *et al*, 2017)

Conclusion

The promotion of TVET is high on the demand for skilled manpower and employment opportunities as a strategy for political agenda these days. Project-Based Learning as a key element in engaging learner for better outcome. Both teachers and students have explicit roles and expectations to accomplish. Likewise PBL curriculum is directed toward achieving specific goals

including autonomy, constructive investigations, goal-setting, collaboration, communication and reflection within real-world practices. With this pedagogy TVET will attend to its set objectives in training, skill acquisition and contribution to industrial and economic development.

Recommendations

Though the recently reviewed TVET curriculum of NCE awarding institutions has provided room towards specialization, Project-Based Learning pedagogy is calling for streamlining the TVET programme by

1. Full implementation of the curriculum provision required of contact hours in practical, lecture and tutorials. This is achievable by restricting all GSE courses to terminate by end of second semester of level one of all programmes.
2. The contact hours stipulated for all core subjects should observed. For example the NCE minimum standard designed 3-1-1 contact for 2credit unit course meaning that 6 hour practical, 2 hour lecture and 2 hour tutorial per week.
3. Teachers should design their teaching modules in a way one single activity will comprise of variety of sub-activities before completion. By this one or two Project-Based activity will engage the learner into series of tasks on progression and without skipping any step as all activities are in sequence one leading to the next step which cannot be attended without the earlier one completed.

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The Effect of Computer Simulation Instructional Package on Physics Students' Achievement in Jalingo Education Zone Taraba State.

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Abstract
This study investigated the effect of computer simulation instructional package on physics students' achievement in electrolysis. The study adopted a quasi-experimental design of non-equivalent non-randomized pre-test post-test. A total number of 108 students,consisting of 62 male and 46 female students participated in this study. Multi-stage sampling techniques were conducted in three stages. Firstly, purposive sampling procedure was adopted to obtain four (4) secondary schools in Jalingo Education Zone, Taraba State, Nigeria forming four intact classes. Secondly, students of the four (4) schools were assigned to experimental group (simulation group) and control group (traditional teaching methods) respectively. Thirdly, stratified sampling technique was used to select the one hundred and eight (108) SS2 students. Two instruments developed by the researcher were used in this study, which are Electrolysis Achievement Test (EAT) and Electrolysis Simulation Instructional Package (ESIP). The instruments were validated by experts in science education. The reliability coefficient of EAT was 0.77 using Pearson Product Moment Correlation Coefficient.Three hypotheses were generated to achieve the objectives of this study. The three hypotheses were tested using T-test and Analysis of Variance (ANOVA).Findings from the study showed that there was a significant difference in academic achievement among secondary school students taught physics with Computer Simulation Instructional Package and those taught with Lecture Method, there was a significant differencein academic achievementbetween male female students taught physics with Computer Simulation Instructional Package, and there was a significant difference in academic achievement among secondary school students taught physics with Computer Simulation Instructional Package and those taught with Lecture Method based on ability level. Based on these findings, it was concluded that there was a statistically significant effectof ComputerSimulation Instructional Package on physics achievement. It's then recommended that physics teachers should try to establish a classroom environment that facilitates the use of simulation packages in teaching and learning of physics concepts.

Keywords: Achievement, Computer Simulation,and Physics.

Introduction
Physics is an international enterprise that plays a role in the future progress of humanity. Physics is an exciting intellectual adventure that inspires young people and expands the frontiers of knowledge about nature. Ogbole (2015) opined that Physics generates fundamental knowledge needed for future technological advances that will continue to drive the world's economic engine. In the view of Oche (2012), Physics improves the quality of life by providing the basic understanding necessary for developing new instrumentation and techniques for

medical applications such as computer tomography, magnetic resonance imaging, particle emission tomography and ultrasonic imaging. Thus, physics plays a vital role in health, economic development, education, energy and the environment. Based on the undisputable relevance of the subject, it is expected that the study of Physics and students' performances in the public examination would be on the increase. The importance of Physics as an essential requirement for the economic, scientific and technological development of any nation cannot be over emphasised. This implies that the development and sustenance of any form of technology will be a wild goose chase unless a solid foundation is laid for effective and efficient Physics education. However, a solid foundation cannot be applied unless more secondary school students offer Physics and perform impressively in national and international examinations. This is based on the fact that physics is a pre-requisite for many science and technology-related courses such as medicine, engineering, pharmacy, computer science, among others, in tertiary institutions.

However, it is disappointing to note that the students' performance in Physics at internal and external examination has left more to be desired despite the relative importance of Physics (Saage, 2010). Hence, necessary measures must be taken to address this issue. The present Nigeria Physics classroom does not provide the fun, hands-on, challenging, interactive and collaborative environment needed by a new generation of students exposed to internet, computer usage, hand-set and other sophisticated gargets. The use of simulationmight be used to solve the problem of this nature.

In this 21st century, the adoption of technology-based instructional strategies that motivate, captivate, and enhance students' achievement and retention should be encouraged. One of such approaches, according to Yaki*etal.* (2014), is technology-enhanced learning such as multimedia presentation which could be either computer-based or video-based instruction. Computers can be used as a supplementary tool to facilitate education in order to achieve educational goals. It is reported that students' abilities and skills are affected positively by use of computers (Dantani, 2011).It is also stated that computers make students feel confident and helps them to discover interactions among the components of a complex system (Mihindi*etal.*, 2017). Great emphasis is placed on the computer-based science and technology laboratories and ordinary science laboratories in the educational curricula of the developed countries (Oguz, 2011). One of the aims of the science and technology course is to train individuals capable of keeping up the fast-growing and changing science world and capable of utilising the recent technological discoveries in every field. Therefore, the importance of using computers in a physics class may not be limited to the ability of computer simulation to improve learning; rather, computer simulation instruction adds another dimension to the teacher's repertoire of strategies, which may improve overall learning. Another important reason to include student to computer use in a Physics lesson is that most (if not all) students, especially those planning a career in Physics, will be required to be computer literate. As students interact with computers in various ways within their Physics courses, their degree of computer awareness and literacy will increase. Attractive and well-designed programmes can be motivational. Students can spend more time on tasks; assessment, diagnostics and remediation can be built into programmes to help learners achieve mastery of the concepts taught (Olele, 2008). CBSI can either be used to enhance practical investigation or as a virtual alternative to real practical work

where a simulation supports the exploration of the investigation model through a computerised representation of the phenomena under study.

Computer-based instruction refers to the process of transfer of knowledge and skills or for remediation presented on a computer. Computer-based instructions are interactive and can illustrate a concept through attractive animation, sound and demonstration. Computer simulation instructional strategy allows students to progress at their pace and work individually. According to Dematera (2017), Computer-based instruction is any curricula in which students interact with a computer as a key element of the learning process. So many researchers have used computer-assisted instructions in different subject areas to improve effective teaching and learning.

Nigerian Policy on Education (FRN, 2014) has made provisions to make education of the citizenry both functional and relevant to ensure all-round development. It also demands that teaching shall be practical, activity-based, experiential, Information and Communication Technology-based (ICT-supported). To that end, teachers must adapt to the new teaching strategy, especially Computer Based Learning Strategy, to make teaching a learner's centre. Specific provisions have also been made for different levels of education system so as to ensure effective curriculum delivery in schools. Orji and Uka (2012) argued that to actualise this in any society, there is the need to attend to certain unavoidable variables such as teaching materials, methods adopted, the curriculum, the teacher, and students 'interest.

This means simulation is a computer program that allows the learner to interact with a computer representation of real-life experience. Simulation programs provide terms of real-life situations, phenomena or processes. Simulations are designed to be realistic, which helps students apply their knowledge in a realistic format. They are often used to teach subject areas such as science because they can imitate objects and explain processes as small as atomic interactions. Simulations help students solve problems and improve their thinking skills. Computer Simulation instruction adds another dimension to the teacher's repertoire of strategies, improving overall learning.This present study intends to use computer-based simulation instructional strategy to enhance students understanding of electrolysis.

Different authors have defined academic achievement in different ways. According to Hassinger and Plourder (2015), academic achievement refers to what the students have learned and is usually measured through standardised tests, performance assessments, and portfolio assessments. They further added that an individual does or realises at school, University or College in class, laboratory, library or field work. It does not include sport or music. The concept could be referred to as the measure of students' acquisition of certain skills at the end of teaching and learning activities. To Abdullahi and Duyilemi (2011), academic achievement is how well an individual has worn his cognitive tasks. In this instance, academic achievement results from an examination written by students which is often a reflection of learning. It is important for the successful development of young Physics in society; students who do well in the school are better able to transition into adulthood and achieve occupational and economic success.

The observed students' poor achievement in Physics is attributed to the use of inappropriate or ineffective teaching method by Physics teachers (Asikhia, 2010). Sam (2011) regrettably observed that the number of students meeting university requirements in science and technology in Nigeria is on the low side. To this effect, researchers (LongJohn, 2019; Igboegwu, 2015), have traced the cause of this consistent problem of failure in Physics and have attributed it to a number of factors. Some of these factors are lack of Qualified Personnel, lack of Teaching Materials and Equipment, Poor Classroom Management, lack of Iinterest on the part of the students, inappropriate medium of instruction, ineffective teaching strategies and students' perception of difficulty in some Physics concepts such as Electrolysis,.

Electrolysis is the chemical decomposition of a compound brought about by the passage of a direct current through a solution or molten combination. Therefore, the process of electrolysis may greatly benefit from the use of computer-assisted instruction because the process manifests itself visibly. When regular teaching methods are used in teaching science subjects, students understand subject at a knowledge level and they usually memorise the science concepts without understanding the real meaning. As a result, students do not conceptualise the science concepts well as intended (Wesi, 2011). Such factors as understanding at knowledge level and memorisinginfluence student's attitude, cognitive development and achievement in science and science education. It is known that it is not easy to eliminate misconceptions by just employing standard instructional methods. One of the ways to overcome this problem is to try to develop and use computer-assisted instruction. Computer-based instruction strategy plays a vital role in contemporary teaching and learning of science concepts (Chang, 2019). That is why this present study intends to use a computer simulation strategy to enhance students' understanding of the concept of electrolysis.

With particular reference to secondary education in Nigeria, various subjects have been included in the curriculum to enable students acquire knowledge and skills. Certain subjects are categorised as core while others are vocational or non-vocational electives. However, the teaching of Physics as one of the core science subjects in senior secondary school is not without problems. Poor achievement of students in Physics has been lamented by many researchers, parents and even the students themselves which in turn resulted to moral decadence that leads to insecurity, drop-out syndrome, frustration, examination malpractice and fear especially among female students.

Gender has been identified as one factor influencing students' academic achievement at secondary school level (Fagbemi*etal.,* 2011). This is why gender issue has received the attentions of many researchers across disciplines and at different levels of education (including the Senior Secondary Education level). Gender is the range of physical, biological, mental and behavioral characteristics of the feminine and masculine (female and male) population (Yusuf *etal.,* 2015). The importance of examining performance about gender is based primarily on the socio-cultural differences between girls and boys. Some vocations and professions have been regarded as men's (engineering, arts and crafts, agriculture etc.) while others such as catering, typing, nursing, and women's. As a result of this way of thinking the larger society has tended to see girls as weaker sex". Consequently, an average Nigerian girl goes to school with these fixed stereotypes. Fatokum and Odagboyi (2010) noted that some subjects such as physics,

chemistry and mathematics are branded masculine while others like home economic, secretarial studies are branded feminine.

Science deals with abstraction, conceptual thinking and generalization of facts, all of which require the use of cognitive process. For students to achieve this, the attainment of formal operational stage is important. At formal operational stage, the child can operate logically through serration, classification, casuality, time and speed. He is also able to combine ideals, solve verbal and hypothetical problems, proportions and conservation of movement. He can transfer understanding from one situation to the other (Ajaja and Eravwoke, 2010). Most of what is taught in science requires ability to think. Many students find abstract subjects such as Physics and Chemistry difficult to learn, this is believed to be associated with their cognitive development. Nzewi and Osisioma (2010), observed that the difficulty is due to not having appropriate cognitive level of comprehension and application. The capacity of students to engage themselves meaningfully in any educational task which requires higher cognitive functioning depends on factors which include their academic potentiality. This could be tagged ability or level of academic attainment. Ability level involves the characteristic mode of functioning that an individual shows in intellectual activities in a highly consistent and persuasive way. Ajaja and Eravwoke (2010) identified three ability levels in relation to teaching-learning situation viz: High, medium and lowFatokum&Odagboyi (2010) opined that high ability learners are more intelligent than the low or medium ability learners in solving task in science courses. Intelligence, according to them, is the general level of cognitive functioning as reflected in the ability to understand ideas and to utilize abstract symbols in the solution of intellectual problems. Owadara (2012) affirmed that some students who show interest to science courses are superior to the nonchalant ones in solving problems of Mathematics origin.

Statement of the Research Problem

In the recent past, it has been observed that secondary schools in Nigeria are not living up to expectations in delivering quality education (Adesulu, 2014). It has been observed that Physics as a Science subject in Secondary Schools in Nigeria faces severe problems about its curriculum content and delivery by the Physics teachers. It has been observed that teaching and learning of Physics in Secondary Schools was bedevilled with issues that impede successful implementation of the curriculum. Poor achievement of students in Physics at the Senior Secondary School Certificate Examination really leaves one in doubt about the effectiveness of the popular teaching method of Physics teachers. Science teachers have applied various techniques and strategies like discovery, questioning, field trips, lecture and discussion methods etc.. Yet, there has been poor performance among secondary school students in the certificate examination throughout the country (WAEC, 2011). The general public outcry against poor academic achievement of senior secondary school students in West African Examination Council (WAEC), National Examination Council (NECO) and similar bodies is illustrative of low-quality education and associated teachers' ineffectiveness to utilise new methods of teaching at this level. Secondary school teachers have been held responsible for the growing decline in students' achievement since the quality of education depends on the teachers as reflected in the performance of their duties (Nzeribe, 2012).

Teachers' ineffectiveness in using the new teaching strategy in classroom interaction with students could be responsible for the observed poor achievement of students and the widely acclaimed fallen standard of education in Nigeria, (Akiri and Ugborugbo, 2009). Therefore, it is against this background that the researcher intends to examine whether students' achievement in physics could be improved when a computer-based simulation instructional strategy is used in teaching the topic electrolysis to SS2 students in Jalingo Education Zone, Taraba State.

Aim and Objectives of the Study

The main aim of this study is to determine the effect of Computer Simulation Instructional Package on SS2 Physics Students' Achievement in Jalingo Education Zone Taraba State.

The specific objectives are to:

1. Determine the effect of Computer Simulation Instructional Package on the mean achievement scores of Physics students taught with Computer Simulation Instructional Package and those with Lecture.
2. Compare the difference of mean achievement scores of students taught Physics with Computer Simulation Instructional Package based on ability level.
3. Determine the effect of Computer Simulation Instructional Package on the mean achievement scores of male and female students in Physics taught with Computer Simulation Instructional Package.

Research Hypotheses

The following null hypotheses were formulated and tested at 0.05 level of statistical significance:

HO_1: There is no significant difference between the mean academic achievement scores of students taught Physics with Computer Simulation Instructional Package and those with Lecture Method.

HO_2: There is no significant difference between the mean academic achievement scores of students taught Physics with Computer Simulation Instructional Package based on ability level.

HO_3: There is no significant difference between the mean academic achievement scores of male and female students taught Physics with Computer Simulation Instructional Package.

Methodology:

The study adopted a quasi-experimental design of non-randomised non-equivalent pre-test post-test.The sample of the study was made up of One Hundred and Eight (108) SS2 Physics students of senior secondary schools in Jalingo Education Zone, Taraba State. The Experimental Group was made up of Sixty-two 62 (39 male; 23 female) students and Control Group forty-six 46 (23 male; 23 female) students. The groups were pre-tested using the same instrument. Then, the experimental group was exposed to treatment.

Results:

The results of the analyzed data are presented and interpreted in line with the research hypotheses.

Hypothesis 1: There is no significant difference between the mean academic achievement scores of students taught Physics with Computer Simulation Instructional Package and those with Lecture Method.

Table 2: T-test analysis of the difference between the control and experimental groups

Group	N	Mean	SD	df	t	P
Control	46	42.94	19.89			
				106	1.459	0.000
Experimental	62	63.18	27.61			

Result from Table 2 shows that students taught with computer simulation instructional package had a mean score of 63.18and standard deviation of 27.61 while students taught with lecture method had a mean score of 42.94 and standard deviation of 19.89, with t-cal=1.459 and P=0.000. Hence, hypothesis one is rejected. Therefore, there is significant difference between the mean academic achievement scores of students taught Physics with Computer Simulation Instructional Package and those with Lecture Method at 0.05 level of significance.

Hypothesis 2: There is no significant difference between the mean academic achievement scores of students taught Physics with Computer Simulation Instructional Package based on ability level.

Table 3: ANOVA analysis of the experimental group based on ability level.

Source of Variation	SS	df	MS	f-cal	P
Between Groups	44199.70	2	22099.85	565.594	0.000
Within Groups	2305.35	59	39.07		
Total	46505.10	61			

Table 3 showed that analysis of variation for the experimental group based on ability level yielded F-ratio of 565.594 and significant value of 0.000. Hence, hypothesis three is rejected. Therefore, there was a significant difference between the mean academic achievement scores of students taught Physics with Computer Simulation Instructional Package based on ability level at 0.05 level of significance.

Hypothesis 3: There is no significant difference between the mean academic achievement scores of male and female students taught Physics with Computer Simulation Instructional Package.

Table 4: T-test analysis of the mean difference of male and female students taught with Computer Simulation Instructional Package.

Group	N	Mean	SD	df	t	P
Male	39	73.13	25.89			
				60	4.160	0.000
Female	23	46.30	21.98			

Table 4 shows that male students had an achievement score of 73.13 and standard deviation of 25.89 while female students had a mean score of 46.30 and standard deviation of 21.98, with t=4.160 and P=0.000. Hence, hypothesis two is rejected. Therefore, there is a significant difference between the mean academic achievement scores of male and female students taught Physics with Computer Simulation Instructional Package at 0.05 level of significance.

Summary of Findings

From the data analysis and the results obtained from the research, the findings were recorded and summarized as follows:

1. There is significant difference between the mean academic achievement scores of students taught Physics with Computer Simulation Instructional Package and those with Lecture Method.
2. There is a significant difference between the mean academic achievement scores of male and female students taught Physics with Computer Simulation Instructional Package.
3. There was a significant difference between the mean academic achievement scores of students taught Physics with Computer Simulation Instructional Package based on ability level.

Conclusion

Based on the findings of this study, it can be deduced that the use of Computer Simulation Instructional Package is more effective in teaching of Physics as it has positive impact students' academic achievement in Physics. The Computer Simulation Instructional Package also improves both male and female students'academic performance, this implies that the strategy is gender-friendly. Through the use of this approach in teaching and learning of difficult concepts in Physics, lessons can be easily delivered to learners in inspiring, understandable and exciting ways. This will undoubtedly positively improve students' achievement in Physics.

Recommendations:

I. Necessary attention should be accorded to computer literacy and operation in the secondary schools and relevant computer assisted instructional packages should be developed for use within the Nigeria school systems.

II. In addition, Nigeria public schools should be equipped with necessary ICT facilities to leverage the potential of ICT in Nigeria schools.

III. Government should ensure that the use of Computer Simulation Instructional Package is incorporated into the senior secondary school as one of current innovation trending in the global world which Nigeria cannot be exception.

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Effects of 5Es Instructional Model and Reflective Discussion Instructional Strategy on Algebra Achievement of Secondary School Students in Niger State.

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Abstract
This study determined the effects of 5Es instructional model and reflective discussion instructional strategy on algebra achievement of secondary school students in Niger State. Three research questions were raised and three corresponding null hypothesis were tested at 0.05 significant level. The study adopted a quasi-experimental design. A sample of three hundred and fourty nine (349) students from nine intact classes served as subjects in this study. Multi-staged sampling method was employed to select nine secondary schools for the research. The instrument for data collection was Algebra Achievement Test (AAT), a fourty item multiple-choice objective type questions with reliability coefficient (r) of 0.937. the results were analyzed using ANOVA test. The result of the study revealed that the student taught algebra using 5Es instructional model and those taught using reflective instructional strategy achieve higher posttest mean score than those taught using traditional method. There was no significant difference in the mean achievement scores among students with different abilities taught using 5Es instructional model and those taught using reflective discussion instructional strategy. It was recommended among others that teachers should employed 5Es instructional model and reflective discussion instructional strategy in teaching algebra to improvestudents' performance in algebra.

Keywords: 5Es Instructional model, Reflective discussion instructional strategy, Achievement, Algebra.

Introduction
There is a widespread outcry over the level of students' performance in Mathematics in Nigeria. This is as a result of low level mathematics achievement of students in external examination. In this subject, the Nigeria society is getting frustrated concerning the low level of students' achievement. A significant area when issue of poor performance in mathematics is tabled that attract attention of students and researchers is algebra. This is as a result of the mature of algebra in critical thinking, logical and systematic manner of approach that demand mental work by the leaner to enable the leaner grab, assimilate the concept and the ability to apply the concept learnt. Algebra is a branch of mathematics in which letters and other general symbols and signs are used in terms of numbers and quantities in formulae and equations.

Adeniji and Ibrahim (2015) described algebra as a branch of mathematics in which symbols represent numbers of a specified set and area used to represent qualities and to express general relationship that hold for all numbers of a set. The role of algebra among others includes; many companies uses algebra as tools to figure out their annual expenditure and predict the demand of a particular product and subsequently place their orders for various stores. Algebraic expressions

and equations serve as models for interpretation and making inferences about data. Algebraic expressions and equations are largely involved in physics, chemistry, biology among others. This indicates that students' overall mathematics achievement and its subsequent applications in today's world activities largely depend on algebraic concepts proficiency. Edwin and Douglas (2018), noted that many students are discontinuing tier study of higher-level mathematics because of their lack of success in algebra. Application of algebra is important in everyday life, is a critical tool, for the present world of science and technological advancement. Any nation that desire to attain reasonable level of development and compete with other nation of the world must ensure that her citizens are proficient in the application of algebra concepts to solve everyday challenges. Literature, review of studies conducted on causes of students' low achievement in algebra reveals that teachers predominantly adopted traditional instructional method (lecture method) in teaching algebra.

Many reports have been released on the need for a shift by researchers to instructional strategies that are activity based which allow the learners construct their knowledge based on their own understanding. These instructional strategies among others includes 5Es instructional model and reflective discussion instructional strategy.5Es instructional model was developed in 1992 by the Biological Science Curriculum Study (BSCS). It involved five phases, these are; engage, explore, explain, extend or elaborate and evaluate (Kauli&Unsal, 2008).Sadiand Cakiroglu (2010); Alebiosu, Bukola and Shakirat (2017), described 5Es instructional model as a learning model consisting of five phases; engagement, exploration, explanation, elaboration and evaluation. These phases are described as follows: engagement phase involved teacher instructing a task, assess the previous knowledge of the learners, connect past learning experiences by asking a thought provoking questions. Exploration phase, here the students are provided with co-operative exploration activities, giving them common, concrete experiences that help them begin constructing concepts and development skills. Explanation phase, the learners articulate their ideas in their own words and listen critically to one another. The teacher clarifies their concepts, correct misconceptions and interprets the activities of the previous phases. Learners are guided to put down observations, questions and learnt items into simple language. At the elaborate spheres, the experiences gained by learners the previous phases are extended to real situation. The teacher introduces new information that linked to what the leaner's have learnt during their activities. At the evaluation phase, the leaners' are assessed to ascertain their level of progress.

Reflective discussion instructional strategy is a teaching strategy that involved students to reflects upon and interprets films, experiences, read or recorded stories or illustration. Annetta (2011) defined reflective discussion as approach where the teacher or learner initiate the discussion by asking a question that requires students to reflect upon and interprets films, experiences, read or recorded stories or illustrations.

Discussion methods are a variety of planned forums for collaborative exchange of ideas among a teacher and students or among students for the purpose of enhancing students thinking, learning, problem solving understanding and appreciation. Learners and teacher present multiple points of view respond to the ideas of others. Reflective discussion as an instructional strategy largely involved discussion of a written text.

Achievement refers to skills attained by a learner in a particular subject, It is measured by a numerical score obtained in a text. Ryan (2011) observed that achievement can be influenced by several factors, among these factors are; students background, teaching method, interest, environment and motivation. Several research reports reveals that teaching method used by a teacher have significant effects on students' achievement irrespective of ability-level. Ability level is the skill differences that exist in between students subjected to a particular discipline. Students are generally classified as high ability level, medium ability students are those who obtained a score of 70% and above (≥ 70%) in a test, the medium ability level students are those who scored between 50% and 60% (50% ≤ 60%) in a test and the low ability level students are those who scored less than fifty percent (≤ 49%) in a test.

Several research results have reported on learning cycle instruction model, most of these studies were conducted outside the country, but few have been conducted in Nigeria, particularly in biology and chemistry. Among those in biology are; Bulbul, 2010; Sadi&Cakiroglu, 2010; Ajaja, 2013; Gbemisola, 2015 in chemistry and Jibrin, babalola& Isaac, 2019 in ecology. None of these studies was on algebra, this create a gap intended to be filled in this study. Reflection activities have been reported in different situation, among these are; reflective reciprocal teaching and reflective thinking. It has not been applied in teaching algebra, hence this gap is intended to be filled in this study.

The desire to determine the effects if 5Es instructional model and reflective discussion instructional strategy is very important to determine what better instructional strategy will enhance high achievement rate of students in algebra. This informed the need for carrying out this research.

Statement of the Research Problem

Low achievement rate of students in mathematics is increasing continuously. Result available have shown that efforts geared towards improvement in teaching methods and the achievement of secondary school students in algebra are yet to produce the expected outcome. The recent results of secondary school students in mathematics presented by west African Examination Council (WAEC) in chief examiners report shows that in 2013, 2014, 2015, 2016, 2017 and 2018 only 36.00%, 31.30%, 34.18%, 38.68%, 59.20% and 33.33% respectively obtained credits grade (A1 – C6) in mathematics this indicates that in 2013 to 2018 an average of less than 50% out of the total population of students that registered and sat for the examination passed at credit level (Chief Examiner's Report, 2013 – 2018). This ugly situation has been attributed to poor instructional approaches which is still dominated by traditional lecture method. The search light in mathematics education in order to enhance students' better achievement in algebra is on better instructional strategy. The strategy that might salvage the problem may be the use of 5Es instructional model and reflective discussion instructional strategy. Ability level issues are still inconclusive, debate. The implications of ability level especially as it affects achievement in algebra needs more verification. The adoption of 5Es instructional model and reflective discussion instructional strategy in teaching algebra neglected, not given needed attention in Niger State. This was what informed the research on effect of 5Es instructional model and reflective discussion instructional strategy on algebra achievement of secondary school students in Niger State. The problem of the study put in question form is would 5Es instructional model and reflective discussion instructional strategy be an effective teaching method of improving students' achievement in algebra among different ability levels in Niger State.

Research Questions:

The following research questions were raised to guide the study:

1. What is the mean difference in algebra achievement between secondary school students taught using 5Es instructional model those taught using reflective discussion instructional strategy and those taught using traditional method?
2. What is the mean difference in algebra achievement among secondary school students of different ability levels when taught using 5Es instructional model?
3. What is the mean difference in algebra achievement among secondary school students of different ability levels taught using reflective discussion instructional strategy?

Research Hypotheses

Based on the stated research questions the following null hypotheses were formulated and tested at 0.05 level of significant.

Hypothesis one (HO_1): There is no significant difference in the mean achievement scores among secondary school students taught algebra using 5Es instructional model and these taught using reflective discussion instructional strategy and those taught using traditional teaching method.

Hypothesis two (HO_2): There is no significant difference in mean achievement scores among secondary school students of different ability levels taught algebra using 5Es instructional model.

Hypothesis three (HO_3): There is no significant difference in mean achievement scores among secondary school students of different ability levels taught algebra using reflective discussion instructional strategy.

Methodology

The study employed quasi-experimental design, particularly the pretest-posttest non-equivalent non randomized control group design. Intact classes were used, it involved two experimental groups that were taught using 5Es instructional model and reflective discussion instructional strategy and a control group that was taught using lecture method. Experimental group one (Exp. I) and experimental two group (Exp. 2) were taught algebra using 5Es instructional model and reflective discussion instructional strategy respectively while the control group was taught using lecture method.

Population of a study is the set of all elements, objectives, or events that are of interest for a particular study (Sambo, 2005). The population for this study is made up of all the fifty-three thousand three hundred and fifty-eight (53,358) senior secondary school two (SS II) students in Niger State, 2018/2019 session (ministry of education, statistic division). The sample for this study consist of three hundred and forty-nine students as subjects from nine (9) intact classes in nine (9) randomly selected secondary schools in Niger State. Multi-staged sampling technique was used to obtain the sample for the study. The multi-staged sampling was done in four stages; educational zones, local government level, school level and class level. Simple random by hat draw method was employed to select three educational zones out of the seven educational zones in Niger State at stage one, at stage two, random sampling technique by hat draw method was employed to selects one local government area from each of the three randomly selected educational zones. These are Gbako Local Government Area (Bida Educational zone), Gurara Local Government Area (Suleja

Educational Zone), and Paikoro Local Government Area (Minna Educational Zone). In the third stage, random sampling technique using hat draw method was used to select three schools in each of the local government area given a total of nine sampled schools.

In each of the nine schools, a classes of SS II students were randomly selected and intact classes were used in each case to form the three hundred and forty-nine subjects for the study, the subjects were classified based on achievement level that is, low, moderate and high achievers.

The research instruments were categorized into two, these are; response instrument and stimulus instruments. The response instrument is Algebra Achievement Test (AAT) and the stimulus instrument are treatment instruments which includes; lesson guide using 5Es instructional model, lesson guide using reflective discussion instructional strategy and lesson guide using lecture method. AAT comprised of forty (40) items objective questions covering the algebra concepts taught with a reliability coefficient of 0.937 (r=0.937) which indicates high reliability. The lesson guide was validated by experts, two lecturers not below senior lecture from Federal University of Technology Minna, Science Education Department, one lecturer in department of Mathematics (Associate Professor) and two teaching staff in secondary schools. The study lasted for eight (8) weeks, one week for pre-test, six weeks for treatment and one week for posttest.

In analyzing the data, the scores obtained from pretest and posttest were used to test the three null hypotheses using analysis of variance (ANOVA) statistics. Statistical Package for Social Science (SPSS) version 16.0 was used to analyze the data at 0.05 alpha level.

Results

Results of data analyzed for this study are presented according to the research questions asked and their corresponding hypotheses that guided the study.

Research Question One

What is the mean difference in algebra achievement scores among secondary school students taught using 5Es model, those taught using reflective discussion instructional strategy and those taught using lecture method? The result is presented in table 1

Table 1: Mean achievement and standard deviation scores for the experimental groups and control group in pretest and post-test.

Group	pretest			Posttest		mean gain
	N	X	SD	X	SD	
Exp. I	117	25.05	10.70	57.73	9.53	32.68
Exp. II	137	26.91	7.43	58.19	9.88	30.28
Ctrl.	95	27.06	5.98	44.94	9.44	17.88

The result in table 1. Indicates that experimental group one had a mean achievement score of 25.05 and standard deviation of 10.70 in pretest, experimental group two had a mean achievement score of 26.91 and standard deviation of 7.43 in pretest while the control group had mean and standard

deviation scores of 27.06 and 5.98 respectively in pretest achievement scores. Similarly in posttest scores experimental group one had mean and standard deviation scores of 57.73 and 9.53 respectively. The experimental group two obtained mean and standard deviation achievement scores of 58.19 and 9.88 respectively, the control group obtained a mean and standard deviation scores of 44.94 and 9.44 respectively in posttest.

The results indicates that the mean achievement of students taught algebra using 5Es instructional model was 25.05 and 57.73 in pretest and posttest respectively, the mean achievement of those taught using reflective discussion instructional strategy was 26.91 for pretest and posttest of 58.19 while the mean achievement of students taught lecture method was 27.06 for pretest and 44.94 for posttest. This revealed that those taught using 5Es instructional model obtained a higher mean score, followed by those taught using reflective discussion strategy and those taught using lecture method had a lower mean score.

Null Hypothesis One (HO_1)

There is no significance in the mean algebra achievement scores of secondary school students taught using 5Es instructional model, those taught using reflective discussions instructional strategy and those taught lecture method.

Table 2: Analysis of variance (ANOVA) comparison of the posttest mean achievement scores of the experimental groups and the control group.

Sum of Squares	df	Mean Square	F-Value	P-Value
Between groups	11759.2472	2	5879623	63.22 .0001
Within groups	32179.613	346	93.005	
Total	43938.860	348		

Significant at 0.05 Level.

The result in table 2 revealed the obtained F-Value as 63.22 with degree of freedom 348 at alpha Value 0.05 level of significance. The P-Value 0.0001 obtained is less than 0.05 level of significant. This result shows that at p= 0.0001<0.05 there is significant difference among the mean achievement scores of the two experimental groups and the control group. Therefore hypothesis one which states that there is no significant difference in the mean algebra achievement scores among secondary school students taught using 5Es instructional model, those taught using reflective discussion instructional strategy and those taught using traditional method is thus rejected. A post-Hoc (Scheffe post-Hoc test) was performed to dictate the direction of the differences, the result is presented in table 4.20 below.

Table 3: Scheffe's post hoc test on performance between experimental groups and control group.

(I) Groups	(J) Groups	Mean Difference (I-J)	STD ERROR	SIG
Treatment 1 group	Treatment 2 group control group	- 46069 12.78548	1,21399 1.22188	.931 .000
Treatment 2 group	Treatment 1 group control group	.46069 13.24617	1.21399 1.28758	.931 .000
Control group	Treatment 1 group Treatment 2 group	-12.78548 -13.24617	1.33188 1.28758	.000 .000

Table 3 above shows the comparison of each of the experimental group with the control group. Experimental group two gave P-Value = 0.931>0.05, this indicates that there is no significant difference in the mean score between experimental group one and two. When control group in compared with experimental group one and two, with P-Value = 0.000<0.005 for each comparison. This implies that there is significance difference in the mean score of experimental group one and control group similarly it implies that there is significant difference in the mean score of experimental group two and control group. In table 1, the mean gain of experimental group one experimental group two and control group one 31.28, 34.09 and 20.45 respectively. This revealed that the differences are in favour of the two experimental groups.

Research Question Two

What is the difference in mean achievement scores among secondary school students of different ability levels taught algebra using 5Es instructional model?

The result is presented in table 4.

Table 4: Means and standard deviations of the algebra achievement scores in pretest and posttest of the experimental group one (Exp. I) based on ability groups.

		Pretest		posttest		
Ability Groups	**N**	**X**	**SD**	**X**	**SD**	**Main Gain**
High Ability	21	27.06	8.75	58.04	9.57	30.98
Medium Ability	53	24.66	10.90	57.81	9.74	33.15
Low Ability	43	24.55	11.40	57.39	9.54	32.84

Table 4. Shows mean and standard deviation of the achievement score of high ability group, medium ability group and low ability group taught algebra using 5Es instructional model. The result revealed mean and standard deviation of pretest and posttest achievement scores of the high ability group to be 27.06 ± 8.75 and 58.04 ± 9.57 respectively, this gives a mean gain score of 30.98. The mean and standard deviation of pretest and posttest achievement scores of medium ability group is 24.66 ± 10.90 and 57.81 ± 9.94 respectively. This gives a mean gain score of 33.15. similarly, the mean and standard deviation of pretest and posttest achievement scores of low ability group is 24.55 ± 11.40 and 57.39 ± 9.54 respectively. This gives a mean gain score of 32.84. However, the average main gain difference between the high ability group, medium ability group and low ability group is 1.1 in favour of medium ability group.

Null Hypothesis Two (HO_2)

There is no significant difference in the mean achievement scores among secondary school students of different ability levels taught using 5Es instructional model.

Table 5: ANOVA table for testing the significance among mean achievement scores for student of different ability levels in experimental groups one.

	Sum of squares	df	mean square	F-Value	P-Value
Between Group	7.193	2	3.596	0.039	0.962
Within Groups	10584.926	114	92.850		
Total	10592.119	116			

Not significant at 0.05 level.

Table 5: Shows the ANOVA table for testing the significance effect of treatment and ability levels on the mean achievement scores of students taught algebra using 5Es instructional model. The table revealed that F-Calculated value of 0.039 and the corresponding P value of 0.962 is greater than 0.05, that is (P = 0.962>0.05) hence the hypothesis is not rejected, meaning that there is no significant difference in the mean achievement scores among secondary school students of different ability levels taught algebra using 5Es instructional model.

Table 6: ANOVA Results of the mean achievement scores for students of different ability levels in experimental group one.

	SUM OF SQUARES	DF	MEAN SQUARE	F	SIG.
Between groups	11.819	2	5.909	.064	.938
Within groups	10580.300	114	92.810		
Total	10592.119	116			

Not significant at 0.05 level.

Table 6: Shows the post test ANOVA analysis among students of different ability levels in experimental group one (taught using 5Es instructional model) which indicated Fcal = .064, P > 0.05, this implied that P – Value of P = 0.938 is greater than 0.05 indicating that there is no significant difference among the mean achievement scores of students taught algebra using 5Es instructional model that are of different ability levels. Therefore, hypothesis two was not rejected, that is there is no significant difference in mean achievement scores among secondary school students of different ability levels taught algebra using 5Es instructional model in Niger State. This implies that 5Es instructional model is not bias in respect to ability levels.

Research Question Three

What is the difference in the mean achievement scores among secondary school students of different ability levels taught algebra using reflective discussion instructional strategy?
The result is presented in table 7.

Table 7: Means and standard deviation of algebra achievement scores in pretest and posttest of the experimental group two (Exp. II) across ability levels.

Ability Groups	N	Pretest X	Pretest SD	posttest X	posttest SD	Main Gain
High Ability	29	23.75	7.51	55.58	8.45	31.83
Medium Ability	58	20.78	7.20	58.10	9.10	37.32
Low Ability	50	23.14	7.36	56.99	9.12	33.85

In table 7: The mean and standard deviation of the achievement scores of high group, medium ability group and low ability group taught algebra using reflective discussion instructional strategy are presented. The result indicates that mean and standard deviation of pretest and posttest achievement scores of the high ability group is 23.74 ± 7.51 and 55.58 ± 8.45 respectively, this gives a mean gain of 31.83. While the mean and standard deviation of pretest and posttest achievement scores of medium ability group is 20.78 ± 7.20 and 58.10 ± 9.10 respectively, this gives a mean gain of 37.32. Similarly, the mean and standard deviation of pretest and posttest achievement scores of low ability group is 23.14 ± 7.36 and 56.99 ± 9.12 respectively, this gives a mean gain of 33.85. However, the average mean gain difference between the high ability group, medium ability group and low ability group is 3.51 in favour of medium ability group.

Null Hypothesis Three (HO_3)

There is no significant difference in the mean achievement scores among secondary school students of different ability levels taught algebra using reflective discussion instructional strategy.

Table 8: ANOVA table for testing the significant among mean achievement scores for students of different ability levels in experimental group two.

	Sum of squares	df	mean square	F-Value	P-Value
Between Group	125.68	2	62.840	.780	.460
Within Groups	10789.214	134	80.517		
Total	10914.894	136			

Not significant at 0.05 level.

Table 8: Showed that F136 = .780 with P-Value = .460, P>0.05 level of significant level. Therefore, P-Value is not significant at 0.05 level. This indicated that there is no significant difference in the mean achievement scores among secondary school students of different ability levels taught algebra using reflective discussion instructional strategy. Hypothesis five is therefore retained.

Table 9: ANOVA Results of the Mean Achievement Scores of Students with Different Ability Levels in Experimental Group Two.

	sum of squares	df	mean square	*f*	sig.
Between groups	237.014	2	118.507	1.218	.299
Within groups	13040.318	134	97.316		
Total	13277.331	136			

Table 9: Show post test result of ANOVA analysis among students of different ability levels in experimental group two (taught using reflective discussion instructional strategy) which shows Fcal = 1.215, P = 0.938 > 0.05 indicating that there is no significant difference among the mean achievement scores of students taught algebra using reflective discussion instructional strategy that are of different ability levels. Hypothesis three was therefore retained, hence there is no significant difference in mean achievement scores among secondary school students of different ability levels taught algebra using reflective discussion instructional strategy.

Discussion

This study revealed that 5Es instructional model has a positive effect on students' achievement in algebra, it has also indicated the effectiveness of reflective discussion instructional strategy on students' achievement in algebra. This was observed in the achievement of senior secondary school students taught with 5Es instructional model and those taught using reflective instructional strategy compared to those taught using lecture method. The two experimental groups obtained a better achievement in the AAT than the control group. This implies that both 5Es instructional model and reflective discussion instructional strategy can be employed in teaching algebra. The findings could be due to the teaching methods employed by the researcher. 5Es model has interactive process which allow the learner share ideals and has hands on activities. Reflective discussion instructional strategy encourages learner's participation and hands on activities which improves learners' skills of solving problems. Therefore, appropriate teaching methods employed by a teacher can improve learners' skills of solving problems in algebra.

This study is in support of the finding of Abu Atta (2013), whose study compared the effect of learning cycle model on thinking skill in mathematics at with grade students in Gaza, Palestine with control group and reported the effectiveness of learning cycle model. Similarly, this work is in agreement with the finding from Ajaja and Eravwoke (2012) on effects of learning cycle strategy on the achievement of students in biology and chemistry.Furthermore, the finding supported Paula (2009) and Gbemisola (2015) that reported effectiveness of reflective practice in effective teaching.

Conclusion

Based on the variables in this study, 5Es instructional model and reflective discussion instructional strategy has positive effects on students' achievement in algebra compared to those taught by lecture method.

Recommendations

1. The use of 5Es instructional model and reflective discussion instructional strategy should be encourage by algebra teachers to aid better understanding and performance of secondary school students in algebra.
2. The two methods should be popularized by organizing seminars for mathematics teachers on how to use the methods to promote meaningful learning of difficult topics in algebra for better academic achievement.

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Assessment of Non-Technical Skills Required by Graduates of Electrical Electronics Technology for Employment in Industrial Organisations in Kano State

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Abstract
*This study centered on assessing the views of professionals(employers) on the non-technical skills considered as essential recruitment prerequisite among graduates of electrical electronics technology in industrial organisations in Kano State. Specifically, the study*assessed *employer's perception on the importance of the basic, cognitive and interpersonal non-technical skills considered as essential recruitment prerequisite for the recruitment of graduates of electrical electronics technology in industrial organisations in Kano State. The study made use of descriptive survey research design. three research questions were formulated to guide the study. The population for the study comprised 65 industrial professionals(employers) in Kano State, Nigeria. A twenty-seven (27) items questionnaire was the instrument used for data collection. The instrument was validated by two experts from the Federal University of Technology Minna and one expert from Bayero University Kano Department of Science and Technology Education. The reliability of the instrument was determined using Cronbach Alpha and the reliability index which stood at 0.79. The data collected were analysed using mean statistic and standard deviation. The study revealed that professionals placed great importance on communication skill, problem-solving skill, decision making skill, planning and organizing skill, dependability, self-confidence, and ability to work without supervision as important recruitment prerequisite of graduates of electrical electronics technology in industrial organisations Kano State. The study revealed that non-technical skills such as communication skill, reading skill, writing skill, numeracy and quantitative literacy, problem solving skill, decision making skill, planning and organizing skill, dependability, self-confidence, and ability to work without supervision are considered by employers as essential recruitment prerequisite among graduates of electrical electronics technology in industrial organisations in Kano State.*

Keywords: Assessment, Non-Technical Skills, Electrical/Electronic Technology, Employment, Industrial Organizations

Introduction
In a quest to catch-up with the pace of the dynamic globalization, the industries and business organizations are subject to the after-effects of global changes. The fast changing global business environment, especially in terms of markets and productivity due to technological advancements, with a more demanding and challenging roles of the employees, academic researchers as well as industry practitioners agree to the fact that the twenty-first 21st century engineers and technologists must be capable enough to handle situations which require a complex set of technical as well as non-technical skills (Suhail, *et al.*, 2018). In the past, focus of electrical electronics technology instructors were on providing excellent technological education, but lately the importance of non-

technical skills such as communication skills, teamwork skills, management skills, creative thinking skills, decision making skills, and problem solving skills cannot be overemphasized as it has been widely acknowledged as part of the crucial areas required for employment in industrial work environments (Bakare, *et al.,* 2019). Today's employers require fresh graduates to add immediate value to the process/business, hence graduates must possess both technical and non-technical skills to in order to catch up with the current demands of industrial organisations (Jackson & Chapman, 2012). According to Dupre & Williams (2011), the most effective way for graduates to stand out among the crowd is for them to possess Non-technical skills, that is non-industry specific desired skills.

Hence, non-technical skills are those skills which are generic in nature and are relevant across various jobs or professions (Awang, *et al.,* 2018). They are those skills that do not require technical knowledge or technical background. There can also be termed as generic skills, basic skills, soft skills, employability skills, key skills, core skills and essential skills (Nasir, *et al.,* 2011). Non-technical skills are social, cognitive and personal skills necessary for safe and effective performance of technical skills, tasks and procedures in an organisation (Leach, 2021). Conrad and Leigh (2015) classified non- technical skills into four types: problem solving & other cognitive skills; oral communication skills; personal qualities & work ethics; and interpersonal & teamwork skills. Wilson *et al.,* (2012) highlighted various non-technical skills to be; communication, critical thinking, problem-solving, team work; lifelong learning, information management, entrepreneurial skills, moral and professional ethics and leadership skills. Studies on non-technical skills of graduates are either from an employers' perspective or students' perspective in an organisation (Leslie, 2021).

An organisation is a group of people who have united together to pursue and accomplish a common purpose as one team (Komora, 2017). An organisation can also be seen as a group of individuals working together to achieve one or more objectives (Belleflamme & Martin, 2010). They are group of individuals oriented towards achieving collective goals. Industrial organisations are businesses that produces (manufactures) goods as opposed to services (Komora, 2017). These industries being a production organisation requires the services of well skilled workers in both technical and non-technical skills in order to efficiently actualize their outlined organisational goals (Omar, *et al,* 2012). To be successful in any industrial work environment, the job candidates must distinguish themselves from other candidates with similar qualifications. Non-technical skills play an important role during the differentiation of graduates from one another (Schulz, 2008).

Graduates of electrical electronics technology are those trained in the university or polytechnic to handle job responsibility that requires the application of scientific knowledge and skills in order to bring about job satisfaction in an industrial organisation. The concept of employability can be observed in situations where new graduates are able to make themselves valuable to the organizations by possessing skills, knowledge, and attitude relevant to the requirement of the organizations. Generally, non-technical skills are needed by students to prepare themselves to meet the needs of many different occupations upon graduation. These skills are meant to enable them to have easy access to suitable employment which could later translate to national economic

development (Osami, 2013). However, it has been established in various past studies that unemployment and skills mismatch among graduates are so rampant and critical (Caleb & Udofia, 2014). This has generated worries throughout the world, and particularly among the developing nations. The twin problems of unemployment and skills mismatch may not be unconnected with the ill-preparation of graduates with the skills demanded by employers for them to be relevant and employable.

Electrical electronics technology education is one of the fields of study that is particularly concerned with equipping its recipients' with the practical skills and knowledge required for them to be self-reliant and be employable in any given industrial organisation. These skills are meant to enable them to have easy access to suitable employment which could later translate to national economic development in the country (Osami, 2013). However, it has been established in various past studies that unemployment and skills mismatch among graduates are so rampant and critical (Caleb & Udofia, 2014). This has generated worries throughout the world, and particularly among the developing nations. The existing gap between the skills acquired by graduates and those required by employers has been revealed to be so wide that most of the graduates are finding it difficult to get employed (Bakare, 2019). The skills of graduates do not match with the requirements of employers. It has also been reported by many scholars that fresh graduates of electrical electronics technology face problems to secure suitable employment in industrial organization due to the fact that they were found being deficient in non-technical skills which the organisation considered crucial for employment. According to Kathleen (2005), the employers in America are not pleased with many job applicants, particularly those who graduated from technical institutions. This problem occurs mostly because the applicants do not possess enough non-technical skills (Suhail, *et al.,* 2018). Rahmah and Wei (2014), specified that graduates lack employability skills (non-technical skills) in Malaysia, which resulted in a low performance in the place of work. Rasul and Mansor (2016), also revealed that there is a mismatch between the skills that graduates acquired and the prerequisite demanded by employers that can make them perform effectively at work. Technical skills development alone without non-technical skills cannot provide assurance for employment in modern industrial and business organisations. In order to overcome this difficulty, it is imperative for this study to consider the non-technical skills prerequisite for employment of graduates of electrical electronics technology in industrial organisations in Kano State.

Purpose of the Study

The main purpose of this study was to assess the views of professionals(employers) on the non-technical skills considered as important recruitment prerequisite among graduates of electrical electronics technology in industrial organisations in Kano State. Specifically, the study sought to assess:

11. The basic skills considered as important recruitment prerequisite among graduates of electrical electronics technology in industrial organisations in Kano State.
12. The cognitive skills considered as important recruitment prerequisite among graduates of electrical electronics technology in industrial organisations in Kano State.
13. The interpersonal skills considered as important recruitment prerequisite among graduates of electrical electronics technology in industrial organisations in Kano State.

Research Questions

1. What are the basic skills considered as important recruitment prerequisite among graduates of electrical electronics technology in industrial organisations in Kano State?
2. What are the cognitive skills considered as important recruitment prerequisite among graduates of electrical electronics technology in industrial organisations in Kano State?
3. What are the interpersonal skills considered as important recruitment prerequisite among graduates of electrical electronics technology in industrial organisations in Kano State?

Methodology

A descriptive survey design was adopted for this study. In the view of Shona (2021), a descriptive survey design deploys the use of questionnaires, interviews and direct observation to ascertain the opinions, attitudes, perception and preference of individuals under study. A well-structured questionnaire consisting of fifteen items was used to ascertain the view of professionals (employers) on the non-technical skills that are considered as important recruitment prerequisite among graduates of electrical electronics technology in industrial organisations in Kano State. The population of the study consisted of sixty-five (65) professionals (employers) in industrial organisations who were purposively sampled to determine their perceptions on the non-technical skills considered as essential recruitment prerequisite among graduates of electrical electronics technology in industrial organisations in Kano State. The questionnaire which consisted of twenty-seven items were structured using Likert five-points rating scale with response choices that range from the most important (MI), very important (VI), important (I), slightly important (SI), and not important (NI respectively for the research questions. The instrument was validated by two experts from the option of Electrical Electronics Technology in the Department of Industrial and Technology Education and one expert from Bayero University Kano Department of Science and Technology Education.The data obtained from the questionnaire were analysed with Cronbach Alpha Coefficient to determine the reliability index which stood at 0.79. The data were collected and analysed by using SPSS statistical tool. The data were analysed using mean and standard deviation.

Research Question 1: What are the basic skills considered important recruitment prerequisite among graduates of electrical electronics technology in industrial organisations in Kano State?
The mean ratings for items on the basic non-technical skills considered important recruitment prerequisite are given in Table 1

Table 1: Mean and standard deviation responses of employers of electrical electronics technology on the basic non-technical skills considered important for employment in industrial organisations in Kano State.

S/N	Items for basic skills	Mean(x)	SD	Remark
1.	Ability to speak clearly with purpose	3.43	0.67	Very Important
2.	Ability to write good report	3.75	0.50	Very Important
3.	Ability to listen and comprehend	3.21	0.61	Very Important
4.	Ability to make good presentation	3.75	0.50	Very Important
5.	Ability to read very well	3.37	0.64	Very Important

6.	Numeracy and quantitative literacy	3.43	0.67	Very Important
7.	ability to acquire knowledge and grow continuously	3.75	0.50	Very Important
8.	ability to acquire skills continuously	3.21	0.61	Very Important
9.	ability to contribute ideas in a team work	3.75	0.50	Very Important
	Average Mean	**3.50**	3.37	**Very Important**

Source: Fieldwork, 2021 SD-Standard Deviation

Analysis of the result presented in Table 1 above indicates employer's opinion on the importance of basic non-technical skills for the recruitment of graduates of electrical electronics technology in industrial organisations in Kano State. The result of the data presented above revealed that all the 5 items are needed by the employers of graduates of electrical electronics technology in industrial organisations in Kano state. The table showed that the mean value of each item was above 2.50 which is the mean cut off point for the basic non-technical skills required by the professionals (employers) for the recruitment of graduates of electrical electronics technology in industrial organisations in Kano State. The table also showed that the standard deviations (SD) of the items are within the range of 0.50 to 0.67; which indicates that the opinions of the employers were not far from one another in their responses.

Research Question 2: What are the cognitive skills considered important recruitment prerequisite among graduates of electrical electronics technology in industrial organisations in Kano State?
The mean ratings for items on the cognitive non-technical skills considered important recruitment prerequisite are given in Table 2

Table 2: The Mean and standard deviation responses of employers of electrical electronics technology on the cognitive non-technical skills considered important for employment in industrial organisations in Kano State.

S/N	Items for cognitive skills	Mean(x)	SD	Remark
4.	ability to imagine solution	3.22	0.66	Very Important
5.	ability to create ideas	3.40	0.62	Very Important
6.	ability to solve work related problems	3.43	0.73	Very Important
7.	ability to acquire knowledge and grow continuously	3.40	0.62	Very Important
8.	Ability to make decisions	3.51	0.60	Very Important
9.	ability to evaluate decision	3.40	0.62	Very Important
10.	ability to implement recommendation	3.43	0.73	Very Important
11.	ability to identify problem and the causes	3.40	0.62	Very Important
12.	ability to establish clear project goals and objectives	3.51	0.60	Very Important
	Average Mean	**3.40**	**0.65**	**Very Important**

Source: Fieldwork, 2021 SD-Standard Deviation

Data presented in table 3 above, showed the mean score of the data from employers' view about the importance of cognitive skills on the recruitment of graduates of electrical electronics technology in industrial organisations. it was evident that all the five items were rated above 2.50. Grand 3.30 average mean was obtained the items which indicated that all employers agreed to the opinion that the cognitive non-technical skills are essentially required for the recruitment of graduates of electrical electronics technology in industrial organisations in Kano State. The results also showed the standard deviation ranged from 0.62 to 0.73 indicating that all the professionals (employers) were not too far one another in their responses, proving that the items were valid. The employers totally agreed that cognitive non-technical skills are essential for the recruitment of graduates of electrical electronics technology in industrial organisations in Kano State.

Research Question 3: What are the interpersonal skills considered important recruitment prerequisite among graduates of electrical electronics technology in industrial organisations in Kano State?

The mean ratings for items on the interpersonal non-technical skills considered important recruitment prerequisite are given in Table 3

Table 3: The Mean and standard deviation responses of employers of electrical electronics technology on the interpersonal skills considered important for employment in industrial organisations in Kano State.

S/N	Items for Interpersonal skills	Mean(x)	SD	Remark
1.	ability to work without supervision	3.22	0.71	Very Important
2.	ability to maintain positive image	3.40	0.61	Very Important
3.	ability to take responsibility	3.20	0.69	Very Important
4.	ability to manage time proficiently	3.43	0.77	Very Important
5.	ability to maintain personal integrity	3.25	0.68	Very Important
6.	ability to adapt and be flexible at work	3.22	0.71	Very Important
7.	ability to maintain positive attitude	3.40	0.61	Very Important
8.	ability to maintain professional work ethics	3.43	0.77	Very Important
9.	ability to maintain good interpersonal relationship	3.25	0.68	Very Important
	Average Mean	**3.30**	**0.69**	**Very Important**

Source: Fieldwork, 2021 SD-Standard Deviation

Based on the data presented in table 3 above, it was evident that all the five items were rated above 2.50. 3.30 average mean was obtained the items which indicated that all employers agreed to the opinion that the interpersonal non-technical skills are essential for the recruitment of graduates of electrical electronics technology in industrial organisations in Kano State. The results also showed the standard deviation ranged from 0.61 to 0.77 indicating that the professionals (employers) were not too far one another in their responses, proving that the items were valid.

The employers totally agreed that interpersonal non-technical skills are essential for the recruitment of graduates of electrical electronics technology in industrial organisations in Kano State.

Discussion of Findings

Data obtained from employers' view about the importance of basic non-technical skills on the recruitment of graduates of electrical electronics technology in industrialorganisations in Kano state, showed that the grand mean of 3.30 was obtained meaning that all employers agreed to the items on the basic non-technical skills that are considered essential prerequisite for the recruitment of graduates of electrical electronics technology in industrial organisations in Kano State. This study is in line with the study of Maripaz *et al.,* (2013) who in their revealed that employers offer special consideration to non-technical skills over to specific job skills. Caleb and Udofia, (2014) in their study revealed that recruitment the conditions of the employers in the contexts of TVE fall into three major categories: professional skills, non-technical skills and entrepreneurial skills. Osami (2013), also revealed that graduates in technical education with both professional skills and non-technical skills/soft skills have more advantage to secure suitable employment.

The findings of the study in research question 2 revealed that all the items have mean score of 3.22- 3.51. This clearly showed that employers require interpersonal skills for the recruitment of graduates of electrical electronics technology in industrial organisations in Kano State. This finding was supported by Bakare *et al.,* (2019) who in their study indicated that the following non-technical skills: communication, teamwork, learning, creative thinking, decision-making, self-management and problem-solving skills are essential to metalwork technology graduates from technical colleges in Nigeria to be employable. Hence, cognitive skills are required for the recruitment of graduates of electrical electronics technology in industrial organisations in kano state.

The findings of the study in research question 3 revealed that all the items have mean score of 3.20- 3.43. This clearly showed that employers view interpersonal skills for the recruitment of graduates of electrical electronics technology in industrial organisations in Kano State. This is also in alignment with a study by Rasul and Mansor (2016) who found that employers are very particular, and they need graduates who are Self-confident with positive image and can work on pressure without supervision. This finding conform to the findings of Caleb and Udofia (2014), who found that the students of Electrical installation in technical colleges of Akwa Ibom State in need generic skills which interpersonal skills are part of for employability.

Conclusion

Based on the findings from the opinions of employers on the basic, cognitive and interpersonal non-technical skills considered as essential recruitment prerequisite among graduates of electrical electronics technology in industrial organisations in Kano State, this study therefore concludes that non-technical skills such as communication skill, reading skill, writing skill, numeracy and quantitative literacy, problem solving skill, decision making skill, planning and organizing skill, dependability, self-confidence, and ability to work without supervision are required by the employers for the recruitment of graduates of electrical electronics technology in industrial organisations in Kano State.

Recommendations

Based on the findings of the study, the following recommendations were made;

1. Communication skills should be integrated into the curriculum of Nigerian universities and polytechnics offering electrical electronics technology programmes to ensure that the graduate's technical skills are balanced, thereby making them to stand a better chance of being employed in industrial organisations and also in the labour market.
2. Students sent on SIWES or industrial attachment should be given roles that will help their intra-personal and problem solving skills.
3. Electrical Electronics Technology students whose dream is to work in industrial organisations after their graduation should seek for more non-technical skills training and certifications from professional training institutes outside the academic environments.
4. Electrical Electronics Technology Teachers in Universities and Polytechnics should use more problem-based learning(PBL) approach in instructional delivery to create more opportunities for students to develop problem-solving abilities together with technical skills development.

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Assistive Technologies for Teaching and Learning among Children with Special Needs

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Abstract
This paper presents a review of assistive technologies for teaching and learning among children with special needs. Assistive technology is a piece of equipment, product system or software programme that is used to maintain, increase or improve the capabilities of persons with disabilities. This review summarizes relevant research on meaning of special needs, teaching and learning, assistive technology, awareness of assistive technology, availabilities of assistive technology, competency in using assistive technology, utilization of assistive technology, theory related with assistive technology, types of assistive technology, application of assistive technology, utilization of assistive technology for teaching and learning. The paper concluded by advocating for government organizations, agencies and non-governmental organization to provide more assistive technologies for special schools. More conferences, seminars and workshops should be organized for the teachers of learners with special needs with the global emerging assistive technologies.

Keywords: Special Needs, Teaching and Learning and Assistive Technology

Introduction:

Special needs are an umbrella term for a wide array of diagnoses, from those that resolve quickly to those that will be a challenge for life and those that are profound. Children with special needs may have developmental delays, medical conditions, congenital conditions and/ or psychiatric conditions. Gibby *et al.*, (2019) postulated that children with learning disabilities like dyslexia and Auditory Processing Disorder (APD) struggle with school work regardless of the intellectual abilities. They required specialized learning strategies to meet their potential and avoid self esteem problems and behavioural difficulties. Children with special needs in the context of this study are those children facing a lot of inborn problems which can lead to deaf, dump, lame and so on. The children with special needs are educated in special schools (for example, a school for the visual impaired) by a special education teacher.

Teacher is a person who helps students to acquire knowledge, competencies or virtue. Ahmed and Ezekiel, (2017) explained that teachers are instructors who instructs individual on correct ways of carrying out a given task. Teachers in the context of this study are those who teach children with special needs. This teachers adopted proper method in teaching of children. Sequara (2012) explained teaching as a set of events, outside the learners which are designed to support internal process of learning. Learning is a relatively permanent change usually brought about intentionally. The teaching and learning are taking place between students and teachers. The special and regular teachers are vested with responsibilities of making the curriculum accessible to the children with special educations needs; this they do by adopting different tools and devices. These tools and devices are broadly referred to as assistive technology.

Assistive technology is piece of equipment, product system or software programme that is used to maintain, increase or improve the capabilities of persons with disabilities. Abani (2015) explained assistive technology as a variety of devices and services that help ensure that children with disabilities are included in a full range of social experiences and are able to function more independently thus improving their quality of life. Different disabilities required different assistive technology. Examples of these devices includes, Braille machine, wheel chair, electronic, communication devices, pencil grip and computers. The utilization of these listed devices of assistive technology by students depends on the teacher competences and awareness.

Awareness is the quality or state of being conscious of something. Jati*et al.* (2019) explained awareness as knowledgeable being conscious, cognizant, informed alert. Awareness is the state or ability to perceive, to feel or to be consciousof events, objects or sensory patterns. Awareness in the context of this study is the awareness of teachers in using assistive technology in teaching children of special needs which will help the teachers to provide students with disabilities equal opportunity and access to the curriculum. Because of the importance of this awareness, several western countries create awareness in their teachers through workshops, seminars and public enlightenment campaigns. Teachers awareness of assistive technology (AT) enables them to compare specific devices based on performance, affordability, reliability and so on. The knowledge will equally be useful in obtaining and utilizing evaluation and training resources, information on maintenance via the availability of the machines.

Availability is the probability that the service is accessible during the last given time period. Availability in the context of this paper is the extent at which the assistive technologies areavailable for the teacher to use in teaching children with special needs. When the equipment or devices needed for teaching children with special needs are available in the schools, other issue of interest of teachers is competence.

Competence is the ability to do task successfully. Abani (2015) explained that competency is the ability to manipulate different kinds of specialized equipment used in teaching persons with disabilities with such skills and experiences that make the teacher present his lesson well as measured. There are different kinds of competency with different functions such as operational competency; which is the competency needed for operating an assistive device. Social competences are skills needed to develop social relationship using assistive technology devices. Strategic competences are skills involving the use of the devices in real world situation and functional competences are skills that give the teachers the knowledge of how assistive technology devices are used.

This paper will be review under the following theories:

Wellness Theory

This theory was propounded by Freire 1972. This wellness theory can be applied to education as a whole in various ways. It can be applied as a policy for staff to create happy, healthy schools which act as agents of learning as well as providing safe, nurturing environments which equip students with both academic and life skills. It also applies to specific educational techniques such as the use of AT in the classroom. This statement encapsulates the very heart of wellness theory, especially as it applies to learning and the promotion of equity and inclusion. Learning is for all, and equity in learning means that everyone is not treated the same, because we are all different, but we are given the same opportunity to access learning but in ways which meet our needs. When a group of students know they are recognized and add value in and to a class, they develop solidarity and the community of learning (Sabriye& Ayten, 2015) is maintained. It is centered on including all students, and providing many opportunities in a variety of ways to suit every learner's with particular learning style. This idea of togetherness can be seen in the pioneering work of Trudi (2015).

The National Wellness Institute in Wisconsin devised three significant questions that can guide persons and organizations, such as schools and higher education institutions in evaluating the degree to which wellness is included in their programmes. These in turn articulate the questions educators need to ask in terms of using AT in a classroom, as follows:

- Is it appropriate to the unique needs/exceptionalities of the student?
- Will it help, extend or hinder their progress?
- Does it capitalize on their strengths so as to build esteem and autonomy to facilitate lifelong learning and inclusion in the mainstream classroom where possible?

Academic growth, progress or achievement is important for students across the world, and is mandated in the many educational acts such as the Action on Inclusion Initiative (2010) in Canada.

Physical and Intellectual Wellness Dimensions and Assistive Technology

Ratey's (2018) seminar work, "Spark Revolution", documents longitudinal studies of the positive impacts of physical exercise on academic performance for both students coded with Attention Deficit Hyperactivity Disorder (ADHD), Attention Deficit Disorder (ADD) as well as student who were not diagnosed with any learning or behavioral disability. Themind-body connection was famously documented in the Naperville, Illinois school district project with Ratey (2018) over series of years which resulted in the school district attaining record results in their science achievement tests. This provided support for maintaining Physical Education in schools during a time when budget cuts were eliminating such programs from US schools. The heightened focus and retention allowed students to be more successful, and findings showed that students reported feeling more confident, alert and in control of their emotions. The research site has mandated Physical Education for one hour every day, which is in keeping with the research of Bailey (2016) who stated that a broad spectrum of benefits can be attributed to physical education. These include aiding "children to develop respect for the body - their own and others and contributes toward the integrated development of mind and body and develops an understanding of the role of aerobic and anaerobic physical activity in health".

The idea of physical wellness encompasses the use of AT as it is linked to developing personal responsibility for one's healthcare. An example is seen in the work of Desroches, Aissaoui and Bourbonnais (2016) which explores wheel chair tilt to provide optimum support. Taking personal control of health issues and making positive lifestyle choices to ensure physical wellness can include decisions to use AT devices such as wheelchairs, eye glasses, hearing aids, walking aids and even prosthetic limbs. One prime example of the excellent advance in medical assistive technologies has allowed wheelchair users who have difficulty sitting upright, or who have postural abnormalities, to benefit from customized seating and positioning systems. The systems use modified back supports, seating components, and tilt or recline features to meet an individual's needs. The systems are designed so that users can achieve the best possible posture and can improve their performance of everyday activities, such as attending lessons in mainstream classes and not being sidelined to resource rooms or special classes.

According to Hettler (2018), an intellectually well person effectively uses the intellectual and cultural activities in the classroom to expand knowledge, improve skills and experience life more fully. Intellectual wellness refers to active participation in academic, cultural, and community activities and involves assimilating what is learned in the classroom with life experience. AT promotes intellectual wellness in that it couples assistive technologies with instructional technologies. These promote reading and writing, which further enhance not only inclusion, but development of skills and the opportunities for students in terms of the classroom and even future work placements. In their research in Ontario Schools, Sider and Maich (2015) indicated that AT use can support students by enabling them to perform and complete tasks with greater autonomy and independence through scaffolding of literacy supports. Integrating such AT devices as interactive white boards, text-to-speech software and classroom amplification systems help to promote inclusion of all learners and provide flexible learning opportunities to enhance engagement and

participation in the classroom. Students who face barriers to participation, and those who do not, in terms of language development and literacy can now access such AT as Kurzweil, for example, which converts scanned text to speech providing a multimodal experience that supports decoding letters, sounds and words by listening to text read aloud. This AT is portable and transferable to a variety of different situations such as home, school or even work place. Text-to-speech accessibility is now more common (Raskind& Higgins, 2017), being added to a wide variety of cheaper, commercially available laptops, phones and even watches (iWatch). This theory relates with this work not only in reading and writing fluency skill development, but also executive functioning such as organization, fine motor coordination, keyboarding and, more importantly, independence.

Critical Disability Theory

The origin of the term 'critical disability theory' dates from 1937 when Max Horkheimer Critical disability theory centres disability as it compares liberalism's norms andvalues with their actualization in the daily life of disabled people. The seven elements of CDT are the social model of disability, multidimensionality, valuing diversity, rights, voices of disability, language, and transformative politics.

a) Models of disability

A theory which centres disability and proceeds from the perspective of disabled people needs to have a conception of disability which is sufficiently inclusive to encompass the population with which it is concerned. What this conception should be and how any definition can avoid being over- or under-inclusive is a key concern of critical disability theory. In my view, a 'universalist' conception of disability, proposes that everyone may be placed on a continuum from disabled to not disabled and that disability is universal since everyone is disabled at sometime in their lives, is an insufficient basis upon which to analyse the social condition of disabled people and develop social policy which is responsive to the interests of this very diverse population. This necessitates some, inevitability contested, conception of disability which reasonably identifies the population in question without lapsing into essentialism.

b) Multidimensionality

I have attached critical disability theory to the family of identity jurisprudences, the members of which are related by their focus on some identifying characteristic which serves as an organising principle for the study of how law and legal institutions impact individuals and groups sharing that identity. Identity jurisprudence grows out of identity politics which, as the name implies, are politics structured around a social identity. One of the dangers of identity based politics is that the need to define the identity of the group tends to exclude potential members, demand members conform to group ideology, and make diversity within the group disappear and the barriers imposed by the social environment to the concept of disability.Public policy must respond to both the biomedical and social aspects of disability.Prevention, treatment and rehabilitation are all appropriate responses to the biomedical, or multidimensionality theory as an integral element of critical disability theory as a means to avoid the pitfalls of exclusion and conformity, which identity politics tends to perpetrate, and it also reflects the reality that disabled people are a diverse and variable population within any particular social structure (country, ethnic group, class, etc.) who are also members of all other social classifications.

c) Valuing diversity

A fundamental value of political and legal liberalism is the principle of political and legal equality. Race, gender, sexual orientation, ethnicity are all differences to which liberalism has had to respond. With race and ethnicity, and to lesser extent, gender and sexual orientation, the response has been to deem what used to be relevant differences to be no longer relevant. In this way, political and legal equality could be extended to these claimants without disturbing the basic structures of society. The consequence of this approach is, however, that diversity must be suppressed: The claimant must appear like thecomparator or else the claimant is found to be different and thus legitimately subject to different treatments.

d) Rights

Despite much scepticism about the relevance of legal rights to disadvantaged groupsin society, critical disability theory embraces legal rights as an indispensable tool to advance the equality claims of disabled people and to promote their full integration into all aspects of their society while at the same time valuing and welcoming the diversity that disabled people bring to their communities.

e) Voice

Traditionally, the voices of disabled people who contest mainstream conceptions of disability and the potential role of disabled people have been suppressed and marginalized. If one starts with a belief that disability is lack and inability, unchosen anddespised, then the voices of disabled people can always be interpreted as symptoms of aperson's healthy or unhealthy relation to that disability.

f) Language

Another theme of critical disability theory deals with how language influences theconcept of disability and the status of disabled people. This theme includes both the wordsused to describe or label disabled people and the words and images used to portray disability.Language is popularly assumed to be a transparent, neutral means of communication. Criticaltheory, however, understands language to be inherently political. Language carries with itideological implications which are more or less transparent. The word disability is used toidentify a sub-set of a population but the fuzzy boundaries which occur with all socialcategories are nowhere more contested than with disability.Human group labelling is a continually evolving process.

Assistive Technology

A beginning frame of reference for the term 'assistive technology' can be found in the Assistive Technology Act of 1998 (United States Congress, 1998) which states, "assistive technology device means any item, piece of equipment or product system, whether acquired commercially, modified or customized, that is used to increase, maintain or improve functional capabilities of individuals with disabilities". This means any item which can be used in a classroom. This includes calculators, blue or yellow overlays for reading, glasses, wheelchairs (physical wellness items), software or computers. It also includes any item which increases the student or person's ability to function and learn (increasing intellectual wellness and social participation), to access curriculum and grow and develop as a lifelong learner. It is important to note that the use of Assistive Technology is not remediation or the use of remediation strategies such as re-teach, chunking information or re-cueing the number of items competed in a set. It is an entirely different realm, working to support remediation, which in many cases has not been successful on its own. Hence there is a need for additional supports and strategies which can be used in tandem with differentiation and remediation to either help overcome students' barriers to learning or add enrichment and extension of their learning experiences (Trudi, 2015).

Types of Assistive Technology for Children with Learning Disabilities

Assistive Technology (AT) is capable of addressing many types of learning difficulties. The types of assistive technologies can be categories as following.

Written Language Assistive Technologies

Some of the written language AT tools that help children with learning disabilities include:

a. *Spell Checkers*:
b. *Proofreading:*
c. *Speech Synthesizers*
d. *Speech Recognition*

Reading Assistive Technologies

Some of the reading AT tools that help children with learning disabilities include:

a. *Microsoft Word*
b. *Tape Recorders*
c. *Speech Synthesis*
d. *Optical Character Recognition (OCR)*
e. *Variable Speech Control (VSC)*

Mathematics Assistive Technologies

Some of the mathematics AT tools that help children with learning disabilities include:

a. *Electronic Mathematics Worksheets*
b. *Talking Calculators*

Listening Assistive Technologies

Some of the listening AT tools that help children with learning disabilities include:

a. *FM Listening Systems*
b. *Tape Recorders*

Memory/ Organization Assistive Technologies

Some of the listening AT tools that help children with learning disabilities include:

a. *Data Managers*
b. *Free-form databases*
c. *Prewriting organizers*

Applications of Assistive Technology

Many different applications of assistive technology exist within the classroom community depending on the student's individual needs. There are several "areas of application" including "existence, communication, positioning, mobility, physical education, and environmental interaction" (Simpson *et al.*, 2019). Applications that assist with existence are functions that "are necessary to sustain life" (Poel, 2017). Examples of activities associated with existence include personal care, sleeping, and feeding. Many of these technologies are low-tech devices that are typically inexpensive; spoons with larger handles or devices that help with putting on shoes are examples of low-tech devices. However, high-tech devices do exist to help in this application and they may be more expensive, such as "augmentative communication aids, powered mobility equipment, and computers and peripheral devices" (Judge, 2020).

Assistive Technology for Students with Mobility Impairments

Students having difficulty with one motor skills may require larger keyboard while using a computer,an on-screen keyboard or speech recognition programs to coordinate with their learningtasks. The use of a standard keyboard in a computer with access to a 'mouth- or head-stick',where the keys can be pressed with the pointing device can help students with mobility impairments;while Track balls, head trackers and touch screens can serve as suitable alternatives to thecomputer mouse. Software utilities can create 'sticky keys' that electronically latch the SHIFT,CONTROL, and other keys to allow sequential keystrokes to input commands that normallyrequire two or more keys to be pressed simultaneously (Fouzia, 2015).

Assistive Technology for Students with Visual Impairment/Blindness

Visually impaired students have difficulty accessing visual material in printed form or on thecomputer screen, where standard keyboards can aid in accessing Braille input devices, with Braillekey labels assisting with the keyboard use. The OBR (Optical Braille Recognition) software canenable users having visual impairment to read Braille documents on a standard A4 scanner, scanthe Braille document, analyze the dot pattern, translate the text, and present it on the computerscreen. Refreshable Braille displays allow line-by-

line translation of screen text into Braille, whichcan help in detailed editing. The Braille printers provide the 'hard copy' output for the visuallyimpaired users. Scanners with optical character recognition can read printed material; whichcan then be stored electronically on computers, and be read using speech synthesis, or printedusing Braille translation software and Braille printers. Such systems provide independent accessto journals, syllabi, and homework assignments for the visually impaired students. Speech outputsystems can be used to read screen text, while the screen readers or the text-to-speech softwarelike JAWS (Job Access with Speech) can help the user in adjusting the volume, pitch and speedof reading, and in choosing or adjusting to a male or female voice according to their preference.

Assistive Technology for Students with Low Vision

Students with low vision may find the standard size of letters on the computer screen or printeddocuments too small to read, while some may also not be able to distinguish one color from another.Use of large print key labels, special equipment for the modification of display or printeroutput, computer-generated symbols, both text and graphics enlarged on the monitor or printer,can prove useful to students with low vision, especially in using standard word processing, electronicmail, spreadsheet, and other software applications. Adjusting the color of the monitoror changing the foreground and background colors, through special software like reversing thescreen from black on white to white on black for individuals who are light sensitive, can helpimprove access and readability. Anti-glare screens can make screens easier to read, while voiceoutput systems can also be used by people with low vision. The printed material can be readby scanners with optical character recognition and stored electronically on computers, where itcan be read using speech synthesis or printed in large print. Assistive devices that are suitable for students with low vision may be used to aid in efficient learning like close circuit television,magnifying glasses and hand magnifiers, Braille language, talking calculators and tape recordings(Burgstahler, 2019).

Assistive Technology for Students with Specific Learning Disabilities

For students having Specific Learning Disabilities, educational software can help in skill building, by offering multisensory experiences, positive reinforcement, individualized instruction, and repetition. Students having difficulty processing written information can complete writing assignmentsand tutorial lessons with the aid of computers, for instance, the standard word processor may provea valuable tool for students with Dysgraphia, an inability to write legibly. Quiet work areas andear protectors may make computer input easier for students who are hypersensitive to backgroundnoise and get easily distracted. Adaptive devices like large print displays, alternative colors onthe computer screen, and voice output can help in compensating reading problems.

Utilizationof Assistive Technology

Technology has great potential in providing education access for all learners, and the ability to access the general education curriculum. Assistive technology is a generic term that includes assistive, adaptive, and rehabilitative devices for individuals with disabilities and includes 'virtually anything that might be used to compensate for lack of certain abilities' (Reed and Bowser, 2005), ranging from low-tech devices like crutches or a special grip for a pen, to more advanced items like hearing aids and glasses, to high-tech devices such as computers with specialized software for helping dyslexics to read (WHO, 2009).

Teachers' Awareness of Assistive Technology

The awareness of teachers about the existence of assistive technology and where they can acquire them is of great importance. Teachers need to be aware of the services that are available to acquire assistive technology and the people that are providing the different services that they need. Special education and regular education teachers must focus not only on course content and pedagogy, but also on technology in accordance with the national policy on education. Teachers must also be trained to use technology with students who have special learning needs. They must be knowledgeable of assistive technology availability and its usefulness for students with needs. Yet

both special and general education teachers lack awareness of both the availability and effective use of assistive technology (Holmes, Burton and Heaton, 2006). In a recent survey by Margolis and Goodman (2012) for the united cerebral palsy project, they found that 87% of the survey respondents (parents of students with disabilities) said that students had access to some form of assistive technology in schools but primarily computers. But there is more to assistive technology than computers. However, less than 12% said that students had access to assistive technology services; for example, most families were not aware that assistive technology services were required to make assistive technology functional.

Availability and Accessibility of Technology

The appropriateness in the choice of technology is not governed by how expensive or complicatedit is; but, by the optimum use of the technology, which can be ensured if the choice and designsuits the lifestyle, culture and environment of the user, and is made to fit users and not vice-versa, enabling students with disabilities to achieve their full potential. With particular emphasison community-level innovation, community collaboration with disabled persons and researchersneeds to be encouraged with timely training and follow-up to ensure the continued appropriatenessof the devices for the users.The assistive technology selected should be appropriate to the needs of the situation, to beaccessible to the user. Also, the student's specific difficulty areas need to be determined (Praisner,2020), and their strengths be identified by including them in the selection process, and then theoptions be narrowed down accordingly in the course of the selection. The acquisition of assistivetechnology should not be seen as a one-time expenditure since hardware and software may needupgradation. It is therefore necessary to plan and periodically evaluate the cost, access, timeperiod needed for training, and the level of comfort of the student. The specific settings shouldbe examined where the technology will be used, ensuring portability for ease and accessibility. Students should be encouraged and aided in assuming increased independence and responsibilityin learning rather than being completely dependent on the aid (Fouzia, 2015).

Conclusion

Special needs children were affected either by developmental delays, medical conditions, congenital condition and / or psychiatric condition which will made teaching and learning difficult for them to acquire knowledge. Hence, there is need for additional support and strategies which can be used in tandem with differentiation and remediation to either help overcome students' barriers to learning or add enrichment and extension of their learning experiences. Thus, this can be done by adopting assistive technology. Assistive technology devices were equipment customized to increase, maintain or improve functional capabilities of individuals with disabilities. This devices are of different types and also depending on the students individual needs.

Recommendations

1. Advocating that government organizations, agencies and non-governmental organization should provide more assistive technologies for special schools.
2. More conferences, seminars and workshops should be organized for the teachers of learners with special needs of the global emerging assistive technologies.

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Assessing the Levels of Awareness and Utilization of Assistive Technology Tools for Learning in Niger State School for Individuals with Special Needs.

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Abstract

This study assessed the Levels of awareness, availability, and utilization of assistive technology tools for learning in Niger State School for individuals with special needs. Descriptive survey research was adopted and special education students in Niger State were employed as research participants. Two research questions and two null hypotheses guided the study and a 16-item questionnaire was used as instrument for data collection. The questionnaire was validated by experts in educational technology. Pilot test was carried out and reliability coefficients of 0.89 and 0.88 were obtained for the two sections of the questionnaire. Data collected from the administration of the research instrument were analyzed using descriptive statistics of Mean and Standard Deviation for research questions and independent sample t-test for research hypotheses. A decision rule was set, in which a mean score of 3.0 and above was considered agreed, while a mean score below 3.0 was considered disagreed. Findings revealed that special education students in Niger state are aware of the various assistive technology tools with grand mean score of 3.22, also the finding revealed that special education students utilize the various assistive technology tools for learning with the grand mean score of 3.22. Based on these findings, it was recommended that excursions, seminars and workshops should be organized for special education students to increase their level of awareness of the various types of assistive technology tools and also ensure the available assistive technology tools are always use for learning process.

Keywords: Awareness, Utilization, Assistive Technology Tools, Special Education School, Individual with Special Needs.

Introduction

Education involves the use of information in changing the behaviour of a less learned person in that area of learning. Education is a continuous learning process. It is internationally acknowledged as the core for individual and national development and is therefore, essential to all – disabled or not (Shirvan, 2020). Education is the process of facilitating learning, or the acquisition of knowledge, skills, values, morals, beliefs, and habits (Setiawan, 2021). Education could also be defined a socially regulated process and is a transfer of experience that occurs continuously from generation to generation (Nazlev, 2017). Educational methods include teaching, training, storytelling, discussion and directed research. Education frequently takes place under the guidance of educators, however learners can also educate themselves. (Mukhalalati*et al.,* 2019). Education can take place in formal or informal settings and any experience that has a formative effect on the way one thinks, feels, or acts may be considered educational (Dutta, 2020).

In recent years there has been a groundswell of interest in how computers and the Internet can best be harnessed to improve the efficiency and effectiveness of education at all levels and in both formal and non-formal settings (Marcel, 2020). But ICTs are more than just these technologies; older technologies such as the telephone, radio and television, although now given less attention, have a longer and richer history as instructional tools, (Mukherjee *et al.,* 2018). For instance, radio and television have for over forty years been used for open and distance learning, although print remains the cheapest, most accessible and therefore most dominant delivery mechanism in both developed and developing countries. The use of computers and the Internet is still in its infancy in developing countries, if these are used at all, due to limited infrastructure and the attendant high costs of access, (Turya*et al.,* 2019). ICTs stand for information and communication technologies and are defined, for the purposes of this primer, as a "diverse set of technological tools and resources used to communicate, and to create, disseminate, store, and manage information"(Das, 2019). These technologies include computers, the Internet, broadcasting technologies (radio and television), and telephony.

Abdul *et al.* (2020) opines that ICTs are a potentially powerful tool for extending educational opportunities, both formal and non-formal, to previously underserved constituencies—scattered and rural populations, groups traditionally excluded from education due to cultural or social reasons such as ethnic minorities, girls and women, persons with disabilities, and the elderly, as well as all others who for reasons of cost or because of time constraints are unable to enroll on campus. Improving the quality of education and training is a critical issue, particularly at a time of educational expansion. ICTs can enhance the quality of education in several ways: by increasing learner motivation and engagement: ICTs such as videos, television and multimedia computer software that combine text, sound, and colorful, moving images can be used to provide challenging and authentic content that will engage the student in the learning process. Interactive radio likewise makes use of sound effects, songs, dramatizations, comic skits, and other performance conventions to compel the students to listen and become involved in the lessons being delivered, (Saravanakumar, 2018). ICTs also facilitates the acquisition of basic skills: The transmission of basic skills and concepts that are the foundation of higher order thinking skills and creativity can be facilitated by ICTs through drill and practice. And ICTs also enhances teacher training: ICTs have also been used to improve access to and the quality of teacher training. For example, institutions like the Cyber Teacher Training Center (CTTC) in South Korea are taking advantage of the Internet to provide better teacher professional development opportunities to in-service teachers. ICTs are also transformational tools which, when used appropriately, can promote the shift to a learner-centered environment. ICTs could also serve as instructional materials to enhance teaching and learning process, Das, (2019).

Teaching as a concept requires that teachers should not only have knowledge and skills in a subject but also the professional competence in the use of methods and materials to be able to influence the behavior of learners by using instructional materials. Asrizal *et al.,* (2018) defined instructional materials as ways and means of making the teaching and learning process easy, more meaningful and understandable. Kukey *et al.,* (2019) in a similar definition, explained that instructional materials are designed to promote and encourage effective teaching and learning experiences. In view of the above definitions, instructional materials are therefore, sight tools for teachers at all levels of education process for effective instructional delivery and the sole aim of any teacher is to ensure effective teaching and learning on the part of his pupils. Therefore, no

teaching is possible at any significant age level without the use of instructional materials. And no teacher who hopes to promote learning can ignore the use of instructional materials in teaching and learning. The use of instructional materials obviously helps the students in remembering and retaining what they have learnt. Lin *et al.* (2018) described instructional materials as Instruments used to transmit information, ideas and notes to learners. Also, indicate that the role of instructional materials in teaching and learning is one of the most important and widely discussed issues in contemporary education policy (Almanthari*et al.,* 2020). Therefore, instructional materials are paramount important issues in classroom interaction and successful transfer of knowledge from the teacher to the learnerspromote learner's academic achievement and enable the achievement of the stated objectives of a lesson

Effective use of instructional materials and its relevance with the topic would enable the learners to effectively learn and retain what they have learnt and thereby advancing their performance in the topic been taught. Setiawan (2021) stated that learning is a process through which knowledge, skills, habits, facts, ideas and principles are acquired, retained and utilized; and the only means of achieving this is through the use of instructional materials in teaching process. Therefore, the use of relevant instructional materials helps and enhances teachers to teach effectively and productivity during teaching process. Moreover, Setiawan (2021) who noted that are only the teachers who will guarantee effective and adequate usage of instructional materials and thereby facilitate success in learning. Honestly, a teacher who makes use of appropriate instructional materials to supplement his teaching will help and enhance learners' innovative and creative thinking as well as help them become believable spontaneous and eagerness in any lesson. Instructional materials can be divided into printed and duplicated materials; non-projected display materials; still projected display materials; audio materials; linked audio and still visual materials; cine and video materials; computer-mediated materials, (Cahapay, 2021). As important and relevant as instructional material is to teaching and learning, so is assistive technology tools to individuals with special needs.

Assistive Technology tools are special tools designed to enhance academic outcomes, performance, and longevity of all individuals' not just students with special needs in the general classroom. As defined by the Individuals with Disabilities Education Act Amendments of (IDEA), Assistive Technology Tool is "any item, piece of equipment, or product system that is used to increase, maintain, or improved functional capabilities of individuals with special need" Lersilp *et al.,* (2018). It enables all students to be successful in the general education classroom (Vigilante *et al.*, 2018). Assistive Technology tool was also defined as an item or piece of equipment or product system either acquired commercially, off the shelf, modified or customized and used to increase, maintain or improve an individual's functional capability for an individual with disabilities (Koch, 2017). The law strongly encouraged and enforced Assistive Technology tool development and implementation to enhance instruction of students with special needs in the classroom. The U.S. Congress supported the effective use of AT in the classrooms on two fronts. First, Assistive Technology Tool can be used to reduce cost and eliminate potential barriers that may block instruction and improve teachers' ability to better address the needs of all students. Second, Assistive Technology Tool can be used to provide compensatory supports for students with disabilities as required by law, (Akpan& Beard, 2013). Education professionals are required to consider Assistive Technology Tool when developing individual program plans for all students with disabilities in public school settings as potential for compensating for the effect of any

disabilities or impairments the user might have. Assistive Technology Tool is a tool that is capable of increasing, maintaining, or improving the functional capabilities of students with special needs. It is a tool that "sustains life, protect the special need student from bodily injury, promote communication, increase mobility, improve cooperative interaction with the environment, and allow the individual to participate in recreational or fitness related activities" (Adebisi*et al.*, 2015). Assistive Technology Tool can facilitate students with special needs' ability to build cognitive links between lesson representations by providing quick access to multiple representations (Hansen & Richland, 2020). Assistive Technology Tool has the potential to stimulate and foster problem-solving solution strategies and the internal locus of control of students with special needs. Assistive Technology Tool devices enable students with special needs to receive special education, significantly improving their physical and psychological wellbeing by enhancing their social and life skills (Lee, 2016). Using Assistive Technology Tool, students with special needs are encouraged to pursue their own strategies for solving real life problems, and in doing so they demonstrating that they are in control of their own learning. As cognitive tools that support problem-solvers critical thinking and engagement Assistive Technology Tool "such as closed circuit monitors, Braille readers, voice-activated software, TTY telephones, and motorized wheelchairs, students are able to participate in educational activities that might have been difficult or impractical otherwise" Akpan, *et al.*, (2013).

Despite, the benefits of utilizing Assistive Technology Tools in improving the quality, effectual and effectiveness of teaching and learning process, most students have not adequately explored the resources available to them. Barriers may exist in the utilization of Assistive Technology Tools on the part of the students since they are the utilizers of these technologies for education. Hence, students need to be aware of Assistive Technology Tools for education (Edwards, 2020).

Awareness refers to a students' ability to understand the available Assistive Technology Tools as well as how they might be applied to enhance their effective learning (Kundu*et al.*, 2020). For students to optimally use Assistive Technology Tools, they need to be aware of its utilization and impact on their academic activities and be proficient in its use. The knowledge of students on the utilization of Assistive technology for education is fundamental to enable students successfully utilize it for their academic activities. This was emphasized by Ankrah and Atuase (2018) who stated that users are unable to realize the potential of information resources to suit their information demands due to a lack of awareness of them. Also the available tools will be of great benefit for students to relate with.

The uses of assistive technologies in special education schools have raised questions among researchers over the years. The principal reason for providing assistive technology in school is to enable students to meet the instructional goals set forth for them. School personnel should look at tasks that each student needs to accomplish, the difficulties the student is having, and the ways that various devices might help the student better accomplish those tasks,(Marston, 2019). Assistive technologies can exist as hardware and software devices that can help people with disabilities and special needs to overcome the challenges of learning and information that they might be facing. Although, there are a few available assistive technologies today, some people, due to gender and other reasons, are finding it difficult to integrate Okonji*et al.*, (2019).

Gender is ascribed to the socio-cultural behaviors and features, duties and parts which are attributed to being females and males in the society, community and environment (Gondo, 2020).

Previous studies reported that females are lagging in the use of modern technologies (Olatokun, 2017).Previous studies also reported that male students were more prepared to use technologies Batane & Ngwako (2017) study shows that female students were better users of technology. Hence, the need to consider students' gender differences in the awareness, availability and utilization of Assistive Technology Tools in education cannot be compromised irrespective of their years of experience.

Research Questions

The following research questions were raised to guide the Study:

1. Are students of the special education schools in Niger State aware of the various assistive technology tools?
2. Are the assistive technology tools available for students in special education schools in Niger State, Nigeria utilized for learning process?

Research Hypotheses

The following null hypotheses were tested in the study:

HO_1: There is no significant difference between male and female students of the two special education schools in the awareness of assistive technology tools in Niger State, Nigeria.

HO_3: There is no significant difference between male and female students of the two special education schools in Niger State in the utilization of assistive technological tools for learning.

Methodology

Descriptive survey design was adopted for this study. The methodology involved the use of questionnaire to elicit needed responses from special education students of their level of awareness and utilization of assistive technology for learning. The population of the study comprises of the entire 679 special education students in Niger State. Purposive sampling technique was employed to select 654based on the presence of hearing impaired students in all the schools and then Krejcie and Morgan (1970) sample size determination table was used to get 242 which were used for the study. Thereafter, Based on the percentage of population, Musa Bello special school has 87 (43 female and 44 male) as its target population while special school of education Minna has 155 (80 female and 75 male) has it target population.

A researcher-designed questionnaire named "Questionnaire for Awareness and Utilization of Assistive Technology' (QAUAT)'' was used for data collection. The questionnaire was divided into three sections; section A, consists of demographic information about the respondents. Section B consists of Assistive Technology Tools to check special education students level of awareness of Assistive Technology Tools while section C consist of statement to assess special education students Utilization of Assistive Technology Tools for learning using the 5-point Likert scale. A mean score above 3.0 will be adjudged as Agreed, while a mean score below 3.0 will be adjudged Disagreed. The questionnaire was validated by two educational technology experts. To determine the internal consistency of the instrument, a pilot test was carried out on 40 respondents within the study population but outside the selected study sample. The instrument was administered once and the scores obtained were computed using Cronbach Alpha's formula. Reliability co-efficient of 0.89, and 0.88 were obtained, hence, the questionnaire was considered as having high reliability and therefore suitable for data collection.

Data Collection and Analysis

A researchers-developed questionnaire was used for data collection. The questionnaire consists of three sections (Sections A, B, & C). Section A was used to collect the respondents' demography while Section B consists of 9 items for special education students' awareness of Assistive Technology tools and section C consists of 7statement to assess Special Education students' utilization of Assistive Technology Tools.

The data collected was analyzed using descriptive and independent sample t-test. Mean and Standard Deviation will be used to answer the research questions. A Mean score of 3.0 and above was considered as Agreement to the items while a mean score below 3.0 was considered as Disagreement to the items. For hypotheses testing, independent t-test was used to determine whether significant difference exists between the mean scores of the two groups.

Results

The responses of the entire 242 participants were used to provide answers to research question one and two. Thereafter, the responses of 119 male and 123 female respondents who participated in the study were collated and analyzed for testing hypotheses one and two. Descriptive statistics of Mean and Standard Deviation were used to answer the research questions as presented in Tables 1 and 2, while independent sample t-test were used to test the hypotheses as presented in Tables 3 and 4.

Table 1: helps to provide answers to the first research question. The results of data illustrate that the mean score for items 1 to 9 ranged between 2.16 and 4.26 and were therefore five (5) Aware and four (4) Not Aware by the respondents.

S/N	Assistive Technology Tools	N	$\bar{X}$	Std.	Decision
1	Communication boards/books/cards	242	4.23	0.68	Aware
2	Gesture to voice technology	242	4.26	0.66	Aware
3	Hearing aids (digital) and batteries	242	4.15	0.81	Aware
4	Flashing doorbells	242	3.48	1.22	Aware
5	TV subtitles	242	3.15	0.98	Aware
6	Text telephones	242	2.87	0.92	Not Aware
7	Flashing alarm clocks	242	2.36	1.03	Not Aware
8	Vibrating alarm clocks	242	2.16	0.94	Not Aware
9	Flashing/vibrating smoke alarms	242	2.34	1.00	Not Aware
	Grand Mean		**3.22**		**Aware**

Decision Mean = 3.0

Table 1 presents the Mean and Standard Deviation on students of special education awareness of the various assistive technology tools in Niger State. From the table, students of special education are aware of Communication boards/books/cards, Gesture to voice technology, Hearing aids (digital) and batteries, Flashing doorbells and TV subtitles, since these items had a mean above 3.0 which is the decision mean. However, students of special education are not aware of Text telephones, flashing alarm clocks, Vibrating alarm clocks and Flashing/vibrating smoke alarms since these items had a mean below 3.0. The table further revealed that the grand mean score response to the nine items is 3.22 which is above 3.0. This implies that students of special education are aware of the various assistive technology tools in Niger State.

Table 2: helps to provide answers to the second research question. The results of data illustrate that the mean score for items 1 to 7 ranged between 2.22 and 4.30 and were therefore five (3) Agreed and four (4) Disagree by the respondents.

S/N	Items	N	$\bar{X}$	Std.	Decision
1	Communication board makes it easy for me to interpret things quickly.	242	4.27	0.74	Agree
2	The use of gesture to voice technology makes learning easy for me.	242	2.64	1.07	Disagree
3	Hearing aid makes communication easy and enjoyable for me.	242	4.30	0.10	Agree
4	Flashing doorbells signals make me do the needful quickly	242	2.45	1.13	Disagree
5	The TV subtitles gives me better underrating and interpretation of things.	242	2.22	0.95	Disagree
6	Text telephone allows me have better understanding of things taught.	242	2.60	0.85	Disagree
7	Flashing alarm clocks, Vibrating alarm clocks and vibrating smoke alarms notify me of what time it is and for what purpose.	242	4.07	1.04	Agree
	Grand Mean		**3.22**		**Agree**

Decision Mean = 3.0

Table 2 presents studentsutilization of the available assistive technology tools in special education schools in Niger State. From the table, the students agreed to use Communication boards/books/cards, Hearing aids and flashing alarm clocks, Vibrating alarm clocks and Flashing/vibrating smoke alarms. However, Gesture to voice technology, Flashing doorbells, TV subtitles and Text telephones are not used by the students. The table further revealed that the grand mean score response to the seven items is 3.22 which is above the decision mean 3.0. This indicated that available assistive technology tools are utilized by students in special education schools in Niger State.

Discussion and conclusion

The discovery of this study reported that students of special education are aware of the various Assistive Technology Tools for learning. This is in line with the discovery of Soman*et al.* (2021) that 55 (49.5%) students are aware of assistive technologies. Similarly, the findings of Okonji& Ogwezzy, (2019) that Visually Impaired Adult and Visually Impaired Older Adult had good awareness of the existence of Assistive Technology Tools. Also, the findings of Jama *et al.* (2019) that a substantial proportion of survey respondents were not aware of existing facilities (Information obtained from a total of 208 individual clinic reception desks).

Furthermore, discovery from this study also reveal that available assistive technology tools are utilized by students in special education schools. This is in line with the findings of Umoeshiet (2020) that business educators are aware of and utilized assistive technologies in business education programme in tertiary institutions. Also, the findings of Dominic,*et al.* (2020) shows that assistive technology tools were rarely utilized. Similarly, the findings of Ajuwon and Chitiyo (2016) that the largest proportion of students using AT are those with deafness or hearing

impairment (53.3%), followed by those with a learning disability (40%). Also, The Findings of Chukwuemeka and Samaila (2019) revealed that teachers do not use high-tech assistive devices regularly to teach students with physical disabilities.

Recommendations

Based on the discovery of this study, the following recommendations are made:

4. Special education students are aware of Assistive Technology Tools, therefore, excursions, seminars and workshops should be organized for them to increase their level of awareness of the various types of assistive technology tools to enhance their learning;
5. Special education teachers should be encouraged to use assistive technology tools during teaching activities to help students get use to it. Therefore, adequate facilities that will enable them to acquire adequate knowledge and mastery of the use of assistive technology tool should be provided by education stakeholders;
6. female and male could perform equally well if enabling environment with adequate infrastructure are provided, therefore, state government should provide conducive and enabling environment to both female and male students for them to effectively use Assistive Technology Tools for education;
7. Assistive Technology Tools could be used to reduce the gender gap that exists in its use. Therefore, female and male students should be properly trained on the use of Assistive Technology Tools to enhance their quick mastery and independence;

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Multimodality in Education: *The English Language Experience*

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Abstract
The art of teaching, generally, has been an issue attracting significant attention of educators in the world of schooling. Efforts at making positive impact on learners' performance has caused many teachers at different levels of education to seek alternative strategies to strengthen teaching and improve students' achievement. However, much of these alternative efforts have been traditional teacher-led, which exclude students from active participation in the process. Recent academic efforts have begun to explore the inclusion of learners, introducing learner-centred activities, aimed at bringing learners to the centre of classroom activities. One of such efforts is multimodality which is the use of multiple modes in teaching and learning. This paper reviews the place of engagement of multiple modes in the classroom, with emphasis on English language. The concept, the benefits of multimodality to the teacher and the learner and also the challenges to multimodality were discussed. The paper also presented reviews of some experimental studies carried out on the effects of multimodal strategy on English language learning in approval of the strategy. Suggestions on how to integrate multimodal learning into the classroom were also made.

Keywords: Multimodality, Modes, Teaching and learning, Classroom activities.

Introduction
In every learning environment, there are different categories of learners, each acquiring and building knowledge at his own pace in his own peculiar way. These varied categories of learners can be found in a single setting with a single teacher who must aspire to meet the needs of every individual leaner to achieve the set educational goals. In trying to accommodate these categories of leaners, with their different learning styles, multimodal learning becomes apparent and necessary. It is often overwhelming for a teacher to adequately meet the learning needs of individuals with different abilities in a single classroom encounter. Yet, each classroom has compositions from different learning backgrounds and abilities that must be accommodated. Thus, multimodality is a bail-out for the teacher in a class of various learning styles.

Multimodality in education implies the application of multiple learning modes, each supporting the other in a unique way. It is the interplay of different learning strategies that benefit learners in one way or the other. In every learning environment, populated by high ability learners, medium ability learners, low ability learners and even struggling learners or special leaners, which is often the case, there is often difficulty carrying all these categories along at the same pace. Thus, the essence of multimodal teaching is to be able to cater for the learning needs of these categories of learners, to the extent that every learner should be able to benefit from, at least, one of these modes in a single learning context. Simply put, multimodal learning means teaching using multiple modes. These modes could be music, speech, writing, drawing, graphics, kinesthetic, language (written or spoken), and so on. It is believed that learning is more effective when teachers appeal to different learning sensory modes at the same time which is only possible through multimodal

learning. The point being made here is that there are relevant options available to teachers in the class other than the use of one mode.

Multimodality came as a response to changes brought about by technological innovations which were directly and indirectly influencing and changing the way people learn and also redefining literacy as a whole. It is also a challenge to monomodal learning strategy which focuses on the use of a single mode of instruction in teaching and learning (Bateman, 2008). In moving away from the traditional practices of teaching with one modality scholars recognize that leaners learn in different ways and so the teacher should be able to deliver lessons with strategies that allow different types of learners to process information through multiple modalities. It therefore, implies that a learner can apply more than one meaning making mode in interpreting and in responding to a text. Similarly, the teacher can apply more than one meaning making mode in lesson delivery because each of these modes often goes with a different effect in promoting learning and literacy practices. The dominant theoretical paradigm within the field of multimodality and education concerns itself with how human beings use different modes of communication to create meaning (Kress and van Leeuwen, 1996, Kress, 1997; Van Leeuwen, 2005). It involves multiple ways of knowing and all these modes are co-dependent.

Multimodal learning practices are rooted in Multimodal theory of Jewitt and Kress (1996) which posit that language is not the only form of communication available in teaching and learning. This theory understands meaning representation and communication to be more than about language but draws on a multiplicity of modes, all of which contribute to meaning, directly or indirectly. It embodies how people learn, communicate and convey information using different forms of channels and using them most effectively to create immersive and dynamic learning experiences. They, therefore, argue that modes other than language can be used for meaningful communication. For instance, a learning situation that integrates pictures, speech/language, gestures/movements, colour, should be expected to carry a good number of leaners along as it concerns understanding and making meaning from the information conveyed. Similarly, in a hearing-impaired classroom, an audio/video presentation would benefit them less than text/video presentation mode.

The summary of this discourse is that scholars are increasingly recognizing that in any communicative occasion, language, whether written or spoken, is only a part of the meaning making resource. Jewitt and Kress (2003) have noted that any communicative event involves simultaneous modes whereby, meaning is communicated in a variety of ways. Thus, other meaning making resources provide different logics and effects, aside language resource, as the user considers most suitable for the expression of meaning at a particular context.

What is a Mode?

A mode is any means or method of expression and presentation of information such as writing, drawing, art performance, speech, images, colour, and so on. In other words, a mode is any form of communication which a communicator has chosen as a means of interacting with an audience in order to convey information. However, any such chosen means should be able to cater for the specific needs and preference of the learner. In the teaching/learning situation, a mode is the way or manner in which teaching/learning is carried out, experienced or expressed. It can also be seen as a method employed to carry out teaching/learning. Linguistically, a mode is a meaning making resource or form of communication within various sign systems that convey accepted meanings

(Stein and Newfield, 2006), enabling different kinds of knowing or being. Every mode of instruction carries a different possibility of meaning, though, some modes are more effective than other modes in meaning bearing, for certain kinds of meaning representation. Thus, different learners engage with different modes differently with respect to their engagements, recognizing that meaning is not inherent or given in only one mode. A teacher can choose to employ two or more modes in a single learning situation thereby bringing in multimodality into learning.

In knowledge construction and meaning making, there is an issue of what to do with one mode or another or with a combination of modes (Evans, 2005). Unlike in a single mode situation, there are different possibilities for meaning making in multimodal contexts. Such modes as language, movements, drawing, colour which integrate both visual, audio and also writing are meant to present learning in a variety of ways to enhance understanding and retention. For instance, an image or drawing or dance will offer different affordances for understanding, interpretation and meaning making. In live multimodal environment, which may include, but not only, dance, performances, oral storytelling and presentations, meaning is conveyed through a combination of various modes such as gestural, audio and spoken languages.

In considering the concept of affordance, the issue of what one mode offers that the other mode does not offer becomes important. What a written passage allows a reader to do that a diagram or play does not, can make a lot of difference in meaning making. Modes like audio, colour, drama, visual, and so on, offer different affordances that can affect meaning, understanding and interpretation. This means that a learner may understand a text better when dramatized than when ordinarily read or drawn. A comparison between a novel and a film based on the same novel can reveal the issue of affordances and how a reader can be positioned in relation to them.

The underlying principle is that the dullest of leaners will be able to actively participate in the learning process and be able to benefit fully and make meaning from, at least, one of the multiple modes used in communication. This is because the distinct potentials of each mode to break down communication into parts harnesses the simplification of complexities of content materials. Thus, Kress and van Leeuwen (2001) referred to affordances as the realization of different kinds of instructional possibilities and learning engagements that multimodality and multiliteracy materials make available to teachers and/or learners.

A Paradigm Departure in Instructional Methodology

Multimodality began to receive significant definition in the 20th Century with exponential rise in technology which created many new modes of presentation. The monomodal or single mode which used to define the presentation of information and interpretation of text is being replaced by complex presentation formats. Multimodality, therefore suggests a shift from the traditional method which is paper-based to more complex methods such as screen-based texts, with the affordances. Comparing a single mode environment and a multiple mode environment is like comparing chalk board and digital board, in both affordances and the ease of use, as well as the inherent potentials in them.

	Traditional/Single Mode	Multiple Mode
1.	Single learning style	Multiple learning styles is a single context (3 or more modes, up to 5)
2.	Teacher centered instruction	Learner centered activities
3.	Single sensory simulation	Multisensory simulation
4.	Passive learning, receptive	Active, enquiry-based learning
5.	One size - fits - all – model	Proactive and well planned.
6.	Regurgitation of information	Authentic learning

Benefits of Multimodal Learning

Among the benefits accruable to learning when the environment allows instructional elements to be presented in more than one sensory mode (visual, aural, written, etc.) are:

- It enables students to make preferences of learning styles which may lead to improved quality of learning when content is matched with the best learning mode. It could lead to learners developing stronger desire to learn new materials.
- Multimodality can give rise to a more balanced approach to studying and learning and hence a more comprehensive devotion to studying and understanding.
- It stirs up creativity and spurs students to use different parts of their brain in critical thinking in view of multisensory modes they employ, thereby, diversifying learners' world outlook.
- It accommodates and engages all categories of learners in a single learning context. Each learner should have one or two modes among others that he/she can comfortably adapt to and benefit from. This is a way of ensuring that no learner is left out of the learning process. It improves the quality of learning by matching content with the best modes of learning.
- Multimodality engages the leaners mind and keeps it from wondering in thought, thus, creating a clearer focus for learning.
- Multimodality is way from the traditional learning experience which reduces classroom experiences to a bore.
- When a variety of activities go on in a single learning encounter, there will be no dull moment. The active involvement of learners will help them extend attention span and also retain information acquired.
- In multimodal learning, leaners can choose any mode of study that best suites them for a particular learning experience. This means that all categories of learners can be taken care of in a single class as each of them fits into a more accommodating mode for maximum benefit.
- Multimodal learning enhances students' ability to learn more because every obstacle is cleared by one mode or the other. For instance, when comprehension of a reading material fails, a visual or kinesthetic presentation of the same material could result in a more positive learning. For instance, reading and comprehension of any Shakespeare's works may be problematic to some students but watching a play let of the same text will offer different kind of experience and understanding.

Benefits of Multimodality in Teaching

Education has evolved to recognize that learning takes many forms and is multisensory. To this end, multidimensional approach that could trigger multiple simulation are being advocated to maximize teaching and learning. This practice can benefit the teacher in a variety of ways:

- It expands the creativity of the teacher when it comes to the point where he/she flexes his/her creativity muscles by researching and piecing together the best resources to supplement lessons. Through these resources, the teacher challenges students to approach problems in new ways and showcase their unique abilities.
- The teacher evolves into a champion of diversity by exposing learners to the complexity of real-world interactions through diversity of learning resources.
- The teacher also enjoys the opportunity of developing his/her own skills and competencies in as many resource skills as possible.
- Multimodality helps the teacher to improve the quality of instruction by matching content delivery with the best modes of learning for learners.
- Multimodality engages the mind and creates a clear focus for the teacher.
- It relieves the teacher of the burden of classroom domination.
- Class management becomes easier for the teacher as even the dullest of learners will be able to understand concepts and make meaning from: at least, two of the modes used in instruction.
- Multimodal instruction will enable the teacher to accomplish more, with students' involvement in the learning process.
- Multimodal teaching strategy is away from the conventional teaching strategy, thus, marking a departure to effective teaching by promoting students' involvement in knowledge acquisition, and interpretation and communication.
- The use of multiple teaching modes helps the teacher select appropriate teaching modes for each category of learning style.

However, multimodality is not going to replace the traditional literacy values but rather introduces new forms to augment the existing form. The traditional knowledge of reading and writing is still important but the new modes are integrated into the old to complement the inherent possibilities and competencies (Miller and McVee, 2012). Learners still need to know how to read and write but new literacy modes are integrated with new learning outcomes presented in new forms as multimodality in the classroom, from paper-based to multiple modal based outcomes.

The English Language Experience

Scholarship in multimodal studies has grown especially within the last decade. This implies a knowledge shift from the sole mode of written language as a means of interpreting written text and making meaning. In a multimodal knowledge shift experiment conducted by Robert on his grade 10 and 11 adolescent students in South Africa out of frustration when his students failed to improve in their English performance because of breakdown in the culture of learning", Stein and Newfield (2004) reported that at the end of the year, Robert's students showed a dramatic improvement. Robert had experimented on the use of drawing pictures, singing songs and performance plays to improve students' performance English language. At the end of the year, there was dramatic improvement, as out of 140 students, only one failed the English language examination.

In a study titled 'Engaging students through multimodal learning environments: The Journey continues', Sankey, Birch and Gardiner (2010) also sought to find out the usefulness of having a combination of resources in a single contact lesson and whether multiple representation of content lead to improved learning outcomes. Their findings showed that 91.8% of participants improved from pretest to posttest scores. Similarly, Chikwendu (2016) in a study examined the effects of

Multimodal Literacy Strategy on English language reading comprehension outcomes of senior secondary school students in Niger State, Nigeria when compared with two other strategies. Using the multimodal resource elements of language, drama and drawing in experiment, findings showed that multimodal literacy strategy had the highest mean scores among male participants both in the high verbal ability group, the average verbal ability group and the low verbal ability group respectively. compared with the other strategies. Among female participants, the multimodal literacy strategy had the highest mean score among high, average and low verbal ability groups. The superiority of multimodal strategy over other strategies is evident in the study.

Kendrick, Jones, Mutonyi and Norton (2006) did a study in English education in Ugandan Primary and Secondary Schools in two different districts and showed how the incorporation of multimodality as an instructional strategy in mainstream schooling offered innovative possibilities for how teachers might validate students' literacy, experiences and cultures to support English language learning in the classroom. The authors showed how the creative use of drawing, photograph and drama provided opportunities for students to improve their understanding and use of English language.

In a study on explore English as a second language learners' exploration of multimodal texts in a junior high school in United States, Ajayi (2009) explored the principles that English as a second language learners employed to interpret advertisement images and how they used visual representation to convey their understandings. The study showed that the use of multimodal resources had the potential to enhance language and literacy learning in a way that was transformative. The students experienced the advertisement in the study in new ways, and produced new meanings which reflected their personal interests. The study also showed that the use of multimodal strategy allowed the students to enter into text composition from different paths. Studies in multimodal teaching and learning resources are diverse and cut across disciplines and subject areas. However, researches in multimodality are evolving, even though there is not much of it in Nigeria. It is hoped that as emphasis is continuously laid on this area and more awareness created through research and reviews, multimodality would be appreciated more in this part of the world. It is also hoped that multimodality could replace monomodal practices in schools and in learning generally, in the future.

Challenges to Multimodality

There are possibilities and challenges to multimodality in teaching and learning English as a second language. Yougjoo (2014) posits that some issues could hamper effective application of multimodal resources in the classroom. Some of the challenges outlined include that:

1. Some students do not have access to digital technology to effectively participate.
2. The task of helping second language learners develop conventional academic literacy along with multimodal (digital) literacies can overwhelm the teacher.
3. Some students are more multimodal than others or are richer in digital experience than others. It can thus, be challenging to accommodate those with little or no digital multimodal experience and those with much experience in the same class activities.
4. Prescribed curriculum could be a challenge to multimodal instruction as much as it lacks multimodal outcome. In the same manner, multimodal techniques are a challenge to conventional curriculum.

5. When teachers are not trained on the use of some multimodal resources especially the ones involving technology, it can be problematic.
6. Sometimes, selection of interaction modes is teacher centered without recourse to students own preferred learning mode. What goes for one may not go for the other. Some learners might just prefer monomodal communication, for instance, only reading written texts or only images.

Integrating multimodality into learning

To make a seamless switch to multimodality, the following suggestions could be useful to the teacher:

Excite your students with interactive exercises through visuals. Visuals are iconic and normally are more concrete symbolic representations of reality. This is not the same with spoken or written word. Since diverse methods are needed to engage diverse learners, the teacher could go for charts, pictures, artworks, drama and other representations that could catch their eyes and attention to make them see the content in a new light. Visual referents promote understanding and enable accurate interpretation and retention of contents. The more iconic or pictorial the referents are, the more likely they are to promote understanding and meaning making.

The teacher could continue direct teaching in learners' familiar style and then introduce mixed modes in the virtual realm. Other modes like play lets, games, and mixed media could come in too, all tailored towards students' needs. The teacher could take advantage of blended learning environment to encourage learners to identify their strengths and personal competencies.

In introducing multiple modes, the teacher should avoid using the same modes for every lesson and every day. Again, using too many modes at a time can even overwhelm learners and become counterproductive. There should be a balance of modes that can engage and yet interest learners. The teacher should track students' progress to ensure they are retaining information and developing their skills in line with the set educational objectives.

Conclusion

Multimodality is emerging and gaining ground in the world of teaching and learning. The life that the strategy brings to classroom activities commends it to scholars in language education as it tends to expand learning and skills acquisition beyond the confines of the classroom. The benefits accruing to multimodal learning seem to outweigh the challenges that befall it. Engagement with multimodal teaching and learning resources could motivate enquiry in learners, promote students' engagement with text materials and improve their learning and even attitude to schooling. This implies that apart from promoting active participation in reading and interpretation of texts, doors are opened for lifelong learning by the developmental skills that learners acquire through engagements with different modes. Thus, in this 21st century, there is need to renegotiate educational expectations and so, educators must pay attention to emerging strategies and technologies which are striving to liberate knowledge from the limitations of traditional educational methodologies.

Recommendations

The following recommendation are made based on this review of multimodal application in teaching and learning in the classroom:

1. Obsolete curriculum currently being used in all levels of school learning should be replaced by more current curriculum that reflect the reality of 21st century multimodal engagements.
2. English Language teachers, and indeed all others, should be exposed to and trained on the use of multimodal learning resources to enable them function effectively in the multimodal classroom.
3. Learners should be exposed to multimodal learning resources early enough in life to enable them get used to the resources when they get to school.
4. Digital technology should be made available to learners both at home and in the school to help them cultivate the culture of independent or shared learning.
5. Teaches should endeavor to understudy their students to understand their individual learning styles to enable selection of appropriate learning resources for different categories of learners.

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Memory-Capacity and Intelligence as Predictors to Academic Achievement in Biology among Biology Education Students in North-Central Universities, Nigeria.

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Abstract
the study investigated memory-capacity and intelligence as predictors to academic achievement in biology among biology education undergraduate students in north-central universities, Nigeria. The study has three (3) objectives and three hypotheses. The study employed correlational expo-factor research design. The population for the study comprised of three hundred and twenty-seven (327) 200level B.Sc (Ed) Biology students of Federal Universities in North-Central Zone, Nigeria. Simple random sampling technique (draw from the hat method) was used in selecting the sample schools in north-central, Nigeria with intact groups. Two research instruments were used to generate the data: Metamemory in Adulthood Questionnaire (MAQ) with a reliability coefficient of 0.84 was used to establish the level of memory-capacity of the subjects; and Raven's Progressive Matrices Test (RPMT) with a reliability coefficient of 0.88 was used to measure intelligence of the subjects. While, the subjects' GPA was used as measure of their academic achievement. The data collected was analyzed using inferential statistics of correlation analysis and regression analysis to test the null hypotheses. From the analysis, the results revealed that there was a positive correlation between memory-capacity, intelligence, and academic achievement. The result also shows that the two independent variables that is memory-capacity and intelligence are good predictors to academic achievement with different level of impact.

Key Words: Memory Capacity, Intelligence and Academic Achievement.

Introduction
Poor academic achievement of students in science particularly in biology in Nigeria has called for divergent investigations into the factors responsible for the problems. Whenever a semester ends and at the end of session examination results are pasted, one observed that most of the students from 100 to 400 levels would have several carryovers. As a result, many of the students are withdrawn; some spend more than the minimum 4 or 3 years to complete the course of study while some graduated with pass degree. This poor biology students' academic achievement was identified by many researchers that many factors are responsible. Many researchers have reported that factors responsible may include teachers factors such as qualifications, years of experience, methodology used, inadequate content knowledge of the subject; environmental factors such as climate, weather, infrastructure, location of school, availability of instructional materials; and students factors such as interest, adjustment to learning environment, inability to organize learning materials (Avis, 2009, Samer & Mohammed, 2012). Of recent, there was a shift of paradigm from all the listed factors responsible for students' poor academic achievement to more influential student's factors that really matter most in their academic environment and these factors play vital roles in determining students' academic achievement such as emotional intelligence, reasoning ability, memory capacity, intelligence and self-efficacy (Mari, 2020).

Memory Capacity is used interchangeably with different meanings in a broad range of research fields. Some researchers' uses memory-capacity (MC) to refer to individual difference constructs reflecting the limited capacity of a person's working memory. Engle (2012) hypothesized that memory capacity "is about using attention to maintain or suppress information".

Working memory capacity is a tool used to help students perform efficiently and effectively in all aspects of their lives. This essential tool is defined as the ability to maintain and manipulate information in the mind for a brief period of time, often termed, "short-term memory" (Beer, Pisoni, Kronenberger, &Geers, 2010). Baddeley (2001) defines working memory capacity as, "…the brain system that provides temporary storage and manipulation of the information necessary for such complex cognitive tasks as language, comprehension, learning, and reasoning". Working memory capacity is necessary for staying focused on a task, blocking out distractions, and keeping one updated and aware of things that are going on in the environment. Students with effective way or good capacity to acquire knowledge could solve problems or perform better.

Memory-Capacity "is not really about storage or memory *per se*, but about the capacity for controlled, sustained attention in the face of interference or distraction. Memory Capacity is the ability to keep information current in mind for a short period, while using this information for the task at hand. It is the 'workbench' the 'screen' of computer where current thinking takes place. Students with working memory capacity difficulties take a much longer time to process information. They are unable to cope with timed activities and fast presentation of information. As a result, they often end up abandoning the activities all together out of frustration or get very poor outcome from the tasks given to them such as poor academic achievement.

Intelligence is the aggregates or capacity of an individual to act purposefully, to think rationally and to deal effectively with his environment." Our learning and thinking are possible through intelligence only. It is an organization comprising the abilities of readiness, correctness and of understanding complicated and abstract things and with its help a person shows necessary mental control and action in solving problems.

Since intelligence is the ability to solve problems and to adapt to and learn from life's everyday experiences. The ability to solve problems and the capacity to adapt and learn from experiences includes characteristics such as creativity and interpersonal skills. The mental abilities that enable one to adapt to, shape or select one's environment, the ability to judge, comprehends, and reasons the ability to understand and deal with people, objects and symbols. The ability to act purposefully, thinks rationally, and deals effectively with the environment.

Binet (2017) observed that intelligence is a general intellectual capacity which consists of the following components 1-to reason and judge well 2-to comprehend well, 3-to take and maintain a definite direction of thought, 4-to adapt thinking to the attainment of a desirable end and 5-to be self-critical in reasoning and problem solving. Binet viewed intelligence as a complex mental process which is capable of being measured, likewise, Deshpande (2014) found that the students from the high achieving schools were higher in intelligence and other variables explained much of the variance between the high and low achieving schools. In another study, (Watkins, Lei, &Canivez, 2007) stated there has been considerable debate regarding the causal precedence of intelligence and academic achievement. Some researchers view intelligence and achievement as

identical constructs. Others believe that the relationship between intelligence and achievement is reciprocal.

From the literature search, it is evident that most of researches conducted on these two variables (memory-capacity and intelligence in relation to academic achievement) were only correlated to establish relationship and non-research find to investigate which between these two variables is a good predictor of academic achievement at university level. Therefore, the present study is geared toward establishing if there is correlation between the independent variables and academic achievement and which among the independent variables best predict academic achievement in biology among biology education students in north-central universities. This research is to address the main student factor that affects their academic achievement and provide the necessary supports in overcoming the shortcomings so that they can excel in their daily academic activities.

Objectives of the study

1. Identify the relationship between memory-capacity and academic achievement in biology among undergraduate biology education students in North-Central universities, Nigeria.
2. Determine the relationship between Intelligence and academic achievement in biology among undergraduate biology education students in North-Central universities, Nigeria.
3. Find out whether memory-capacity and Intelligence are predictors to academic achievement in biology among undergraduate biology education students in North-Central universities, Nigeria.

Null Hypotheses

Ho_1: there is no significant relationship between memory-capacity and academic achievementin biology among undergraduate biology education students in North-Central universities, Nigeria.

Ho_2: there is no significant relationship between intelligence and academic achievement in biology among undergraduate biology education students in North-Central universities, Nigeria.

Ho_3: There is no significant effect inmemory-capacity and intelligence as predictors to academic achievement in biology among undergraduate biology education students in North-Central universities, Nigeria.

Methodology

The study is a correlation studies involving survey and ex-post-facto design. The population for the study comprises of all the 200L B.Sc (Ed) biology students of the federal Universities in North-Central, Nigeria. The universities are located in Abuja, Benue, Kogi, Kwara, Nasarawa, Niger and Plateau and each of the states have only one federal university with population of 359 students out of which males are 144 while females are 215 with average age of 22 to 24 years. The study has the sample size of 327 participants which were drawn from five universities out of six by simple draw from the hat method. Participants for the study were purposely selected (students in an intact class) since the sample size is manageable. Two instruments were used for data collections which are Meta memory in Adulthood Questionnaire (MAQ) with reliability coefficient of 0.84 and Raven's Progressive Matrices Test (RPMT) with reliability coefficient of 0.88. The instruments were administered to the students' one at time and was score and subjected to correlation and regression analysis to test the null hypothesesas shown below:

The data collected to answer null hypothesis one, was analyzed using correlation coefficient statistics as shown in Table 1

Table 1: Correlation between Memory-Capacity and Academic Achievement

Variables	N	R	P	Decision
Memory-Capacity	327	.666**	.000	Significant
Academic Achievement	327			

Significant at P< .005

Table 1 shows that high and positive significant relationship exist between memory-capacity and academic achievement as shown by Spearman's rho correlation coefficient r = .666** for memory-capacity while that of academic achievement is 1.000 at P< .005. The relationship is high since the rho value is .666** which is higher than r= .50. Therefore, the null hypothesis which states that there is no significant relationship between memory-capacity and academic achievement was rejected.

The data collected to answer null hypothesis two, was analyzed using correlation coefficient statistics as shown in Table 2

Table 2: Correlation between intelligence and Academic Achievement

Variables	N	R	P	Decision
Intelligence	327	.693**	.000	Significant
Academic Achievement	327			

Significant at P< .005

Table 2 revealed that a high and positive significant relationship exist between intelligence and academic achievement as shown by Spearman's rho correlation coefficient r = .693** for intelligence while that of academic achievement is 1.000 at P< .005. The relationship is high since the rho value is .693** which is higher than r= .50. Therefore, the null hypothesis which states that there is no significant relationship between intelligence and academic achievement was rejected.

The data collected to answer hypothesis six was analyzed using regression analysis statistics in Table 3

Table 3: Regression Analysis of Memory Capacity and Intelligence on Academic Achievement of Biology Students

Variable	N	R	R^2	R^2 Adjusted	Coefficient Beta	F-cal	Sig.
Memory Capacity	327	.666**	.592	.589	.391	234.648	.000
Intelligence	327	.693**	.592	.589	.485		

Dependent Variable: Academic Achievement

The R square shows how much of the variance in the dependent variable (academic achievement) is explained by the model. The R square value is .592 which is expressed in percentage, which means that the model (which includes memory capacity and intelligence) explains 59.2 per cent of the variance in academic achievement, which is arrived at by multiplying R square by 100. While in the standardized coefficient (Beta) column, the independent variable with larger Beta value predicts better academic achievement. Therefore, coefficient beta value revealed that both memory capacity and intelligence has Beta= .391 and .485 respectively. This means that intelligence with Beta value of .485 predict academic achievement of students better than memory capacity with Beta value of .391.

The two independent variables; memory-capacity and intelligence make a significant unique contribution to the prediction of dependent variable (academic achievement) at significance of .000. Therefore, the null hypothesis which stated that memory-capacity and intelligence have no significant effects on academic achievement of biology undergraduate students in north-central zone, Nigeria was rejected. Significant relationship exists as intelligence predicts academic achievement of biology students better than memory-capacity.

Discussion of Result

Result in table 4.3b shows that a highly positive significant relationship exists between memory-capacity and academic achievement of biology undergraduate students in north-central zone, Nigeria. The table revealed that memory-capacity is a good predictor to academic achievement of biology students. The finding of this study is in line with that of Alloway et al. (2005); Bull (2008); Hunda et al (2009); Swanson (2016) who revealed that students with high working memory-capacity have advantage to perform better than student with low working memory-capacity. The finding of this study is also in agreement with that of Gamze (2013); Diane (2014); Stephen (2018) who revealed that working memory-capacity has positive correlation with academic performance of students and predicted the academic performance of the students. The finding of this study disagreed with that of Ershova et al (2016) who revealed no significant correlation between memory-capacity and academic performance of students.

Result in table 4.4b shows a high positive significant relationship between intelligence and academic achievement of biology undergraduate students in north-central zone, Nigeria. The table revealed that intelligence is a good predictor to academic achievement of biology students. Therefore, the finding of this study is in line with that of Archana (2002); Martin (2004); Laidra et al. (2007); Deshparde (2014) who revealed that students' academic achievement relies most strongly on their cognitive abilities through all grade levels. The finding of this study is also in line with that of Gottfredson (2005); Watkins et al (2007); Kaufman et al. (2010); Majerova (2017) who reported that there is a correlation effect of IQ on students' performance irrespective of their origin, that intelligence is a good predictor to academic performance of students. The finding of this study disagreed with that of Habibollah et al. (2010); Riggon et al. (2013) who revealed no significant relationship exist between students' intelligence and academic achievement.

Result in table 4.6b shows a positive significant relationship between memory-capacity and intelligence as predictors to academic achievement of biology undergraduate students in north-central zone, Nigeria. The finding of the present study revealed that both memory-capacity and intelligence have positive relationship with academic achievement and that both the two independent variables positively (memory-capacity and intelligence) predict the independent

variable (academic achievement) of biology students. The result of this study established that intelligence is a better predictor of academic achievement of biology students than memory-capacity. The finding of this study is in agreement with that of David et al. (2017); Wolfgang et al. (2017) who revealed a positive correlation between memory-capacity and intelligence and also established that both the independent variables are good predictors to academic performance of students. The present study through accessible literature search could not find any study that disagreed with the present finding. Likewise, the findings of earlier researchers failed to establish which of the two independent variables have better predicting power to academic achievement which the present study did.

Conclusion

In conclusion, there was high positive relationship between memory-capacity and academic achievement, and high positive relationship between intelligence and academic achievement. This simply put that increase in memory-capacity, and intelligence leads to increase in academic achievement in biology among biology education undergraduate students in north-central universities, Nigeria. Therefore, the need for intelligence skills has more potentials of enhancing academic achievement of biology students than memory-capacity.

Recommendations

From the findings and conclusion of this study, the following recommendations are hereby made:

1. Students of all levels should be exposed to memory-capacity and intelligence skills in re-addressing students with academic problems.
2. Acquiring formal intelligence skills should be the priority of students of biology at university since it improves their academic achievement.
3. Research evidence and benefits of memory-capacity and intelligence could be made available to science educators and publishers so that learning materials could be modified to accommodate reasoning ability and memory-capacity skills where necessary.

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Enhancing Critical Thinking Skills of Students' through Project-based Instruction: A Mandate for Secondary Schools in Nigeria

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Abstract
The quest to help learners acquire critical thinking skills because it is one of the sought-after skills by employers in the 21st-century is in the forefront of academic discourse. Therefore, this paper examined enhancing critical thinking skills in students: a mandate for secondary schools in Nigeria. This paper sought to examine ways by which secondary education in our country (Nigeria) can be restructured in a manner that critical thinking skill could be inculcated in the young learners, to make them problems solvers, hence they become asset in the society rather than liabilities to the Nigerian society. This paper in clear terms examined the concept of critical thinking, the importance of critical thinking to the nation, Project-Based Instruction as a methods of inculcating critical thinking skills in students specifically in secondary educational level. It was concluded thatcritical thinking skills are criticalfor personal success, national peace, progress and development, it should be integrated at all level of education especially at the secondary level of education for the common good of all. It was recommended among others that teachers should adopt innovative and suitable methods of teaching such as project-based instruction that are consistent with the development of critical thinking skills in students.

Keywords; Critical thinking skills, Project-based Instruction, and Secondary education

Introduction
The world is bedeviled with social, environmental, health and educational problems. The daily interaction of man with both his physical and social environments created these problems. These problems continue to get more and more complex on a daily basis. In any society, human life is a series of confrontations (Adeyemi 2012). Confrontation with oneself, with other people, with societal institutions and with one's environment leaves man with countless problems to battle with in the society. The person who deal with these problems and issues successfully is one imbued with the right type of knowledge, skills and competencies required to solve these problems.

Education certainly has a responsibility and function to equip learners with techniques of dealing with the problems and evolving issues, in order to make them live a happy and fulfilled life in the society. Hence, the reason why the most challenging role of education generally today, is to equip the students with the ability and capability to deal successfully with the fast changing world and the unknown future. Certainly, the presents situations and problems may become obsolete when students of today face the world as adults tomorrow. One of the tools which education can perfectly provide for these youngsters is critical thinking which provides them with the needed skills to solve problems and issues in life regardless of their nature. More than ever before in Nigeria today, there is the need for commitment to the resolution of ensuing societal problems through appropriate education. The individuals who seek to resolve issues and problems without the appropriate skills, abilities and proper understanding of the problems, often tend not only to behave

irresponsibly and erratically, but also in ways that damage their own future and the human condition in the society.

Education is a pivotal factor or the most potent weapon when it comes to the development a nation. It has been described as an instrument "par excellence" in the national policy on education for affecting national development (FRN 2004). Experts in the field of education has define education in various ways. But for this paper, a simple and functional definition of the term will be used as it one of the keywords in this paper. Jekayinfa and Kolawole (2008) define education as "the process of development of an independent and integrated personality, which entails the training and acquisition of special knowledge, skills, attitudes and values needed by an individual to be responsible and which would enable him to contribute his own quota to the growth of the society of which he is a member". After subjecting this definition to series of analysis it was seen that the definition agreed with the Nigeria philosophy of education which are as follows;

10. Development of individual in to sound and effective citizen.
11. Provision of equal asses to educational opportunities to all citizens of the country at all levels both inside and outside the school system.
12. Full integration of individual in to the community.

Nevertheless, the goals which the Nigerian nation set to achieve through the provision of sound education to her citizens include:

2. Inculcation of national consciousness and national unity.
3. Inculcation of the right type of values and attitudes for the survival of the individual and the Nigerian Society.
4. Training of the mind in the understanding of the world.
5. Acquisition of appropriate skills and the development of mental, physical and social abilities and competencies as instrument for the individual to live in and contribute to the development of the society.

From the goals stated above the needs and ambitions of the nation have been captured appropriately by these goals. This mean that any form of education provided in the country must be aware of the need of the people for that education to be seen as viable. In view of item 4 (Acquisition of appropriate skills and the development of mental, physical and social abilities and competencies as instrument for the individual to live in and contribute to the development of the society). The appropriates skills includes the 21st century skills which are; critical thinking skill, creative skills, collaborative skills, communicative skills and problem solving skills. These 21st century skills do not only provide a frame work for successful learning in the classroom, but ensure students can thrive in a world where change is constant. And they are also tremendously important for our nation's well-being. Our business community demands a workforce with those skills to ensure our competitiveness in a global economy.

Education is a life-long process, which aims at imparting skills and knowledge needed to lead a purposeful life and equip the learners so as to be able to adjust to the remote and immediate environment in which he finds himself. Thus, in order for education to be seen as carrying out its expected roles in the society, it must provide the learner with the relevant body of knowledge, skills, attitudes and values that would make him an effective and active member of his society.

One of such skills the learner is expected to be imparted with is critical thinking, which is the focus of this paper. Paul and Elder (2016) states that when learners are imbued with critical thinking, they are able to gain knowledge, understanding, insight, and solve his personal problems, problems in his family as well as solving societal problems in whatever sphere of life such problems may manifest. This way, the learner becomes a problem solver rather than a liability. And these are the kind of individuals the society needs today, which is in accordance with the goals of education stated above.

Critical Thinking

Living in the 21st century requires higher thinking skills such as critical thinking (Riechman & Simon 2013). Thinking is an activity in which an individual search for a proper answer, filtering out various kinds of data or information, solve problems, and make decision Colley *et al.,* (2012). Critical thinking features prominently in all the skills or abilities learners are expected to acquire through the education being provided. One, who cannot think, may not be able to solve even the smallest problem. We now live in a world of problems which include educational problem, social problem, political problem, economic problem, religious problem, ethnic problem, Science and technologically related problems to mention a few. It only takes a sound mind, a mind imbued with reflective thinking, which can engage in deep analysis, to come up with causes of the problem at hand and generate possible solutions or options to arrive at a decision to solve the problem.

Given the complex nature of critical thinking, researchers use diverse concepts to define critical thinking. According to Lunenburg, (2011) Critical thinking is a process that occurs because of an understanding of the various information that is integrated through learning skills. Because critical thinking occurs through learning, it requires a thinking process that requires the ability of analysis, synthesis, and evaluation. In other words, critical thinking is the purposeful and reflective judgment about what to believe or what to do in response to observation, experience, verbal or written expressions or arguments. Hence, critical thinking involves determining the meaning and significance of what is observed or expressed, or concerning a given inference or argument, determining whether there is adequate justification to accept the conclusion as true.

This definition is in consonance with the one given by Fisher and Scriven (2011) as skilled and active interpretation and evaluation of observations, communications, information and argumentation. Critical thinking therefore gives due consideration to the evidence, the context of judgment, the relevant criteria for making the judgment, the applicable methods or techniques for forming the judgments and the applicable theoretical construct for understanding the problem and the question at hand. Critical thinking employs not only logic but broad intellectual criteria such as clarity, credibility, accuracy, precision, relevance, depth, breath, fairness and significance.

Similarly, Bromley (2011), said that critical thinking is the ability and tendency to analyze complex issues and situations, recognize and evaluate assumptions and alternative points of view according to acceptable criteria, make conclusions, draw reasonable conclusions based on accurate information, make interdisciplinary connections, and transfer insights to new contexts. Critical thinking is define as a cognitive skill that determines how well a person collects, processes, and uses information to identify the best way to achieve goals or navigate complex situations. Given the above definition, it can be concluded that critical thinking is a systematic, complex intellectual process, involving various attitudes and skills, accompanied by a process of analyzing and

evaluating within the framework of making improvements. Critical thinking as an intellectual process involves the activities of attitudes, knowledge, and skills.The main activities in critical thinking are analysis, evaluation, and argumentation (Butterworth & Thwaites, 2013).

Consequent upon the foregoing, it may be summarized therefore that, critical thinking is self-guided, self-disciplined, self-directed, self-monitored and self-corrective thinking, which attempts to reason at the highest level of quality in a fair-minded way. Thus, people who think critically consistently, attempt to live rationally, reasonably and empathically. They are keenly aware of the inherent flawed nature of human thinking when left unguided. People who can think critically strive to improve the world in a more rational and civilized way they can contribute.

Importance of Critical Thinking to the Nation

Critical thinking is crucial for economy development, promotes creativity, it's a key for career success, helps in better decision making, developing better citizens, and enhances problem solving skills among students. There are various classroom activities that can enhance critical thinking in students these includes; Debates/arguments, student-led discussion, questioning techniques, research an brainstorm, explore specific issues or problems, developing a solution and presenting it in the class e.tc. Given the foregoing, the importance of critical thinking to the individuals in particular and the nation at large is unquestionable. However, thinking is often casual and informal. Most of our thinking if left to itself is partial, distorted, biased, uninformed or down-right prejudiced. Yet the quality of our lives and that of what we produce, make or build depends precisely on the quality of our thought. Mediocre thinking is costly, both in money and in quality of life. This fact buttress the importance of critical thinking in the life of a nation and that of the individual. This is because critical thinking enables one to analyze, evaluate, explain and restructure his thinking, thereby reducing the risk of adopting, acting on, or thinking with a false belief. However, even with knowledge of the method of logical inquiry and reasoning, mistakes can happen due to a thinker's inability to apply the methods or because of character traits such as egocentricism. Critical thinking includes identification of propaganda, prejudice, distortion, bias, misinformation self-deception, and so on. We live in a world of problems, and it is imperative for the individual, particularly students in the country to be equipped with the skills, abilities and capabilities to get their problems and those of the society solved, thereby, making the nation a worthwhile place to live in. However, Delgado et al (2011) described Twenty-first century skills as critical thinking skills that are the most sought-after skills by employers of labour to improve and increase their output. This underscores the importance of education that is relevant to the needs of the 21st century to produce critical thinkers and problem solvers. Consequently, critical thinking is a mandate for our schools in Nigeria because it help student's deal with everyday problems as they come their way.

Developing Critical Thinking Skill in the Students

One pertinent question that comes to mind at this point is how to enhance critical thinking skills in students. It is interesting to note that critical thinking ability can be inculcated in the learner at any point of the educational hierarchy starting from primary school level to tertiary level. What differs is the level of engagement at each level. Thus, while it is important to start developing critical thinking in the learner right from the primary school, it is better effected in students at the secondary level. This is because students at this level are more mentally matured to cope with the challenges involved.

However, the question on how to develop the critical thinking ability in students still remains. This is a methodological issue. What method do we adopt in order to effectively develop critical

thinking in the students? As it has been observed, critical thinking is about being both willing and able to evaluate one's thinking, and could be effected through the teaching and learning of any subject in the school curriculum. Developing critical thinking skills in students, involves learning how to evaluate, make judgment, analyses, and interpret statement. To do this successfully, one should adopt a perspective rather than judgmental orientation that is, avoiding moving from perception to judgment as one applies critical thinking to issues.

Critical thinking is based on concepts and principles, not on hard and fast rules. These concepts are exemplified in: identification of problem, rational inquiry, conceptual analysis, logical reasoning, nature of argument, identification of premises, and conclusion; while principles involved in critical thinking include: acquisition of knowledge through thinking, reasoning and questioning based on facts, learning what to think through how to think; judgment of effectiveness of argument through reflective thinking, critical thinking as a search for meaning and critical thinking as a skill that can be learned among others. It employs not only logic (formal/informal), but broad intellectual criteria of clarity, credibility, accuracy, precision, relevance, depth, breadth and significance. Critical thinking is highly significant to learning. There are two phases to the learning of content. The first occurs when learners construct in their minds the basic ideas, principles and theories that are inherent in the content, for the first time. This is a process of internalization. The second phase occurs when learners effectively use those ideas, principles and theories as they become relevant in the learners' lives which is known as the process of application.

Good teachers cultivate critical thinking, that is, intellectually engaged thinking, at every stage of learning. The teacher questions the students often in an elenctic manner. The point here is that, the teacher who fosters critical thinking fosters reflectiveness in students, by asking questions that stimulate thinking which is essential to the construction of knowledge. Each discipline adapts the use of critical thinking concepts and principles. The core concepts are embedded in the content of each subject. For students to learn content, intellectual engagement is crucial. All students must do their own thinking and construction of knowledge. Good teachers are aware of this, and therefore focus all teaching and learning activities in the class to stimulate the mind to master key concepts, principles and generalizations underlying the subject.

The ability to think critically does not take place in a vacuum. Therefore, to enhance learners' critical thinking skills, the classroom instruction should be characterized by;
open-ended problem,
Questioning and question prompt,
Real-world scenario,
Collaboration/cooperation learning,
Hands-on and Minds-on activities
The instructional approaches that are learner-centred that could be adopted to help learners acquire critical thinking includes;
Project based learning
Integrated STEM Approach,
Collaborative instruction
Design-based learning/ Engineering Designed-based learning
Inquiry-based instruction, among others.

Critical Thinking for Secondary Education in Nigeria

It has been substantially demonstrated in this paper that critical thinking as an intellectual engagement belongs to the higher order level of cognitive abilities which involves analysis, synthesis, interpretation, inference and evaluation. A fact that makes it almost an exclusive function of secondary education in some countries.

This explains why in United Kingdom school system, critical thinking is offered as a subject at the Advanced level. It has also been reported about the effectiveness in fostering critical thinking in California, USA. According to the study carried out by Thomas and Nelson (2010), critical reports by authorities on higher education, political leaders and businessmen, claimed that higher education is failing to respond to the needs of the students and that many of the graduates' knowledge and skills do not meet society's requirements for well-educated citizens. The study concluded that:

1. Faculty aspires to develop students' thinking skills, while in practice teachers aim at facts and concepts in the discipline at the lowest cognitive level, rather than development of intellectual or values.
2. Faculty agrees that the development of students' higher order intellectual/cognitive abilities is the most important educational task of colleges and universities. These abilities underpin the students' perceptions of the world and the consequent decisions they make.
3. Specifically, critical thinking the capacity to evaluate skillfully and fairly the quality of evidence and detect error, hypocrisy, dissembling and bias is central to both personal success and national needs.

As it were, while this report essentially raises questions about the standard or level of performance of higher education with regards to the inculcation of critical thinking ability in students, it is clear that it is the responsibility of higher education to provide that needed skill. Nigeria's higher education sub-sector, is not an exception. Similarly, Abrami, *et al* (2008) carried out a meta-analysis study of 117 different studies of pedagogical intervention in the area of critical thinking involving a total of 20,698 participants in Canada. One of the questions addressed in the analysis was, what types of pedagogical intervention were most effective in supporting students to develop critical thinking skills? The study identified four approaches to the teaching of critical thinking namely:

1. General approach- Critical thinking being taught separately from subject area content.
2. Infusion approach- Critical thinking is infused into subject area content.
1. Immersion approach- Instructions in the subject is thought provoking, but critical thinking principles are not made explicit.
2. Mixed approach- A combination of a general approach and either infusion or immersion.

Findings of this study showed that: The immersion method was the least effective. The mixed approach was the most effective, closely followed by the infusion approach. Students' learning outcomes were significantly improved where teachers received professional development related to the teaching of critical thinking skills. Students' collaborative work resulted in small but statistically significant advantage in critical thinking.

While this author aligns with the findings above, the study however failed to make categorical statement on classroom strategies that may help develop critical thinking skills in students. This is where the concepts and principles of critical thinking highlighted earlier are highly relevant and

useful. At the classroom level, students are made to identify the problem to address, which may come from any sphere of our lives. This step is closely followed by rational inquiry into the problem and subsequent generation of possible alternative means of solving the problem. A step that actually calls for conceptual analysis of issues involved and logical reasoning, supported by sound arguments to enable students get to the fact of the case, thereby leading to the premises on which sound conclusion(s) are made. In the process, students acquire more knowledge through thinking, reasoning, and questioning based on facts and learning "what to think" through "how to think" and assessing the effectiveness of arguments through reflective thinking. This way, students could have acquired the necessary skills in critical thinking to enable them solve personal problems, those of the community and the nation at large.

Project-based Learning

Project based learning has been defined by so many scholars in many ways and there is no consensus in the definition of PjBL. PjBL has been referred to as a "model", "approach" or a "technique", or as "learning" or "teaching". Project based learning according to Schwalm and Tylek (2012) Project based learning (PjBL) is a model of instruction that exposes students'with real life, multidisciplinary problems that require critical thinking, hands on activities and collaboration (Jamali et al, 2017) Buck institute define PjBL as a systematic pedagogy that engages students'in learning knowledge and skills through an extended inquiry process structured around complex, authentic question and carefully designed product and task. Dalimonte, (2013) define project-based learning as a studentcentered approach that engages students'as they use the inquiry process as they are given a realworld situation or problem to solve while also being aligned to content standards. Infact as long as there is a tendency that the teachers do not have time to develop a learning device that is capable of integrating the issues in real life by planting a character that can improve critical thinking skills of student in defining the problem, taking action to get findings, taking decisions and evaluating issues in real life is also a sensitive issue and it contains a moral dilemma, which is supposed to be a valuable learning resource for the character development of students'in school (Duran & Sendag, 2012). Sahin and Top (2015) pointed out the goal of PjBL is make students'become aware of the connections between the academic knowledge and its applications in real life while gaining a deeper understanding of concepts. The genesis of a PjBL is inquiry, in a project-based learning environment, the focus in the classroom shifts from teacher led instruction to student-led instructions. The students'become the navigators directing their learning through the inquiry process and the development of project- based learning experiences. The teacher becomes more of a facilitator as the focus in the classroom moves from the instructors teaching the content to students'learning the content through the inquiry process and problem solving (Dalimonte, 2013). The instructor provides the students'with a list of guidelines, a timeline, and helps them create a plan of action for the project (Coyne et al., 2016). The students'will decide how they will solve the project-based learning project through the use of the inquiry process. Due to the nature of project-based learning, the students'may arrive at a solution which is not an area of expertise for the instructor (Smith and Cook, 2012). These situations create discussion opportunities and the possibility of a new and exciting solution to the problem (Smith & Cook, 2012). Thus, creating a learning environment that is conducive and exciting for learners. The main focus of PjBL is an emphasis on students'having autonomy to make decisions about the direction of their project (Boss & Larmer 2018). PjBL begins with a student- driving question and uses an integrated curriculum approach to investigate the question, or problem. In this way the

teacher facilitates the process but the learner is in the 'driver's seat' and is guided through each step of the process by the teacher (Bell, 2010).

Conclusion and Recommendations

From the discourse above, it can be concluded that since critical thinking is a precursor to personal success, national peace, progress and development, it should be addressed with all the seriousness it requires by all stake holders for the common good of all. To this end, it is hereby recommended that:

1. Critical thinking is introduced as a separate subject or course in our tertiary institutions.
2. Teachers should be encouraged to operate more in classroom, at higher level of cognition than the lower level.
3. Teachers should adopt suitable methods of teaching such as Elentic methods, Inquiry method, project-based learning and problem solving method etc. that are consistent with the development of critical thinking skill in students.
4. Both teachers and students should imbibe the attitude of intellectual empathy and intellectual humility, culminating in broad mindedness needed for the development of the skill.
5. It is not just enough to acquire the knowledge and the skills involved in critical thinking, learners should be encouraged to apply such skills in their daily lives.

In summary, Edward M Glaser proposed that the ability to think critically involves three element namely;

10. An attitude of being disposed to consider in a thoughtful way the problems and subjects that come within the range of one's experiences;
11. Knowledge of the methods of logical inquiry and reasoning; and
12. Some skills in applying those methods

Critical thinking calls for a persistent effort to examine any belief or any form of knowledge in the light of the evidence that support it and the further conclusions to which it tends.

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Rethinking Science and Mathematics Education for The 21st Century: Panacea for Technological Breakthrough in Nigeria.

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Abstract

Technological breakthrough is generally perceived as a social transformation of the society, projected to bring economic, social and material improvement in the life of the majority of the people with a view to gaining control over the environment. This paper recognizes the fact that Science, Technology,Engineering and Mathematics (STEM) Education is an enabler of national development. It examined the role of STEM Education as a tool in national development. The paper highlighted some salient issues on STEM with the hope that the awareness therein will bring about the desired development and improvement of human life. Recommendations were made; it concluded that, with sound STEM Education, there can be technological breakthrough.

Key words: Development, Education, Engineering, Mathematics, Science, Technology.

Introduction

The philosophy of education in Nigeria is geared towards social, cultural, economic, political, scientific and technological progress. Education is adjudged to be an instrument par excellence for effecting National Development (FRN, 2014). Education is the process of receiving or giving systematic instruction especially at a school or university. Ategwu and Obia (2019), education is a process of discovering and living the truth, expanding one's vision of life and the world and of acquiring practical knowledge. Every educational policy has its aims and objectives to be carried out and resources to be utilized to achieve the expected goals. The purpose of education therefore is to equip one with self-transforming knowledge which can be used to change the environment and execute whatever task that may be assigned, hence the saying that in every formal education process, there is a transition from the home to the school, and there is a transformation from the school to the home. It is not gain saying that every facet of a society's life is affected by education in one way or the other especially education in Science, Technology, Engineering and Mathematics (STEM) It explains events in nature , helps people to think and reason in a logical manner, solves problems encountered on a day to day basis, develops social skills through proper handling of objects and equipment, develops social skills by establishing friendship while working cooperatively in groups and helps satisfy curiosity through opportunities in carrying out investigations (TESSA, 2011 & STAN, 2019). Technology is a process of practically applying knowledge and using the resources of matter, energy and natural phenomenon to solve human problems and making life easier. There are simple and common examples of technological products such as building of houses in different forms and shapes, using different materials. The construction of modern machines like cars, generators, airplanes, ships for commercial activities is done through STEM education. Several activities are carried out by STEM in our environment in order to make work easy for economic purposes which results to national development.

STEM Education

STEM is an acronym for: Science, Technology, Engineering and Mathematics. Accor ding to Olorundare (2010), the inclusion of engineering into STEM Education can be justified by the mere fact that young children tend to be engineers first; building, making and doing projects long before

they can explore scientific principles that allow their buildings to stand or "canals" between puddles to carry water. The important contribution of STEM as an enabler for sustainable national economic growth was affirmed at the World Summit on Sustainable Development (WSSD) in 2002. According to David,

Dallatu and Yusuf (2018), it is in this regard that in the framework of the New Partnership for Africa's Development (NEPAD), African leaders recognized that Science and Technology will play a major role in the economic transformation and sustainable development of any nation. STEM education is used in research, policy issues, teaching for innovation, problem-solving and prospects. STEM is needed towards globalization demands. The complexity of today's world requires all people to be engaged with new set of core knowledge and skills, to solve difficult problems like novel coronavirus pandemic, gather and evaluate evidence and make sense of information they receive from varied print and increasingly digital media. It is therefore clear that the learning and doing of STEM help develop skills and prepare students for a workforce where success results not just from what one knows but what one is able to do with the knowledge. STEM had been the critical instruments used to uplift not only the standard of living but the economy of any nation. Developed nations such as USA, China, Japan and UK are not unconnected to the type of science and technology available to them (Wasagu, 2019). STEM education is important in meeting societal needs like food, shelter, shelter, clothing, water, energy, employment, basic education, healthcare, defense and security, governance, etc. Modern industries depend on basic science for its supply of innovations. The support of pure science is justifiable because it will lead eventually to economic benefits through improved industrial products or processes. This is why nations continue to invest huge amount of resources research and development in STEM education and training. This investment is seen as strategic because of the importance of these disciplines to national development.STEM global initiative has attracted several countries of the world for its development. These countries believe that with STEM knowledge, they can rise above over-dependence on developed countries technological prowess. Presently, countries in the world are classified as; developed, developing and less under developed. The difference between the developed, developing and under-developed countries however rests on the ability of the developed countries to convert scientific ideas to usable technology while the developing and under-developed countries are yet to do so effectively (Sambo, Udofiak, &Okoko, 2018).

Science and Technology

Science is defined variously as:- knowledge about the physical world based on testing and providing facts, or work that results in gaining knowledge (Longman Active study,2006). science is universally regarded as an organized study of natural phenomena. To Sulai, Sulai andKaluri (2018) Science is defined as an intellectual activity carried out by human, designed to discover the ways in which this information can be organized to benefit human race. A scientifically literate person should possess a body of scientific knowledge,a set of scientific skills and behave scientifically in his or her day to day activities. Science holds a unique position among all aspects of school curriculum because it offers countless opportunities for students. It also helps in nation's development. One of the aim of science education is to bring about more scientifically literate citizenry and to develop more manpower to meet up with the world advancement in science and technology.

Technology is viewed as application of knowledge for development and improvement of human life. It is science of mechanical and industrial arts which involves application of science in solving human problems (Suleiman, Fagbemi, Oyebani& Suleiman, 2018). According to Alabede, (2017), technology is a systematic approach of applying scientific or other organized knowledge to a particular task. It is about product and process. The process is the application, while the product is the outcome of application, which includes hardware and software materials. Technology is the practical application of knowledge especially in a particular area to achieve some results Technology simply means the practical application of scientific or other knowledge and a major source of economy expansion. Zakariyya and Bello (2018) and Adeniran andOdebode (2018), view technology as application of knowledge obtained from scientific discovery for development and improvement of human life. It is the mechanical and industrial arts which involves application of science and mathematics in solving human problems. All the definitions seem to be pointing to the development and improvement of human life. Technology therefore has economic, social, ethical and aesthetic dimensions which depends on the use to which it is put, where it is used and the circumstances that prevail at the time it is used. For example, education technology is used to help students apply scientific knowledge and concepts to better their environment, to use their brain and hands, make work easier, help them develop positive attitude towards work and productivity and to encourage critical thinking and creativity among them. Science, technology and mathematical knowledge are related in nature.

Mathematics and Engineering

Is seen by Inweregbuh (2015) as a branch of science which deals with numbers and their operations which revealed hidden patterns that help us to understand the world around us. To Guwam (2017), the knowledge of Mathematics is very useful in our daily life. Its usefulness is seen in the enhancement of the development of a critical mind which enables man to circumvent problems like poverty, unemployment and recession that abound in the society. Lending credence to this, Usman andOjo (2014) pointed out that mathematics is the only essential tool that is applicable in many fields like natural science, engineering, medicine, finance and social sciences, which can be relied on to generate think – tanks that can launch Nigeria on the path of sustainable economic growth and development. Mathematics is commonly referred to as "the language of science" (Obafemi &Ogunkunle, 2013). Study Up (2009) pointed out that, the study of mathematics at all levels is the most pronounced tool to aid science. For example, scientists studying in all fields of science interweave equations into their everyday theories. The study of physics benefits from conceptual understanding in mathematics. Physics and mathematics are actually inseparable. Obafemi andOgunkunle (2013), further noted that, physical sciences cannot do without mathematics. This is because many of the expressions used in these subjects are lent from mathematics. Mathematics Education is considered as science of counting, measuring and describing the shapes of objects (Majasan,1995; Augie, 2013; Suleiman &Abdullahi, 2018). The subject deals with logical reasoning and quantitative calculation and involves the science of structure, order and relation. The subject provides basis for scientific and technological advancement which is a necessary ingredient to the economic growth of any nation (Augie, 2013). Also, mathematics is the lynch pin in the task of national capacity building in science and technology. Therefore, any shortcoming in the subject constitutes drawbacks to the achievement of science and technology objectives in today's technological globalization. As viewed by Fitz (2013) and Idoezu (2018), STEM in its nature is interdisciplinary since it involves other disciplines. Shaughnessy (2013) however, approached STEM through a complementary view that

draw from the individual discipline and described STEM Education as referring to problem-solving techniques that harness from the models and procedures in mathematics and science while amalgamating the collaboration and design approaches of engineering using relevant technology.

Engineering is the branch of science and technology concerned with the design, building and use of engines, machines and structures.The features of the separate disciplines in STEM are in an interconnected manner.Engineering is integrated into science and mathematics teaching in the form of Engineering Design Process (EDP), which is an iterative problem solving process. EDP enhance meaningful learning of science and foster the acquisition of 21st-century skills such as creative, critical thinking, collaborative and communicative skills. These skills are very critical for employment in the labour market.From the foregoing explication, it is evident that STEM education has relevance in fostering national development. Salman andAdeniyi (2012), Amao (2002), Salman (2005), Adeyegbe (2008) and Opeyinka andKehinde (2017). The world is rapidly developing technologically and of which mathematics is a required instrument because without mathematics there is no science and without science there is no technology and without technology there is no modern society.

Relevance of STEM Education in the 21st-Century.

Mathematics is the core of science and technology, engineering inclusive. According to Charles, Ogan, Ekwueme and Agomuo (2017), every nation needs technology to develop its economic, human, material and natural resources. They posited that, if mathematics education is faulty, the basis for both scientific and technological development becomes faulty. A massive boost to national development is seen in the way mathematical concepts have facilitated the revolution in electronics which has changed the way we think and live. Information and Communication Technology (ICT) has changed the world into a global village. This advance in science and technology which has helped to sustain the development of our nations has been made possible through the application of mathematical concepts. Mathematics education ensures that the knowledge of the subject gained is applied to all areas of life, such as business, economics, finance, engineering, farming, sports, sciences, and arts and ensures that everybody excels in his/her area of specialization. Chado and Bala (2014) Mathematics education has effectively been an agent of sustainable development and self-reliance. Mathematics is an effective tool for developing life-long skills which makes an individual self-reliant. Ogunkunle (2014) posited that mathematics is filled with unending skills and confidence that working with mathematics concepts will improve one's practice daily, which gives support and encouragement. Notable among these skills are communication, manipulative ability, estimation ability, computation and problem – solving skills. It pre-supposes therefore that an individual with the aforementioned skills will be able to build a good inter-personal relationship which enhances unity and builds the nation. In the words of Abakpa andAgbo-Egwu (2014), mathematics education has the potential of developing life-long skills in an individual that will enable him to add significantly to the development of the society in which he lives. In the same vein, Momoh and Yusuf (2012) and Charles – Ogan et al (2017) stated that mathematics has been recognized as a tool for solving every day's challenges faced by individuals and ensures national stability. Branches of mathematics such as college algebra, trigonometry and statistics underscore the importance of truth and honesty and analytical thinking that can tackle the problem of bribery and corruption. That is why the need for promoting the subject and building students' proficiency is urgent if we must ensure a better future for the nation and the next generation that will inherit it.

Mathematics is an important part of Nigerian education curriculum (FRN, 2013), due to its significance in national development, the Federal Government of Nigeria made the subject compulsory from primary through secondary schools, and students are required to pass it as part of the minimum requirement for further education, this is because of its importance and the dynamic role played by the subject in modern – day society, this is affirmed by Bassey (2010) and Ogan (2014). Mathematics also plays an important role in practical work and observation of nature as main source of scientific discoveries. Scientific discovery depends on critical thinking that is Charles – Ogan et al (2017) defined mathematics as a way of thinking about and organizing one's experience. Adeniran andOdebode (2017), mathematics is a skill developer. Seen as such, critical thinking develops skills, and skills build up viable economy. Mathematics therefore provides the vital underpinning of the knowledge of economy. It is essential in the physical sciences, technology, business, financial services and many areas of ICT. Mathematics forms the basis of most scientific and industrial research and development. Mathematics has been successfully used in the development of science and technology in 20th and 21st century. The areas like advanced semi-conductor devices, bio-technology, digital image technology, Nan-technology, artificial satellites, and rockets are all based on mathematical concepts. Mathematics enhances career development; it also enhances security. The knowledge of science, technology, engineering and mathematics combine together lends to economic and national development. The knowledge is used to harness the forces of nature and to transform the raw resources with which nature endows man into goods and services for better quality of life. The knowledge, skills and competences in STEM affects people's lifestyles. It affects the way people eat, drink, travel, work, lead, play and sleep. It also carries alone with environmental implications such as pollution (Olaitan, 2007).Science, technology and mathematical knowledge are related to life in the community. Everyone in the society sees, hears, touches or uses various objects in the course of a single day. Such objects include soap, tooth paste, broom, knife, safety razors, hot water, mobile phones, cars, buses, train and objects in the offices, factories, homes, schools, restaurants and theatres in addition to all these, one is likely to touch and use such devices designed to save physical labour, as tractors, those designed to help in communication, entertainment, transportation, high – speed computers and medicines. All these and many more are called products of technology (Awachie, 2001). Goods and services are products and processes of STEM. Advance in STEM is central to any nation's ability to manufacture better and qualitative products, improve health care services, develop cleaner and more efficient domestic energy sources, preserve the environment, safeguard national security and grow the economy. Studies have shown that many national leaders have acknowledged the significance of STEM (Ideozu, 2018). For instance, former President of the United States of America, George Bush hurled the American Competitiveness Initiative, whose aim was to improve STEM education and in turn grew the number of working scientists. According to Izeodu (2018), advanced economics need a continuous training of scientists and engineers who are critical in driving the innovations. The innovations, in turn have a crucial role in the growth of the Gross Domestic product (GDP) of countries. Former President Barrack Obama also frequently acknowledged the significance of STEM and also, initiated the "Educate to Innovate" campaign in support of the STEM education. Many studies agree that only innovation compelled development has the perspective to generate value –added jobs and industries (OECD, 2010 in Ideozu, 2018). Nevertheless, innovation is mostly as a result of advances in the STEM disciplines, and as a result, there has been a rise in employment at all levels requiring STEM skills, which triggered research on the subject and the impacts of STEM education on economic growth.

STEM education produces scientifically, technologically and mathematically literate citizens. It also promotes all round development of basic skills and the effective use of these skills in the development of the individual and the society.

Conclusion

The paper examined the role of Science, Technology, Engineering and Mathematics education as a tool in national development. From the discourse, it can be seen that:

(i) Life-long skills in individuals that can enable them to add significantly to the development of the society are inherent in the learning of mathematics;

(ii) The application of mathematical concepts has helped in advancing science, technology and engineering, thus sustaining the development of our nation;

(iii) The more the number of individuals having STEM education, the more the worth of theindividuals and the level of development of the society and the result is overall nationaldevelopment.

It is therefore concluded that with sound STEM education in this 21st century can be achieved. For education to achieve all ends, it has to be carefully planned, the plan must take into consideration the needs of the society, the political, socio- cultural, economic, military, scientific and technological realities of the environment are very important to its development.

Recommendations

1. There is need to improve on the quality of Science, technology, engineering and mathematics teaching in schools so that learners can gain knowledge, skills and competencies needed for the gradual but lasting national development.
2. The Government should avail the general populace with sound STEM education, for in that; national development can be achieved.

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Integrated STEM Education: The Nexus for Sustainable Development

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Abstract
Many initiatives have indicated the critical role of Science Technology Engineering and Mathematics (STEM) in the process of reaching a sustainable future. In an effort to make STEM education an active contributing factor in achieving sustainable development, this study is focused on the integration of stem education as a focal point for sustainable development, this paper recognizes the fact that Science, Technology, Engineering and Mathematics (STEM) Education is an enabler of national development. It examines the role of STEM Education as a tool in national development. As quality Science, Technology, Engineering, and Mathematics (STEM) education is vital for the future achievement of students. Integrated STEM education is one way to make learning more connected and relevant for students. This paper discusses STEM education, integrated STEM education and role of STEM education in sustainable development. It was concluded that the more individuals having STEM education, the more the level development of the society it then recommended that there is need for government to improve the quality of stem teaching in schools.

Keywords: STEM, STEM integration education, sustainable development

Introduction
The 21st century is characterized by advancement in science and technology. For Nigeria to realize accelerated development in the 21st century, it needs qualitative science education in schools especially in senior secondary schools. Over the last two decades, there have been repeated calls for reforms and innovations aimed at improving Science Education in Nigeria. This suggests that there are issues in science Education in Nigeria that needs to be improved upon (Ewansiha&Omorogbe, 2013). 21st century system of education is very challenging since teachers are required to teach the students to solve STEM problems in various fields of Science, Technology, Engineering and Mathematics (STEM). The problem education is facing is mainly one of productivity and efficiency. Here, efficiency means the balance between resources invested and the outcomes in terms of students' performance and equity.

In considering the requirements for twenty-first century learning, (claxton, 2007) identifies the need for a greater and different student learning capacity. He calls for an 'epistemic culture change' in schools to replace stand-alone courses in thinking skills or 'tricks of the trade' type learning. According to him, "these approaches are exploring ways in which schools as a whole, and its classrooms in particular, can become settings in which the various constitute elements of learning capacity are acknowledged, discussed, understood and systematically strengthened" Aspects of this epistemic culture will include the ways teachers and learners work together, the range of activities and methods they will engage in, the ways students can transfer thinking and how teachers can role model the attributes, dispositions, and demeanours appropriate for successful participation in future milieux.

The aims of education in secondary school should ensure that students should have knowledge and skills to be successful in college and in the workplace (O'Sullivan & Dallas, 2010). Rich (2010) explained that 21st-century learning means that students master content while producing, synthesizing, and evaluating information from a wide variety of subjects and sources with an understanding of and respect for diverse cultures. Students should not only demonstrate the three Rs, but also demonstrate the three Cs: creativity, communication, and collaboration. They should demonstrate digital literacy as well as civic responsibility. Virtual tools and open-source software create borderless learning territories for students of all ages, anytime and anywhere. Classroom learning experiences therefore need to be designed to develop students' competencies in term of collaborative, problem solving, self-control, critical thinking, and ICT skills. These learning experiences should empower students as individual and citizens as an agent of change who are responsible and creative.

Nations invest in innovation to promote sustainable economic growth. While many countries are suffering from the effects of global economic difficulties, such as rising unemployment and soaring public debt, the role of labor input is decreasing in the 21st century economy. Only innovation-driven growth has the potential to create value-added jobs and industries (Organisation for Economic Co- operation and Development [OECD], 2010a). Because it is largely derived from advances in the science, technology, engineering, and mathematics (STEM) disciplines (National Academy of Sciences, National Academy of Engineering, & Institute of Medicine, 2011), therefore an increasing number of jobs at all levels require STEM knowledge (Lacey & wright, 2009). As a result, nations need an innovative STEM workforce to be competitive in the 21st century.

The important contribution of STEM as an enabler for sustainable national economic growth was affirmed at the World Summit on Sustainable Development (WSSD) in 2002. According to David, Dallatu& Yusuf (2018), it is in this regard that in the framework of the New Partnership for Africa's Development (NEPAD), recognized that Science and Technology will play a major role in the economic transformation and sustainable development of any nation.

STEM education is used in research, policy issues, teaching for innovation, problem-solving and prospects. STEM is needed towards globalization demands. The complexity of today's world requires all people to be engaged with new set of core knowledge and skills, to solve difficult problems like novel the Coronavirus pandemic, gather and evaluate evidence and make sense of information they receive from varied print and digital media. It is therefore clear that the learning and doing of STEM help to develop skills and prepare students as potential and workforce where success results not just from what one knows but what one is able to do with the knowledge. STEM had been the critical instruments used to uplift not only standard of living but the economy of any nation (Wasagu, 2019).

African countries with STEM knowledge could rise above over-dependence on developed countries technological prowess. Presently, countries in the world are classified as; developed, developing and less / under developed. The difference between the developed, developing and under-developed countries however rests on the ability of the developed countries to convert scientific ideas to usable technology while the developing and under-developed countries are yet to do so effectively (Sambo, Udofiak, & Okoko, 2018).

Many educational research studies have indicated that students' interest and motivation toward Science, Technology, Engineering and Mathematics (STEM) learning has declined especially in Western countries. Concern for improving STEM education in many countries continues to grow as demand for STEM skills to meet economic challenges increasingly becomes acute (English 2016; Marginson et al. 2013; NAE and NRC 2014). Many education systems and policy makers around the globe are preoccupied with advancing competencies in STEM domains and and as a result, engaged in some education reforms. However, the views on the nature and development of proficiencies in STEM education are diverse and increased focus on integration raises new concerns and needs for further research. Recent reforms in USA (such as Next Generation Science Standards1) advocate for purposefully integrating STEM by providing deeper connections among the STEM domains. Such an approach raises issues such as competing agendas between disciplines, lack of coherent effort, locating and teaching intersections for STEM integration mainly because STEM subjects often are taught disconnected from the arts, creativity, and design (Hoachlander and Yanofsky 2011).

STEM Education

STEM education includes the knowledge, skills and beliefs that are collaboratively constructed at the intersection of more than one STEM subject area. It is described as a STEM related individual subject, a learning package offering learning pathway for STEM elective subjects and as an integrated STEM approach (Ministry of Education, 2016). The description of STEM education as discrete STEM subjects and learning package have a long standing in the previous and current curriculums. The definition of STEM education as an integrated approach that blends the STEM content, skills and values in solving contextual problem seems to agree with that in many of the literature (eg. Jolly, 2017; Kelley & Knowles, 2016; Kennedy & Odell, 2014; Kim, Chu, & Lim, 2015; Truesdell, 2014; Vasquez, 2014; Xie, Fang, &Shauman, 2015).

This STEM perspective integrates the disciplines of Science, Technology, Engineering and Mathematics for the purpose of solving everyday science-related problems. Roehrig, Moore, Wang and Park (2012) proposed integrating the four disciplines to gain a deeper understanding of science, broaden understanding of science by relating it to technology and engineering, and develop students' interest in STEM-related professions. Teaching using a STEM perspective is a strategy aimed at improving the academic achievement of learners, as well as introducing them to skills that are important for future jobs.

For example learning in any STEM subject area, particularly Chemistry, is a cumulative process. Students' pre- existing beliefs influence how they learn new scientific knowledge and how it plays an essential role in scientific learning (Takbir, 2012). According to (Nweze, (2015), a country cannot have a strong scientific and technological enterprise without a strong foundation in chemical education.

STEM Integration

Stem integration involves the introduction of stem related activities into the school curriculum. Moore et al. (2014) defined integrated STEM education as "an effort to combine some or all of the four disciplines of science, technology, engineering, and mathematics into one class, unit, or lesson that is based on connections between the subjects and real- world problems". Integrated STEM curriculum models can contain STEM content learning objectives primarily focused on one

subject, but contexts can come from other STEM subjects. Integrated STEM education could be defined as the approach to teaching the STEM content of two or more STEM domains, bound by STEM practices within an authentic context for the purpose of connecting these subjects to enhance student learning.

Quality Science, Technology, Engineering, and Mathematics (STEM) education is vital for the future success of students. Integrated STEM education is one way to make learning more connected and relevant for students. The STEM model is a good starting point for teachers as they implement and improve integrated STEM education.

The research on teaching integrated mathematics and science provides a good basis for teaching integrated STEM education. Successful integration of science and mathematics depends largely on teachers' understanding of the subject matter (Pang & Good, 2000). Many teachers have shortcomings in their own subject content knowledge (Stinson et al., 2009) and asking math and science teachers to teach another subject may create new knowledge gaps and challenges (Stinson et al., 2009). What is known from research on effective practices in science and mathematics education provides insight into effective practices in STEM integration.

Zemelman, Daniels & Hyde (2005) list ten best practices for teaching math and science:
(1) Use manipulatives and hands-on learning; (2) Cooperative learning; (3) Discussion and inquiry; (4) Questioning and conjectures; (5) Use justification of thinking; (6) Writing for reflection and problem solving; (7) Use a problem solving approach; (8) Integrate technology; (9) Teacher as a facilitator; (10) Use assessment as a part of instruction.

Two important features in Science Technology Engineering Mathematics (STEM) education are integration and solving real world problems. Despite the efforts to promote STEM education awareness and interest among students and teachers, documented studies on how to explicitly integrate the existing STEM subjects' curriculum standards in solving real world problems are limited.

Therefore, educators here may subscribe to one of the given descriptions in implementing STEM education. Nevertheless, many teachers may not be familiar with integrated STEM as an approach in teaching and learning. So, guidelines and some resources are provided in order to assist educators to implement integrated STEM as an approach in classroom teaching and learning. In the Implementation Guidelines for STEM Education in Teaching and Learning by the Ministry of Education (Ministry of Education, 2016), there are general guidelines and a few teaching plan examples to assist teachers to carry out integrated STEM education during class or co-curricular activities. Further description and application of STEM education as an approach is found in the recent STEM resource modules for Physics, Chemistry, Biology, Additional Mathematics, Computer Science and Design and Invention (Rekacipta) respectively (Curriculum Development Division, 2017e, 2017d, 2017f, 2017b, 2017a, 2017c). The degree of STEM content and skills integration in each subject varies depending on the issues or problems posed for each topic. These resource modules are among some of the initial resources available for the teachers at the time of writing. They are targeted for the upper secondary school students who are in the pure science and technical classes which may not meet the needs of other students especially those in the lower secondary level. More teaching and learning materials on integrated STEM education have to be

developed for all levels of students. The design of the series also aimed to serve as a model for teachers to develop their own STEM education material for other topics in the future. Hence, teachers can plan, develop and implement their own integrated STEM lessons or programs that suit the context of their own students.

Sanders (2009) described integrated STEM education as "approaches that explore teaching and learning between/among any two or more of the STEM subject areas, and/or between a STEM subject and one or more other school subjects" (p. 21). Sanders suggests that outcomes for learning at least one of the other STEM subjects should be purposely designed in a course—such as a math or science learning outcome in a technology or engineering class (Sanders 2009). Moore et al. (2014) defined integrated STEM education as "an effort to combine some or all of the four disciplines of science, technology, engineering, and mathematics into one class, unit, or lesson that is based on connections between the subjects and real-world problems" (p. 38).

One of the biggest educational challenges for secondary school education is that few general guidelines or models exist for teachers to follow regarding how to teach using or applying STEM integration approaches in their classroom. Furthermore, research into teachers' current integrated STEM teaching practices can inform STEM education stakeholders and assist in identifying barriers as well as determining best practices.

Need for integrated STEM

In recent years, the importance of providing students with a strong education in Science, Technology, Engineering and Mathematics (STEM) has been stressed. Qualified STEM professionals are needed to remain economically competitive in the global market and to fill contemporary demands such as ensuring sufficient and sustainable energy, efficient healthcare and well-considered technology development (Bøe et al., 2011). Moreover, all citizens, even non-STEM professionals, should have the skills and competences necessary to deal with the challenges of our information-based and highly technological society (National Society of Professional Engineers, 2013). STEM-literacy, that is, the awareness of the nature of science, technology, engineering, and mathematics and the familiarity with some of the fundamental concepts from each discipline, should be an educational priority for all students (Bybee, 2010; National Academy of Engineering and National Research Council, 2014). A promising approach in this regard, is the use of an integrated STEM curriculum, which provides opportunities for 'more relevant, less fragmented, and more stimulating experiences for learners' (Furner and Kumar, 2007, p.186). Real-world problems are not fragmented in isolated disciplines as they are taught in schools and to solve these problems people need skills that cut across the disciplines (Beane, 1995; Czerniak et al., 1999). Studies in a broad range of disciplines have shown that students involved in an integrated curriculum perform as well or even better than their peers in traditional instruction with separate disciplines (Czerniak et al., 1999; Hinde, 2005). Moreover, the use of an integrated curriculum has been found to improve students' non-cognitive learning outcomes, such as interest in STEM (Mustafa et al., 2016; Riskowski et al., 2009) and motivation towards STEM learning (Wang et al., 2011), which in turn could lead to increasing numbers of STEM graduates (National Academy of Engineering and National Research Council, 2014).

Engaging students in active educational programs focused on fostering STEM competencies is vital for students' future employment prospects (Bunshaft et al., 2015; Crawley, Malmqvist,

Östlund, & Brodeur, 2007; Jang, 2016). Ferrini-Mundy (2013) was more specific and noted, more hands-on, authentic STEM activities should be provided at the secondary level.

How STEM can be implemented in the classroom

Instruction is the direction of the process in teaching and learning. Among the success factors in education innovation are teachers. Previous empirical studies showed that teacher's STEM instruction have impacted on student identity development (Slavit, Nelson, &Lesseig, 2016), achievement (Henry et al., 2014) and interest (Price, 2010).

Hence, in STEM instruction, teachers need to able to break the boundaries of Science, Technology, Engineering and Mathematics and incorporate it into the lesson. There are many approach in implement STEM in teaching and learning session. In Malaysia Secondary School Standard Curriculum, there are three approach that have been emphasized in implementing STEM, i.e.: inquiry learning, problem based learning and project based learning (Curriculum Development Division, 2016b).

According to (buturlina, 2021) the main stages for implementing stem education are:

Primary Education which is carried out in preschool education institutions, primary schools, where students are engaged in primary scientific and technical creativity. The main task is to stimulate curiosity and support interest in learning, knowledge, motivation for independent research, creating simple devices, structures;

basic education which is carried out in the general secondary and out-of-school education in order to form steady interest to natural and mathematical subjects, involve in research, invention, project activity, promote such professions as an engineer, a scientist, a researcher;

Field-Specific Education is carried out on the basis of field-specific senior school of comprehensive secondary and out-of-school education institutions. The main task is to promote the conscious choice of further education of the STEM specialization, in-depth mastering of the system of knowledge and skills in STEM subjects, mastering of research methods;

Professional / Higher Education ensures forming STEM specialists; it is carried out on the basis of vocational / higher education institutions and through improving teachers' professional skills to implement new learning technologies, including STEM courses; implementation and realization of STEM projects.

STEM Education and Sustainable Development

Sustainable development is a continuous search for improving our daily life as well as a country, so that we benefit both today and, in the future, while minimizing the negative effects exerted by humans on the environment. This requires active and creative citizens who can successfully prevent problems and cooperation issues and who are ready to combine theoretical knowledge with innovations and practical ideas. The approach on teaching and learning should focus on students, encouraging them to form and develop their own ideas and values hence this approach is supported through STEM education which emphasizes on the application of knowledge to real-world problems that tends to underpin on critical thinking, problem-solving, and creativity, which is important for any national development. STEM education integrated into the school curriculum

where teachers consider students' as being an important and active factor in the learning and acquiring knowledge process.

Badejo (2005) noted that sustainable development can only be meaningful when most of the inhabitants of a country have rudimentary knowledge of Science, Technology, Engineering and Mathematics (STEM).

The importance of Science, Technology, Engineering and Mathematics (STEM) education for the attainment of sustainable development in Africa cannot be over emphasized. STEM education is fundamental to the strengthening of higher levels of education, capacity building and self-reliant development. The strategic and inimitable role of STEM education towards the development of the world is beyond doubt (Okoro, 2013). STEM education contributes to general educational development and practice. It has become a stimulating elixir, the necessary catalyst, which has engendered the spirit of sustainable development worldwide. However, the role of STEM education for achieving sustainable development for Africa is so self-evident that any country that fails to pay due credence to the development of a veritable STEM-based education at the grass root can only do so to her peril. Fafunwa (1972) observed that, "we are living in a world where science and technology have become an integral part of the world's culture and any country that overlooks this significant truism does so at its own peril". therefore, science education is a worthy platform to prepare African youths for the challenges ahead, in a highly technological world. To Akpan (2008), "the international competitiveness today is increasingly being defined in terms of ability to access, learn, adapt, utilize and innovate from available technology". This means that nations that fail to innovate lose their competitive position. Explicitly, a sound and veritable STEM based oriented education at the grass root holds the key to the answer.

Role of sustainable development can be summarized as follows

Chapter 36 of Agenda 21, adopted at the 1992 Earth Summit in Rio, identifies four major thrust of Education for Sustainable Development (Ilechukwu et al, 2014). They include:

- Promoting and improvement of basic education
- Reorienting existing education at all levels to address sustainable development.
- Develop public understanding and Awareness of sustainability
- Training

Therefore, the role of education in sustainable development can be summarized as follows:

1. Education is here regarded as an instrument of social change which could transform the society in significant ways. Education is paramount when trying to enable a change in values and attitudes towards sustainability. The report of UN's World Commission on Environment and Development (WCED) (1987) recognized that "sustainable development requires changes in values and attitudes towards environment and development" and that education plays a central role in achieving those changes in values and attitudes (Sims & Falkenberg, 2013). Education for Sustainable Development (ESD) is one of the most important tools for raising awareness about the environmental issues within a sustainable development context.

2. Education for sustainable development involves learning how to make decisions that considers the long term future of the economy, ecology and equity of all communities. UNESCO argues that education has a special responsibility to generate the knowledge needed as well as communicate

this knowledge to decision makers and the public at large. (UNESCO, 2001, 2003). As a result, the body calls on all relevant stakeholders to review the programmes and curricula of schools and universities, in order to better address the challenges and opportunities of sustainable development. Therefore, contemporary sustainable development education is expected to orient on future development, ensuring proper quality of present and future life.

3. A strong STEM education system provides the essential underpinning of an innovative and scientifically literate culture which develops the capabilities for individuals to function effectively within a science and technology based society.

4. STEM Education helps students' solve the global challenges of our generation. Engagement with science, technology, engineering, mathematics, and computer science in addition to languages, the arts or social-emotional learning should be an integral part of future-oriented education to which every child and every young person has a right.

5. It supports independent thinking and responsible action, as well as the reflective engagement with technological and societal changes for the benefit of sustainable development3

Conclusion

This paper examined the role of Science, Technology, Engineering and Mathematics education as a tool in national development. From the discourse, it can be seen that:

(i) The application of mathematical concepts has helped in advancing science, technology and engineering, thus sustaining the development of our nation;

(ii) The more the number of individuals having STEM education, the more the worth of the individuals and the level of development of the society and the result is overall national development. It is therefore concluded that with sound STEM education, national development can be achieved. For education to achieve all ends, it has to be carefully planned, the plan must take into consideration the needs of the society, the political, socio- cultural, economic, military, scientific and technological realities of the environment are very important to its development.

Recommendation

1. There is need to improve on the quality of Science, technology, engineering and mathematics teaching in schools so that learners can gain knowledge, skills and competencies needed for the gradual but lasting national development.
2. The Government should avail the general populace with sound STEM education, for in that; national development can be achieved.
4. Following the encouraging efforts made so far by curriculum development experts, governments are called upon to increase the present level of funding of these agents so that more innovations in STEM education may be enhanced.

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SUB-THEME: ICT in STEM and TVET

Performance Evaluation of Integrating ICT in Teaching and Learning: Imperative to Biology Instruction in Secondary School in Kano State

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Abstract
Integrating Information and Communication Technology (ICTs) in the school system is abysmal. Information and communication technology (ICTs) plays a significant role in students' academic performance. The application and effect of Information and Communication Technology (ICT) is considered to be a topic of interest in different areas of real life mostly in education and specifically in teaching and learning of biology. Educators can now use ICT as a tool that allows modifying the instructional approach in the classroom in order to get better students' performance. Learning institutions are adopting ICT based instructional approach and presenting ICT oriented academic programs. Integration of Information, Communication, and Technology (ICT) will assist teachers to the global requirement to replace traditional teaching methods with a technology-based teaching and learning tools and facilities. The results indicated that ICT integration in teaching and learning has a great effectiveness for both teachers and the students. Findings indicate that teachers' well-equipped preparation with ICT tools and facilities is one of the main factors in success of technology-based teaching and learning. It is recommended that biology teachers should be integrating ICTs facilities during biology instruction.

Keywords: Biology Instruction, ICTs Integration, Performance Evaluation

Introduction

Researches indicate that with the emergence and expansion of ICT in education, the most basic changes in terms of quality teaching and learning have been achieved with regards to teachers' performance and classroom interactions. ICT, as an industrial revolution, has brought about a new era of Information and Communications followed by information society, where ICT is among its main elements**.** Modern global achievements which have rendered in immense development and dynamism in the area of global education is the expansion of ICT which accounts for all-out efforts by humans while optimally using of the elements of time, place and facilities within the learning and teaching process. Looking into instructional and educational processes, particularly learning-teaching process, there are gross differences as regards the quality of information transference in the light of modern technologies, which it is impossible to neglect it from the standing of teaching and learning, whether using ICT for an instructor from a complementary facet relating to teaching methods and easing the transference of concepts or for utilizing it for expanding and developing personal and professional skills (Mostafa, 2017).

Information and Communication Technology (ICT) is the application of computers to retrieve, transmit and manipulate data, in education or other systems. One of the most vital contributions of

ICT in education is easy access to learning and teaching process (Idris, 2016; Sharma, Gandhar, & Sharma, 2009). ICT is an umbrella concept that include any communication device, encompassing: radio, television, cellular phones, computer and network hardware and software, satellite systems as well as the various and application associated them, such as video conferencing and learning. ICT are often used in education, healthcare, libraries, security etc. The positive effect of ICT on learning, education and libraries has been highlighted (Falobi, 2014; Ubulom& KAYII, 2016). There is widespread belief that ICT increase quality of education, and transforming teaching and learning processes from being highly teacher dominated to student-centered, and this transformation will result in increased learning for students, creating and allowing for opportunities for learners to develop their creativity, problem-solving abilities, informational reasoning skills and communication skills (Khan et al., 2015). ICTs are generally accepted as a modern tool that enables the teachers to modify the teaching methods to increase students' learning and achievements. From general perspective, ICT covers any product that store, retrieve, manipulate, transmit or receive information electronically in a digital format. It consists of hardware, software, social networks, media, processing, and presentation of information (Mbaeze, Ukwandu, &Anudu, 2010). ICT stands for Information and communication technology. It refers to those technologies which are helpful for the user to access the essential information through communication technologies (Onyije&Opara, 2014). The emphasis of ICT is basically on communication tools and resources which are same as information technology abbreviated with IT. These technological resources and tools are Smart Phones, Laptop, Personal Computer, Television, Internet, Tablet, iPad, Software Program Wi-Fi and Many Other Sources (Talukder, et al., 2015). The integration of information and communication technologies can help teachers and students toward educational planning and development (Manichander, 2016). According to Bourne (2017), the evolution in technology and the role it plays in the society across the globe is increasing with the passage of each day and it becomes important part of learning kit for every student. Thus, educational organization required to implement information and technology-based teaching learning methods in education and launch programs that focus on improving technological practices for professionals associated with education (Ullah, et al., 2019). The increasing emphasis of scholars on the implementation and use of information communication technology in the field of education have been evident. The advancement in information technologies shows high impact on students' competence of acquiring information, resources and material related to their academic tasks. Researcher claimed that technological tools are best source for demonstration of concept and changes education system from teacher centered to student centered (Watson and Watson, 2011). According to Toro and Joshi (2012), new innovations in technologies make visible changes in teaching learning process and sizeable improvement in the education system.

ICT Integration in Teaching and Learning

Information, communication, and technology (ICT) integration in education refer to incorporating computer-based communication into the regular classroom instructional process. Teachers are seen as critical players in using ICT in their regular classes and training students for the new digital age (Richard, 2021). This is because of ICT's ability to create a dynamic and proactive teaching-learning environment (Arnseth andHatlevik, 2012).Various researches conducted on ICT integration in education have proved that integrating ICT in teaching and learning improves the quality of learning and performance of learners. Moreover, ICT integration simplifies abstract and complex concepts, creates cooperative learning, and creates interest in learning among students.

In essence, integration of ICT creates a learner centered learning environment (Belay, et al,. 2020).Intent to practice ICT denotes to the tendency of a person to use and carry on usage of ICT. Learners' intent to utilize ICT is a contributing factor of technology inclusion and use in education (Al-Rahmi.et, al 2019). A learner's motivation towards use of ICT is simply reflects his intentions for his better learning results and outcomes. The usage of ICT for academic attainment is a main aspect of growing mean of technology use in education (Teo& Zhou, 2014). Educational organizations are embracing the means of teaching which contains ICT and its contribution into related educational packages (Talukder, et al., 2015). Information and communication technology make it easy for the learners to interconnect with one another. It offers knowledge and opportunity to learn. ICT certifies the formation, provision, expansion and creation of a skillful community thus such types of community lead to all round development of state (Hashmi andAzhar, 2018). The adoption of ICT in Teaching the Students in Secondary School had significant impact on the performance of the students. ICT is a teaching approach that are characterized by being tailored to student's needs, which ultimately arouse students interest and engagement in learning activities and improving their performance. If ICT is effectively used in secondary schools, it will improve learning and performance of the students (Foluke, 2017).

ICT Integration and students' Academic Performance

The students' academic performance refers to the enhancement of the students' current state of knowledge and skills reflected in their Grade Point Average (GPA) and also in the formulation of their personality and academic growth from lower levels of study to higher levels. The rationale of studying academic performance in the context of ICT adoption is to present a significant relationship that exists between integration of ICT facilities in teaching and learning and students' academic achievement (Basri, et al., 2018).Study conducted by Foluke (2017) on Analysis of the Impact of ICT on the Performance of Students in Secondary School, Oyo State. It is concluded that ICT has positive significant impact on performance of Students in Secondary School in Oyo state.Ishaq, et al., (2021) study on Effect of Information Communication Technology (ICT) On Students' Motivation and Their Academic Achievement at University Level. The result implies that excessive use of ICT in education increase the performance of the students.The findings of The study by Makgati and Awolusi (2019) on Influence of Information Communication Technology (ICT) Integration on Teaching and Learning in South African Schools shows a e positive influence of ICT integration in teaching and learning practices in the classroom for both teachers and learners. The result of correlation from a study conducted by Seifu, (2021) on Determinants of information and communication technology integration in teaching-learning process at Aksum University indicated that ICT integration had positive relationship with students' academic performance. The effective ICT use integrated with teaching and learning practice add interest, encouragement and motivation among the students that helped the students to process information in a better way and increases their understanding and expands their memory. The results of the undergoing research, it was established that ICT had a significant and positive impact on students' academic performance. Study conducted by Lin, et al. (2017) on Effects of Digital Learning on Learning Motivation and Learning Outcome. The research results conclude that ICTs adoption in learning presents better positive effects on learning motivation and better positive effects on learning outcome than traditional teaching method does. On the contrary, it was also found that Information Communication Technology has no significant impact on academic achievement of students. These results are consistent with Talukder, Alam and Apu (2016)

Barriers to ICT Integration in Teaching and Learning

Use of information and technology in education is one way through which learner achievement can be enhanced (Beetham and Sharpe, 2013). In line with changes in the society, the 21st century economy requires school graduates to be well conversant with modern electronic knowledge, embracing computer technology and other forms of media so as to remain competitive in the global employment market. This indicates that learners without literacy in computer technology are at risk of being left out of global employment opportunity. Learning institutions therefore have opportunity to improve performance skills and enter into the service sector economy by adopting use of computer technology. This will ensure that learners have the skills required for the ever increasingly competitive labour market (Mwanda, et al., 2017). It was unfortunate, literature examined indicated that despite effectiveness of adoption and utilization of ICTs during instruction, studies shows' non integration of ICTs by teachers when teaching and learning.Akubuilo, (2021) study on Availability and Utilization of Information and Communication Technology (ICT) Facilities in Teaching of Social Studies in Secondary Schools in Enugu State, Nigeria.Result revealed that ICT facilities for teaching Social Studies were not adequately available in urban and rural secondary schools in Enugu State; the available ICT facilities were not adequately utilized. Findings of the study conducted by Onu and Ezhim (2019) on Utilization of ICT Facilities for Enhancing Instructional Delivery of Agricultural Science in Nigerian Secondary Schoolsrevealed that most ICT facilities were not available, and the few available were not utilized because of non-functionality in most secondary schools in the study area. The findings of the study by Nwana, et al., (2017) on Availability and Utilization of ICT Resources in Teaching Computer Education in Secondary Schools in Anambra State, Nigeria revealed that many of the ICT resources needed for the teaching of computer education are not available. It was also revealed that majority of the resources needed for the teaching of computer education are not being used by the teachers. Maisamari, et al., (2018) study on Assessment of Secondary School Teachers' Use of Information and Communication Technology (ICT) in Anyingba Metropolis, Kogi State, Nigeria The findings of the study revealed among others that there is poor teachers' use of ICT to facilitate teaching and learning. Study conducted by Briones, (2018) on Teachers' Competency on the Use of ICT in Teaching Physics in the Junior High School reported the top five most pressing challenges encountered that includes; poor/no internet connection,lackofseminarsand training inICT,lackoftechnicalsupport,lackoftime to plan and prepare lessons using ICT, and unavailability of ICT tools and software.

Need to Integrate and Use ICTs in Teaching and Learning of Biology

Biology is the study of living things. Biologists investigate animals, plants and Microbes in many different ways and on a huge range or scales from molecules and cells to individual organisms 'population and ecosystem (Onyeike, et al., 2017). Biology is a branch of natural science that deals with the study of living organisms, their structures, functions, evolution, distribution and interrelationships. Biology occupies a unique position in the secondary school education curriculum because of its importance as science of lifeBiology at the senior secondary school level can be grouped under such headings as: Cell and Unicellular Organisms, simple multicellular animals, insects, the arthropods, higher animals, reptiles and birds, mammals, flowerless plants, flowering plants, physical processes found in living organisms, respiration, food substances, nutrition of green plants, transport systems, excretion, ecology, genetics, nervous system etc. (Isaac, 2013).Despite the tremendous importance of biology studies shows poor performance in biology among students.The poor performance in biology subject can be attributed to poor or

inappropriate instructional methods due to lack of instructional materials in schools, overcrowded curriculum denying students adequate time to grasp basic principles and concepts learned and as well as over enrolment leading to overcrowded classrooms where teachers cannot provide students with individualized attention.Satyaprakasha and Buhera(2014). The most common methods of teaching science in schools even to this day are lecture and lecture-demonstration method. Both these methods stresses upon naming, memorizing and recalling information. These methods may make the learner to be passive in the learning process. Learning is to effect desirable changes in behavior, in our habits, style of living and adjustment of knowledge, skills etc. Traditional methods may reduce the achievement of students, limit ones' interest to investigate and decline the spirit of inquiry. In such classrooms students are unhappy, disinterested and unsatisfied. They further added that, due to a vast expansion of scientific knowledge and technology a teacher has to equip him/herself with various efficient methods to make his/her classroom interesting and teaching effective. Science educators give special recognition to biology among sciences because of its educational values, its close relation to man as a living organisms, its peculiar field of experimentation and inter relationships with the other sciences (Arokoyu&Chimuanya, 2017). According to Ude (2011) to produce experienced and qualified doctors, biology teachers and all those concerned with the study of animal and plant life, a good foundation in biology is required. The knowledge of biology is highly indispensable for national development and global competitiveness in areas of medicine, agriculture and health and physical and health education, especially sports, and environmental studies among others. It is a subject for the empowerment of the youth with basic knowledge about their body functionality, inter-relationship with other living things and environmental sustainability. It is a subject for the empowerment of the youth with basic knowledge about their body functionality, inter-relationship with other living things and environmental sustainability (Ezeyi, et al.,2016).

Consequently, there is need for a change in methods of instruction to include use of strategies which can increase learner participation in the learning process. Such may include use of computer technology in management and delivery of instructional duties. Studies indicate that use of computer technology improves quality of instruction by increasing learner participation and by assisting teachers in the complex task of managing and supporting instructional programs in schools (McKnight, et al., 2016; Dell, et al., 2016). With computer technology, teachers can bring events of far distance in time and space into the classroom for lesson discussion. Similarly, teachers can keep and retrieve information records, communicate with parents and even carry out assessment of learning with ease and speed using computer technology. Newby, et al., (2011) suggests that when teachers effectively integrate computer into classroom teaching and learning, the speed of the management of students' data, search for information and presentation of learning materials is greatly increases.

Conclusion

ICTsfacilities are one of the major factors for producing the rapid changes in our society. It can change the nature of education and roles of students and teacher in teaching learning process.ICT had impacted students differently; it has led to students' improvement in terms of ICT skills, knowledge and increased student involvement in the learning process. Besides, ICT has managed to transform teaching and to learn in a real-life situation. These are through the pictures and videos that are part of the learning content installed in the software, hence no need to arrange for many field trips. The use of ICT in teaching leads to the student-centered type of learning that considers

different learners needs. ICTs tools allowed learners to learn at their own pace, to refer back to previous documents and provides many practice lessons which relate to the content learned. Equally Integration of ICTs in teaching and learning plays an important role in enhancing students' academic performance notwithstanding challenges teachers are facing towards ICTs facilities integration during instruction.The use of ICT in education is very beneficial to both teachers and students, as they both acquire ICT knowledge and skills, making learning real and enjoyable. ICT tools and software allow students to grasp difficult concepts quickly and complements learning especially for visual learners. Teachers' work is simplified since the learning software meets all learners' needs. For slow learners, also, the software allows students to learn at their own pace. Lesson planning materials and extra learning materials are accessible in the software. Additionally, classroom instruction delivery methods are improved through the use of ICT tools.

Recommendations

Government should provide adequate ICT facilities for secondary schools to aid effectiveinstructional delivery of biology content. School administrators should liaise with philanthropic individuals and non-governmentalorganizations for the procurement and maintenance of ICT facilities.

Seminars and training workshops to empower the teachers with skills needed for usingthe ICT facilities for instructional delivery in the learning process by the schoolmanagement and relevant government authorities.

Individual students should be encouraged to purchase some ICT facilities that are withintheir reach like Laptops for use during classroom instructions and at homeInformation communication technology should be incorporated in daily class activity andencourages the students for searching through technology and appreciate their work.Online courses should be promoted and motivate students to enroll in online learning activities.Students should be encouraged to develop positive attitude toward ICT integration. Curriculum shouldbe restructured that promote ICT in education and students get more advantage throughinformation communication technology.Educational institutions should introduce ICT in such a way that promotes students' academicperformance. It should be strictly use for academic purposes and banned use of irrelevantwebsites.Parents and teachers should be conscious and ensure that their children's use ICT for academicpurpose.

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Technology-Based Learning Platform for Instructions amongPre-service Teachers in Nigerian Colleges of Education: The way forward.

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Abstracts
This paper focuses on technology-based learning (TBL) platformfor instructions among pre-service teachers in Nigerian Colleges of Education.Technology-based learning in the early 21st century is transforming the way people learn at a time when two powerful trends converge. The first trend is the rapid acceleration of technological change and the demand that this change places on education and workforce training during their professional live. It is transforming training and education by providing new technological opportunities to address new learning needs. The paper also summarises the concept and nature of technology-based learning,how TBL addresses a number of challenges,different instructional modes, sectors of application, benefits and challenges of technology-based learning. It was recommended in the paper that National Commission for Colleges of Education (NCCE) and the Colleges of Education stakeholders should provide enabling environment for the pre-service teachers to effectively utilise technology-based learning platforms for learning. Periodic orientations, symposia, conferences, seminars and workshops should be organised for the pre-service teachers so as to keep them up-to-date with the emerging technological trends. Government, Non-governmental organisations (NGOs), National Educational Research Development Agency (NERDA) and other research institutes should fund and encourage more researches in the field of technology integration in education as more gaps are yet to be filled.

Keywords: Technology-Based Learning Platform, Technology Acceptance Model, Instruction, Pre-service Teachers, Colleges of Education.

Introduction

The world is becoming more sophisticated technologically. The industrial age gave way to information age; an info-tech era which is as vital as the water we drink because it has brought positive changes to the society, businesses, and other facets of human life. In fact, the educational sector is not exempted from the benefit of participating in an information rich computer age society. To keep to date with the emerging technological changes at the national, regional and global environments, our present educational system is continuously upgrading its resources through the modernisation of the various elements of the system (Danjuma 2015). Teaching and learning may be influenced by diverse factors, one of which is employing modern technologies to create conducive learning environments. Modern technologies and Information and Communication Technology (ICT) provide extraordinary infrastructure to deliver the knowledge in numerous ways, in different regions with different learners (Mellati & Khademi, 2018). The integration of information and communication technology (ICT) into teaching and learning has been the focus of 21st century education. Specifically, the application of computer technology in classroom environment continues to play a vital role in enhancing teaching and enriching learning (Falode, 2018). Technology integration includes educational software, computers, simulation, and

other resources that enhance learning. One of the potential benefits of modern technology was the advent of Technology-Based Learning (TBL). The importance of technology-based learning (TBL) include; accessibility for all students, learning matched to learners' need, timely update, immediate feedback, captivate learners' attention during learning, maximizes interactivity among students, keep students focused for longer periods of time, encourage critical thinking and creativity, streamlined and effective delivery among others.

Technology-based learning is a type of learning that takes place partially or entirely via electronic technology. This includes online and Web-based education, Intranet sites, audio- and video-conferencing, Internet chat rooms, simulations, electronic gaming, CD-ROMs, and a variety of mobile options (Carruth & Carruth 2013).Ghavifekr and Rosdy(2015) deduced that, technology-based learning (TBL) is the way of learning using the electronic technology such as internet, intranet, audio and video conferencing, webcasts to mention but a few. Technology-based teaching and learning can make many changes in school that requires for proper planning and policy making. Researchers and policymakers must both have the same insight about the future plan. With the development of learning technologies in the late 20th century, education system has changed rapidly. This is due to the capability of technology to provide a proactive, easy access and comprehensive teaching and learning environment. Ejoh, (2020) declares that, in developing countries such as Nigeria, skill development for students requires teaching and learning initiatives to be evaluated to identify a model that will be the best fit for schools.

However, several models have been brought forth to address users' responses to the use of new technologies for learning, one of such is Technology Acceptance Model (TAM). According to Bumin*et al.* (2019), the widespread usage of every new technology necessitates acceptance of the technology and adoption. The TAM proposed by Davis (1989), has two constructs of beliefs that determine attitude to use technology, that is, perceived usefulness (PU) and perceived ease of use (PEOU). Davis (1989) defines perceived usefulness as the prospective user's subjective probability that using a specific application system will enhance his or her job or life performance. Whereas, Perceived ease of use (PEOU) can be defined as the degree to which the prospective user expects the target system to be free of effort. According to TAM, ease of use and perceived usefulness are the most important determinants of actual system use. Hence, the researcher seeks to adopt Technology Acceptance Model (TAM) as a framework to guide the study.

Overview of Technology-Based Learning

Technology-based learning in the early 21st century is transforming the way people learn at a time when two powerful trends converge. The first trend is the rapid acceleration of technological change and the demand that this change places on education and workforce training during their professional live. The education, secondary and tertiary cycles uses more often the technology in the educational processes, on one side. This is very important because it brings a new trend in the educational field and can be applied at all the levels. On the other side, while successful economies have always depended on a skilled and knowledgeable workforce, today's rate of change in production processes and workplace tools requires much more training and retraining of individuals on the job than it did in the past. As more workers become knowledge workers, the demand for frequent retraining and specialisation is further accelerated with each technological shift. Industry has to be able to retrain its workforce much more quickly, and the development cycles of training programs have to be shortened if companies want to stay competitive. Given that

updating workers' skills rapidly and as the need arises is so critical in today's economy, the efficiency with which companies do so can thus be critical in helping them maintain a competitive edge (Gudanescu, 2010).

According to Gudanescu (2010), Technology based learning is the way of learning using the electronic technology such as internet, intranet, audio and video conferencing, webcasts etc. Technology based learning is transforming training and education by providing new technological opportunities to address new learning needs. TBL programs come in different delivery modes and forms. They can include online tools, such as discussion boards and e-mail, and real time events, through videoconferencing and web conferencing. They can be self-paced, and have a varying focus of instruction. Technology-based learning uses a series of delivery methods and hardware and software tools to manage and deliver learning content and manage and track learner progress, as well as learner-to-learner and learner-to-instructor communication.TBL is learning that takes place partially or entirely via electronic technology. This includes online and Web-based education, Intranet sites, audio- and video-conferencing, Internet chat rooms, simulations, electronic gaming, CD-ROMs, and a variety of mobile options (Carruth&Carruth 2013).

TBL, as stated by Gan*et al.* (2014), broadly encompasses interventions that rely on advanced electronic or communication technologies to supplement or replace classroom-based instruction. Over the past decades, the rapid evolution and increasing adoption of TBL has dramatically altered the landscape for workforce training and education. One notable turning point was the introduction of personal computing and the Internet, which allowed for standardisation and increasingly widespread access to training and education. As noted above, a new "generation" of TBL is dramatically altering its reach, adaptability, and the user experience. Due to both the diversity of technologies and breadth of applications, TBL does not have a single definitive characterisation or definition. Rather, it is a continuum of interventions shaped primarily by how integral the technology is to the learning process. TBL models may rely entirely on technology for learning; may balance the use of technology and classroom learning (hybrid or blended models); or may incorporate some lesser use of technology into a predominantly classroom-based setting.

TBL holds considerable potential for addressing challenges associated with workforce training and education. When considering implementation of a TBL resource, it is useful to consider how TBL addresses a number of challenges, including: monitoring and assessing engagement and learning,adapting learning to individual's needs, promoting motivation and interpersonal interaction, using resources cost-effectively, ensuring individuals have the appropriate supports for learning, and assuring that the skills imparted are responsive to business and industry needs.

Monitoring and Assessing Learner Engagement Remotely

The biggest challenge for TBL is related to delivering the quality and effectiveness of instruction and the related challenge of maintaining the necessary level of learner engagement. The literature consistently finds evidence of low learner engagement in TBL. Learner drop-out, low effort, or "social loafing"; cheating; as well as learner isolation are real and common concerns for TBL (Carruth&Carruth 2013). Thus the use of technology may present challenges to, as well as facilitate, learner engagement, and ultimately, the instructional effectiveness of TBL.

Adapting Learning to Individuals' Needs

A related challenge to instructional effectiveness posed by TBL can be the consistency and lack of individualisation. On one hand, prerecording lessons provides a greater level of control over what content is being delivered; thus, a higher level of consistency (and potentially quality and efficiency) exists across multiple instructors involved in the content delivery (McDonald & Smith 2013). However, the uniformity of this content-centric TBL may also raise challenges in delivering material to a diverse group of learners. Whereas a traditional classroom allows for feedback from responsive instructors, content- centric TBL is limited to delivering pre-recorded or programmed material. Not only can these forms of TBL not monitor learner engagement, they also may not be able to monitor and respond to learner questions or their variable levels of comprehension, interest, or needs. On the other hand, technology may also offer the unprecedented opportunity to contextualize and individualise instruction and learning content (Gan*et al.* 2013; Maxwell 2012). In technology environments, each learner can:

i. repeatedly access and reflect upon content they find challenging,
ii. receive content in a variety of formats to fit their needs, including text, audio, and video,
iii. interact with and even create learning material (for example, through discussion forums, Wikis, and other Web 2.0 technologies) and
iv. Receive individualized assistance based on emerging "digital tutors" that are incorporated into some learning systems.

Promoting Interpersonal Interaction

Particularly in asynchronous TBL models, program designers and instructors may find it challenging to incorporate adequate substitutions for learner-to-learner and instructor-to-learner interactions and collaboration (Ke&Kwak 2013; Maxwell 2012). Research suggests this is a crucial part of the learning process, especially for adults (LeNoue*et al.,* 2011). For instructors, it may be more difficult to develop rapport with learners or gauge whether they were able to understand course lectures (Dunham *et al.,* 2011). In some instances, the use of technology may result in learners' feeling isolated, disconnected, and unsupported. However, technology may also increase interpersonal interaction. Blended models may represent useful options because they offer opportunities for synchronous interaction. Alternatively, some TBL programs are incorporating technologies that can themselves facilitate or at least allow for effective communication and interpersonal interaction within both blended and technology-only courses. For example, Web 2.0 technologies, online and video discussion forums, virtual technologies, and other tools can provide a platform to develop and promote interaction and collaborative learning communities (Dunham *et al.* 2011; Ke & Kwak 2013; Maxwell *et al.* 2013; McKay & Izard 2012). Instructors can scaffold or support interactions via asynchronous feedback or synchronous video-conferencing with multiple participants (Dunham *et al.* 2011; Ke &Kwak 2013). In the workplace, Intranet and chat forums can facilitate the distribution of ideas and practices across an organization.

Saving Costs and Resources

The associated time and resource costs are major considerations for adopting and implementing TBL. These costs may be associated with such things as developing content, integrating technology and content, programming, training instructors, and supporting implementation of the necessary technology, personnel, and infrastructure. For the workforce system in particular, Gan*et al.* (2013) finds that one of the biggest barriers to implementing TBL is the cost. This cost become more burdensome the more TBL seeks not just to broadcast and archive content and materials

delivered in traditional classes (e.g., a pre-recorded Webinar that can be accessed asynchronously), but to engage learners more actively. In these instances, instructors often need more time, training, and support to use technology effectively and to keep their learners engaged (Bowen & Ithaka 2012; Maxwell 2012). Related cost concerns are those associated with hosting or accessing content. Technology requires infrastructure (example include, computer labs, broadband access). In the workplace setting, employers may incur additional costs in establishing the technological infrastructure for networking and collaborative workspaces (McKay & Izard 2012). Similarly, the workforce system may bear the costs of adopting and maintaining the infrastructure necessary to support effective TBL.

Strengthening Access and Readiness

Another set of issues is related to effectively supporting the technological access and readiness of learners. While online technologies have made basic education and training more accessible to adults, a "digital divide" mitigates this access for many people. The "digital divide" most commonly refers to a difference in access to technology (that is, those who have it and those who do not) (Gungor&Prins 2011). However, it can also refer to a difference in accessibility or the difference in technological "literacy" between those who use technology regularly ("digital natives") and those who do not ("digital immigrants") (Bynner*et al.* 2010). This issue exists for both learners and instructors. The impact of learners' technological access and readiness is relevant to all forms of TBL. The impact of instructors' access and readiness is slightly less pervasive, but impacts any TBL that requires personal interaction between the TBL and the learner. Using TBL effectively may require not just technology support, but also instructors effectively using and interacting with the TBL product or curriculum so they can guide learners through the materials and complement the TBL. Learners and instructors with low technological literacy and comfort levels often become frustrated trying to use the technology or when they encounter technical difficulties (Sitzmann*et al.* 2010). Instructors, as well as learners, frequently feel challenged without adequate training or support. To deal with these issues, some programs provide initial training support (such as orientations, assistants, courses) to familiarize instructors and learners with the technology or to impart effective technology based pedagogical practices to the instructors (Dunham *et al.* 2011; Maxwell *et al.* 2013). For learners with learning and physical disabilities, TBL programs offer a variety of assistive technology options. For example, programs may provide screen readers and closed captions for online videos (Betts, *et al.* 2013). Screen readers, such as iPhones' Voice-Over or Android 4.0's Talk-Back, are used by individuals who are blind or have learning disabilities (for instance, dyslexia, dysgraphia, attention deficit disorder) (Betts, *et al.* 2013).

While these challenges are faced by traditional forms of instruction as well, they are uniquely complex when learners are remotely located, face-to-face interaction may be limited, and a critical threshold of "technological literacy" is needed to thrive. While TBL may present a number of unique challenges (like the possibility of learner isolation), it also affords unique remedies (24/7 access to personalized content). Ultimately, TBL is multifaceted and evolving, with strengths and weaknesses that vary by learning population, context, and content.

Modes of Technology-Based Learning

The followings are some of the modes of Technology-based learning which include;

Computer-based training (CBT)
Computer-based training (CBT) refers to self-paced learning activities delivered on a computer or handheld device such as a tablet or Smartphone. CBT initially delivered content via CD-ROM, and typically presented content linearly, much like reading an online book or manual. For this reason, CBT is often used to teach static processes, such as using software or completing mathematical equations. Computer-based training is conceptually similar to web-based training (WBT), which is delivered via Internet using a web browser.

Flipped classroom
This is an instructional strategy in which computer-assisted teaching is integrated with classroom instruction. Students are given basic essential instruction, such as lectures, before class instead of during class. Instructional content is delivered outside of the classroom, often online. The out-of-class delivery includes streaming video, reading materials, online chats, and other resources (Hall & DuFrene, 2016).

Computers, tablets and mobile devices
Computers and tablets enable learners and educators to access websites as well as applications. Many mobile devices support m-learning (Kolpashnikova & Bartolic, 2019). Mobile devices such as clickers and Smartphone can be used for interactive audience response feedback (Tremblay, 2010).

Virtual classroom
A virtual learning environment (VLE), also known as a learning platform, simulates a virtual classroom or meetings by simultaneously mixing several communication technologies. Web conferencing software enables students and instructors to communicate with each other via webcam, microphone, and real-time chatting in a group setting. Participants can raise hands, answer polls, or take tests. Students can whiteboard and screen cast when given rights by the instructor, who sets permission levels for text notes, microphone rights, and mouse control (Farwell, 2013).

Augmented Reality
Augmented reality (AR) provides students and teachers with the opportunity to create layers of digital information, including both virtual world and real-world elements, to interact within real-time.AR technology plays an important role in the future of the classroom where human / Artificial Intelligence co-orchestration takes place seamlessly (Sharples, 2013). Students would switch between individual and collaborative learning dynamically, based on their own learning pace, while teachers, with the help of AR, monitor the classroom and provide necessary interventions in cases where computer systems are not yet designed to handle. In this vision, the technology's role is to enhance, rather than replace, human teachers' capabilities.

Learning Management System
A learning management system (LMS) is software used for delivering, tracking, and managing training and education. It tracks data about attendance, time on task, and student progress. Educators can post announcements, grade assignments, check on course activity, and participate in class discussions. Students can submit their work, read and respond to discussion questions, and take quizzes (Courts & Tucker, 2012).

Computer Assisted Instruction

Sharma (2017) defines Computer Assisted Instruction as an interactive instructional technique whereby a computer is used to present the instructional material and monitor the learning that takes place.

Sectors of application of Technology-based learning

Education: At different educational levels technology is used as a component of blended learning programs meant to improve traditional curriculum by providing authentic learning experiences. Instructors often implement blended learning to teach students to use technology as well as to help them apply the technology to develop math, science, and reading skills. Researchers have found that Technology based learning components promote active learning and ownership of the learning experience for students. This is because the Internet provides students with the immediate opportunity to research topics they are studying in class and build on information they acquire from traditional classroom instruction.

Post-Secondary Education: Technology-based learning has provided the students with opportunities to access the best programs offered by a variety of educational institutions and offer working adults more access to education and professional specialization through distance learning. The use of technology based learning in post-secondary institutions is continuously growing. Other delivery systems include networks and affiliations of colleges that join together to offer learners the best of each institution's courses. Students work with their own college degree or certificate program and receive credit for courses they complete through other institutions belonging to the network or affiliation. Another growing trend in delivery systems is the public-private technology-based learning partnerships. Certainly, post-secondary institutions in the world have fostered significant innovation in technology-based learning strategies, with one of the most common being the online university.

Economy: Private corporations have made great efforts to capitalize on the benefits of technology-based learning. The web and computer-based models are especially valuable to companies in competitive markets and those with a large and widely dispersed employee base. More and more private companies realize the importance of investing in a quality workforce while maximizing profits through cost-effective technology-based learning programs. Although overall training budgets fell considerably in 2009 due to the global economic crisis, many companies are choosing to spend money on e-learning due to the efficiency of the solutions offered. Employees take advantage of these opportunities through integrated on-the-job training as well as off-site professional development programs.

Public sector: Government at state and local level has turned its attention to technology-based learning as a cost-effective strategy to provide training and professional development for the workforce; up-to-date, on-demand training for military personnel and other government workers. Current issues of importance to governments in every country include funding for accessibility, intellectual property, and the standardization of management systems throughout learning environments. Reports from these bodies point to technology based learning, is related to the capacity to produce a stronger, better qualified workforce if advances are made in these areas (Gudanescu, 2010).

Benefits of Technology-based learning

There are numerous advantages to technology based learning in comparison to face-to-face learning. Some of the primary benefits, as itemized by Gudanescu (2010) are the following:

i. Accessibility for learners who intend to follow any type of courses,
ii. Learning matched to learners' need,
iii. Scalability: well-designed technology based training programs can also accommodate larger volumes of customers at little extra cost.
iv. Timely Update;
v. Streamlined and Effective Learning Delivery.

Challenges

The introduction of technology based learning at all educational levels is not without challenges. They include:

i. Digital Divide: The digital divide directly affects technology based learning implementation since a significant portion of the population still does not have access to computers or to the Internet. Internet use is lowest for low income people, those who are over 50 years old, the unemployed, and individuals who have never attended college.
ii. Social Loafing: technology based learning is also more likely to produce "social loafing," in which learners reduce their level of effort when they perceive that doing so will not have negative social effects.
iii. Accommodation for Individuals with Disabilities: Access to technology based learning courses for individuals with disabilities can also pose a challenge. While technology based learning generally offers access options for those disabilities, accommodations must be made in order for technology based learning to be accessible.
iv. Compatibility: Another challenge for technology based learning is the need for compatible technology.
v. Development Costs: Another disadvantage of technology-based learning is high upfront development costs, which can require significant programs, because they spent so many hours developing the materials and so few students enrolled in the course.
vi. Lack of Credibility: Lastly, technology based learning degree programs still lack the level of credibility of traditional degree programs (Gudanescu, 2010).

Conclusion

In conclusion, the very first stage of technology integration must be effective to make sure that, pre-service teachers are able to make the best use of it. Thus, preparations of a technology-based learning begin with proper implementation and supports by the school management. If the implementation process of technology integration in schools take place appropriately from the very early stage and the continuous maintenance are adequately provided, it will result in a huge success and benefits for the pre-service teachers. The use of technology in teaching and learning is more about practicality as compared to theories and that is why teachers must be given time to learn and explore it, face the "trial-and error" phase before they are completely comfortable with its usage and able to make use of it for teaching and learning. Technology based learning components promote active learning and ownership of the learning experience for students. This is because the Internet provides students with the immediate opportunity to research topics they are studying in class and build on information they acquire from traditional classroom instruction. It has provided

the students with opportunities to access the best programs offered by a variety of educational institutions.

Recommendations

National Commission for Colleges of Education (NCCE) and the Colleges of Education stakeholders should provide enabling environment for the pre-service teachers to effectively utilize technology-based learning platforms for learning. Periodic orientations, symposia, conferences, seminars and workshops should be organized for the pre-service teachers so as to keep them up-to-date with the emerging technological trends. Government, Non-governmental organizations (NGOs), National Educational Research Development Agency (NERDA) and other research institutes should fund and encourage more researches in the field of technology integration in education as more gaps are yet to be filled.

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Information and Communication Technology Skills Needed by Teachers for Effective Teaching of Motor Vehicle Mechanic in Technical Colleges in Kaduna State.

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Abstract
The paper identified the information and communication technology skills needed by motor vehicles mechanic teachers for effective teaching in technical colleges in Kaduna State. Two research questions were raised to guide the study and two hypotheses were formulated and tested at .5 level of significant. Descriptive survey research design was used for this study. The study was carried out in Kaduna State, Nigeria. The population of the study consisted of 27 respondents comprising of all the 18 technical college administrators and 9 MVMW teachers in the six technical colleges in Kaduna State, Nigeria. No sampling technique was employed in the selection of the respondents. The instrument used for data collection was a structured questionnaire. The instrument was content validated by three technical education experts. Cronbach Alpha statistical technique was used to determine the reliability of the instrument and yielded 0.88 and 0.89 coefficients. The study employed the use of mean to answer the research questions and Z-test statistics to test the null hypotheses. Finding revealed that, abilities to use: word processing to develop teaching materials, database management to manage teaching materials, spread sheet skills to compute students' scores, electronic presentation in teaching, internet to source for teaching materials, virtual teaching technologies, electronic record keeping software and multimedia in teaching were found to be the ICT skills needed by motor vehicles mechanic teachers for effective teaching in technical colleges in Kaduna State, Nigeria. The study recommended among others that, Kaduna State Science and Technical Schools Board should be organizing short courses, workshops, symposium and conferences to equip MVMW teacher with the needed ICT skills for enhancing teaching.

Key Words: Information and Communication Technology Skills, Teaching, Motor Vehicle Mechanic Works Teachers

Introduction
Technical college is a formal institution where work-related education at aimed at providing skills, knowledge and attitude required for employment in an occupation is provided. According to Abdulkadir (2011), technical college education is meant for the: provision of full time courses in the areas of technology, applied science and commerce relevant to the needs of the development of Nigeria. The importance of technical colleges in the socio-economic development of Nigeria cannot be over emphasized. According to Federal Republic of Nigeria (FRN) (2004), the aim of technical colleges is to produce craftsmen with saleable skills, knowledge and attitude necessary for effective employment in various disciplines that include Motor Vehicle Mechanics Work.

Motor Vehicle Mechanics Work (MVMW) is a trade course obtainable in technical colleges in Nigeria. According to the National Board for Technical Education (NBTE, 2001), the goal of MVMW course is to produce skilled craftsmen capable of carrying out troubleshooting maintenance of vehicles. Unfortunately, the academic achievement of students in MVMW is not

encouraging and cannot guarantee the production of skilled craftsmen. Adewumi (2019) noted that, low academic achievement of students in school subject is attributed to several factor among which is the quality of teaching by teacher, including MVMW teacher.

The MVMW teacher could be seen as a professional person in the classroom situation who is highly knowledgeable in the subject matter saddled with the responsibility of realizing the goal of the course. Umunadi (2009) stated that, technical teachers (including MVMW teachers) must have the capacity to prepare students by equipping them with the skills required to succeed in the world of work. Adewumi (2019) disclosed that, equipping students with skills is not only determined by the plan and the development of education but by the quality of curriculum contents implementation which depends on teachers' skills. The lack of skills among teachers could be partly responsible for the low academic achievement of MVMW students in technical colleges. In order to ensure the realization of the objectives of MVMW course, teachers need to equip themselves with the teaching and learning practices relevant to 21st century developments and needs. Ekong (2008) rightly confirmed that, the willingness, enthusiasm and ability of technical teachers (including MVMW teachers) to actively implement curriculum contents are often conditioned by many factors which include the lack of skills Information and Communication Technology.

Information and Communication Technology (ICT) is a terminology that refers to the technologies used for collecting, storing, editing and communicating information in various formats. It involves the use of computers and other electronic devices to process information. Aduwa and Iyamu (2019) noted that, ICT play important role in education as it is considered as the viable tool for teacher (including MVMW teachers) in the effective implementation of curriculum contents. Brown (2009) confirmed that, despite the importance of ICT in the achievement of various educational objectives, technical college teacher (including MVMW teachers) lack sufficient ICT skills.

ICT skills are set of abilities in the utilization of computer applications such as office suite, web browser and data based systems among others to achieve certain task. According to Light (2017), these skills include word processing, spreadsheet, database management, electronic presentation, internet navigation, email management, networking and touch typing skills. Okorafor and Nnajiofor (2019) noted that, lack of ICT skills among technical college teacher (including MVMW teachers) hinder the achievement of the goal of MVMW. In order to address this shortcoming, there is need to identify the ICT skills needed by MVMW teachers for enhancing effective teaching in technical colleges. Thus, identifying these skills could be achieved through the services of technical college administrators.

The technical college administrators are persons saddled with the professional responsibility of piloting the general affairs of technical colleges. They include, the principal and vice principal administrative, and academic. According to Kai *et al.* (2019). The major responsibility of technical college administrators is to ensure the supervision of teaching and learning processes. The supervision of teaching and learning processes reveals to the administrator the strength and weakness of teachers. Hence, this implied that, technical college administrators could be useful in identifying the ICT skills needed for enhancing teaching among motor vehicle mechanic works teachers in technical colleges in Kaduna State, Nigeria. The goal of MVMW course is to produce skilled craftsmen capable of carrying out troubleshooting maintenance of vehicles. Unfortunately,

the academic achievement of students in MVMW is not encouraging and cannot guarantee the production of skilled craftsmen. Adewumi (2019) noted that, low academic achievement of students in school subject is attributed to several factor among which is the quality of teaching by teachers. Teachers' lack of skills could be partly responsible for the low academic achievement of MVMW students in technical colleges. Okorafor and Nnajiofor (2019) noted that, lack of ICT skills among technical college teacher (including MVMW teachers) hinder the achievement of the goal of MVMW. Thus, there is need to identify the ICT skills by motor vehicles mechanic teachers for effective teaching in technical colleges in Kaduna State, Nigeria.

Aim and Objectives of the Study

the study aimed at identifying the ICT skills needed by motor vehicles mechanic teachers for effective teaching in technical colleges in Kaduna State, Nigeria. Specifically, the objectives of the study sought to identify:

1. The ICT skills needed for enhancing teaching among MVMW teachers in technical colleges in Kaduna State, Nigeria
2. The strategies for equipping MVMW teachers with the needed ICT skills for enhancing teaching in technical colleges in Kaduna State, Nigeria

Research Questions

The following research questions were raised and answered:

1. What are the ICT skills needed for enhancing teaching among MVMW teachers in technical colleges in Kaduna State, Nigeria?
2. What are the strategies for equipping MVMW teachers with the needed ICT skills for enhancing teaching in technical colleges in Kaduna State, Nigeria?

Hypotheses

The following null hypotheses were formulated to guide the study:

HO_1: There is no significant difference between the mean responses of administrators and MVMW teachers on the ICT skills needed for enhancing teaching in technical colleges in Kaduna State, Nigeria

HO_2: There is no significant difference between the mean responses of administrators and MVMW teachers on the strategies for equipping teachers with the needed ICT skills for enhancing teaching in technical colleges in Kaduna State, Nigeria

Methodology

Descriptive survey research design was used for this study. The study was carried out in 6 technical colleges in Kaduna State, Nigeria. The population of the study consisted of 27 respondents comprising of all the 18 technical college administrators and 9 MVMW teachers in the six technical colleges in Kaduna State, Nigeria. Due to the manageable size of the population, all the 27 respondents were used for the study. Hence, no sampling technique was employed in the selection of the respondents. The instrument used for data collection was a structured questionnaire developed by the researcher and designed on five-point Likert's scale with responses: Strongly Agree (SA), Agree (A), Disagree (DA), Strongly Disagree (SD) and Undecided (UD) with numerical values of 5, 4, 3, 2, and 1, respectively. The instrument contained two sections, A and B. The Section A comprises of ICT skills needed for enhancing teaching among MVMW teachers in technical colleges in Kaduna State, Nigeria while the section B comprises of strategies for equipping MVMW teachers with the needed ICT skills for enhancing teaching in technical

colleges in Kaduna State, Nigeria. The instrument was content validated by three technical education experts, two from Federal University of Technology, Minna and one from Vocational Enterprises Institute, Karshi, Abuja. Cronbach Alpha statistical technique was used to determine the reliability of the instrument and yielded 0.88 and 0.89 coefficients for the two sections. The study employed the use of mean to answer the research questions and Z-test statistics to test the null hypotheses. Z-test statistics was used because, it is the most suitable technique for testing hypothesis between two group with population above thirty (n >30) (Uzoagulu, 2011). Decision on research questions was based on real limit of numbers and decision on the hypotheses was based on comparing Z-value with P-value.

Results:

Research Question 1

What are the ICT skills needed for enhancing teaching among MVMW teachers in technical colleges in Kaduna State, Nigeria?

Table 1: Mean of respondents on the ICT skills needed for enhancing teaching among MVMW teachers in technical colleges in Kaduna State, Nigeria

S/N	Items	$\bar{X}_1$	$\bar{X}_2$	$\bar{X}_A$	Remark
1	Ability to use word processing to develop teaching materials	3.59	3.61	3.60	Agreed
2	Ability to use spreadsheet skills to compute students' scores	3.60	3.60	3.60	Agreed
3	Ability to use database management to manage teaching materials	3.76	3.78	3.77	Agreed
4	Ability to use electronic presentation in teaching	3.57	3.57	3.57	Agreed
5	Ability to use internet to source for teaching materials	3.65	3.63	3.64	Agreed
6	Ability to use virtual teaching technologies	3.84	3.84	3.84	Agreed
7	Ability to use electronic record keeping software	3.65	3.64	3.65	Agreed
8	Ability to use multimedia in teaching	3.66	3.69	3.68	Agreed
	Grand Mean	**3.67**	**3.67**	**3.66**	**Agreed**

Key: $\bar{X}_1$ = mean of administrators, $\bar{X}_2$ = mean of teachers and $\bar{X}_A$ = average mean of administrators and teachers.

Table 1 revealed that all the eight items had average mean value above 3.49 and below 4.50. This indicate that, the respondents were of the opinion that all the eight items are the ICT skills needed for enhancing teaching among MVMW teachers in technical colleges in Kaduna State, Nigeria.

Research Question 2

What are the strategies for equipping MVMW teachers with the needed ICT skills for enhancing teaching in technical colleges in Kaduna State, Nigeria?

Table 2: Mean of respondents on the strategies for equipping MVMW teachers with the needed ICT skills for enhancing teaching in technical colleges in Kaduna State, Nigeria

S/N	Items	$\bar{X}_1$	$\bar{X}_2$	$\bar{X}_A$	Remark
1	Organizing mentorship programme by technical college administrators	3.64	3.60	3.62	Agreed
2	Organizing focus group discussion by technical college administrators	3.89	3.76	3.83	Agreed
3	Organizing short courses by Science and Technical Schools Board	3.53	3.57	3.55	Agreed
4	Organizing workshop by Science and Technical Schools Board	3.52	3.65	3.59	Agreed
5	Organizing Symposium by Science and Technical Schools Board	3.86	3.84	3.85	Agreed
6	Organizing conferences by Science and Technical Schools Board	3.59	3.65	3.62	Agreed
	Grand Mean	**3.67**	**3.68**	**3.68**	**Agreed**

Table 2 revealed that all the six items had average mean value above 3.49 and below 4.50. This indicate that, the respondents were of the opinion that all the six items are the strategies for equipping MVMW teachers with the needed ICT skills for enhancing teaching in technical colleges in Kaduna State, Nigeria**.**

Hypotheses One

There is no significant difference between the mean responses of administrators and MVMW teachers on the ICT skills needed for enhancing teaching in technical colleges in Kaduna State, Nigeria

Table 3: Z-test analysis for the test of significant difference between the mean responses of administrators and MVMW teachers on the ICT skills needed for enhancing teaching in technical colleges in Kaduna State, Nigeria

Respondents	N	$\bar{x}$	SD	df	z-value	p-value	Remark	Decision
Administrators	18	3.67	0.87	30	0.07	0.93	Not Significant	accepted
MVMW Teachers	9	3.67	0.79					

Table 3 revealed that the p-value > 0.5, which implied that there is no significant difference between the mean responses of administrators and MVMW teachers on the ICT skills needed for enhancing teaching in technical colleges in Kaduna State, Nigeria. Hence, hypothesis one was accepted**.**

Hypotheses Two

There is no significant difference between the mean responses of administrators and MVMW teachers on the strategies for equipping teachers with the needed ICT skills for enhancing teaching in technical colleges in Kaduna State, Nigeria

Table 4: Z-test analysis for the test of significant difference between the mean responses of administrators and MVMW teachers on the strategies for equipping teachers with the needed ICT skills for enhancing teaching in technical colleges in Kaduna State, Nigeria

Respondents	N	$\bar{x}$	SD	df	z-value	p-value	Remark	Decision
Administrators	18	3.67	0.82	30	0.05	0.76	Not Significant	Accepted
MVMW Teachers	9	3.68	0.78					

Table 4 revealed that the p-value > 0.5, which implies that there is no significant difference between the mean responses of administrators and MVMW teachers on the strategies for equipping teachers with the needed ICT skills for enhancing teaching in technical colleges in Kaduna State, Nigeria. Hence, hypothesis two was accepted.

Discussion of Findings

Findings on the ICT skills needed for enhancing teaching among MVMW teachers in technical colleges in Kaduna State, Nigeria revealed abilities to use: word processing to develop teaching materials, database management to manage teaching materials, spread sheet skills to compute students' scores, electronic presentation in teaching, internet to source for teaching materials, virtual teaching technologies, electronic record keeping software and multimedia in teaching. The finding is in harmony with Yusuf (2019) who revealed that, abilities to use electronic presentation, internet navigation, word processing and spreadsheet are the requisite ICT skills for enhancing teaching. This implied that, for effective teaching among MVMW teachers in technical colleges in Kaduna State, these ICT skills are required.

Nevertheless, findings on the test for significant difference between the mean responses of administrators and MVMW teachers on the ICT skills needed for enhancing teaching in technical colleges in Kaduna State, Nigeria revealed not statistical significant. The finding is related to the finding of Obi and Akarahu (2017) that revealed no statistical significant difference between the responses of teachers and lecturers on the Information and communication skills required by teachers of business education for effective teaching of marketing in colleges of education in south east, Nigeria. This implied that, both administrators and MVMW teachers shared similar opinion regarding ICT skills needed for enhancing teaching in technical colleges in Kaduna State.

Findings strategies for equipping MVMW teachers with the needed ICT skills for enhancing teaching in technical colleges in Kaduna State, Nigeria revealed organizing mentorship programme and focus group discussion by technical college administrators, and short courses, workshops, symposium and conferences by Science and Technical Schools Board. The finding is in harmony with the finding of Chukwuedo and Igbinedion (2014) that revealed short courses, regular training workshop, and symposium as capacity building strategies for empowering technical college teachers with ICT skills. This clearly indicated that, the identified strategies have the potentials to serve as avenue for equipping MVMW teachers with the needed ICT skills for enhancing teaching in technical colleges in Kaduna State, Nigeria.

Furthermore, findings on the test for significant difference between the mean responses of administrators and MVMW teachers on the strategies for equipping teachers with the needed ICT skills for enhancing teaching in technical colleges in Kaduna State, Nigeria revealed not statistical

significant. The finding is related to the finding of Ifeanyieze and Osinem (2015) that revealed no statistical significant difference between the responses of male and female teachers on the 21st century skills needs for sustainable development. This implied, both administrators and MVMW teachers shared similar opinion regarding the strategies for equipping teachers with the needed ICT skills for enhancing teaching in technical colleges in Kaduna State, Nigeria

Conclusions

Based on the findings that emerged from the study, it is concluded that abilities to use: word processing to develop teaching materials, database management to manage teaching materials, spread sheet skills to compute students' scores, electronic presentation in teaching, internet to source for teaching materials, virtual teaching technologies, electronic record keeping software and multimedia in teaching were the ICT skills needed for enhancing teaching among MVMW teachers in technical colleges in Kaduna State, Nigeria. This implies that, if MVMW teachers are equipped with these ICT skills, it will enhance teaching of MVMW in technical colleges in Kaduna State, Nigeria.

Recommendations

Based on the findings from the study, the following recommendations were drawn:

16. Technical college administrators should be organizing mentorship programme and focus group discussion to equip MVMW teachers with the needed ICT skills for enhancing teaching.
17. Kaduna State Science and Technical Schools Board should be organizing short courses, workshops, symposium and conferences to equip MVMW teacher with the needed ICT skills for enhancing teaching.

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Accessibility, Availability and Attitude towards E-Learning Resources for Teaching Electrical Installation and Maintenance among Student of Technical College in Kaduna State, Nigeria

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Abstract
Electrical installation and maintenance which is expected to be an interesting practical science subject is posing a great threat to many students nowadays. This is commiserating with the attitude of the students, lack of commitment and laxity of teachers in their quality of teaching and availability of E-learning resources to help students in solving academic problems is affecting the students. The paper aimed to assess the Accessibility, Availability and Attitude of Students towards E-learning resources for teaching Electrical Installation and Maintenance in Technical colleges of Kaduna State. The study adopts a descriptive survey in other to document current condition that exists at the moment. The data collected for the study was analyzed using simple frequencies, mean and standard deviation. The findings shows that websites have the mean value of 1.73 with the standard deviation of 0.85 which signifies it's highly available among the identify E-learning resources and Full text databases has the mean value of 3.01 with the standard deviation of 0.83 which signifies not available in technical colleges in Kaduna State as investigated by the respondents. The findings further show students attitudes towards the use of E-learning resources, it was discovered that "I believe using e-learning will improve the quality of my work" with the lowest mean value of 1.93 and standard deviation (0.88) is strongly agreed by the respondents. The study concluded that e-learning facilities are moderately available in the study area but it can be seen from the findings that e-learning facilities that will improve the academic performance of students and bridge the gap that exist between theories and practical are not effectively available. Thereby recommends that authority should give priority in the provision of e-learning facilities through collaboration for effective teaching and learning to take place.

Keywords: Electrical Installation and Maintenance, Accessibility, Availability, Attitudes and E-learning

Introduction
Technology is a major part of students' lives and their academic training requires an introduction to scholarly uses of technology (Salavati, 2013). Technology offers tremendous promise for student learning and has ignited the imagination of those who are interested in bringing about revolutionary gains in the achievement of all students (Skolverket, 2016). Yet, the use of technology in vocational education also raises a whole host of challenges, including those related to cost-effectiveness, teacher professional development, assessment, equity, and safety. Despite the challenges of utilizing technologies in education and teaching, the importance of the adoption and use of digital technologies in school education should not be underestimated. Technology constitutes a strong and powerful influencing force on how education is to be carried out and what is expected of the future generation (Salavati, 2016).

E-learning means a lot of different things and it is understood differently by players with very different roles. Heterick, (2015) describes E-learning "as an umbrella term describing any type of learning that depends on or is enhanced by electronic communication using the latest information and communication technologies (ICT)".The trend of using E-learning as learning and teaching tool is now rapidly expanding into education (Lau and Woods, 2015). E-learning covers a wide set of ICTs Technology-based applications and processes, including computer-based learning, web-based learning, virtual classrooms, and digital collaboration and networking (Heterick, 2015).

Electrical Installation and Maintenance Works Programme is one of the TVE programmes which, according to the curriculum of the programme (National Board for Technical Education, NBTE, 2013) provides training that leads to the production of skilled personnel like craftsmen and technicians who could either secure employment at the end of thetraining, set up their own businesses or further their studies in Polytechnics, Colleges of Education (Technical) and Universities. The curriculum of the Electrical Installation and Maintenance Works programme covers a period of three years. In the course of the programme, students are expected to use a variety of tools and equipment, culminating in the following behavioural objectives:

1. Demonstrate various experiments involving resistors, capacitors and inductors (Series/parallel connection)
2. Undertake both domestic and industrial installation;
3. Install electrical machines;
4. Prepare and join electrical cables;
5. Install/connect batteries for charging systems;
6. Use tools to dismantle, recoil and recouple an electrical machine (generator or motor) and
7. Undertake tests on installations and machines using appropriate tools (NBTE, 2013).

All the above skills require the use of e-learning resources for practical demonstration. That is why the Nigeria National Policy on Education (FGN, 2014) specifies that the approach to instruction is both class teaching and practical work. Practical teaching, according to Omosewo (2017) develops in students, appreciation of the spirit and methods of problem solving. Andural and Ikyumen (2016) added that today a lot emphasis is being placed on practical teaching which prepares recipients for various occupations. That is why the National Board for Technical Education (NBTE, 2013) Standards and Criteria for Accrediting Programmes in Technical Colleges, recognizing the importance of practical teaching, recommended that the class size for workshop practical work shall be 15 – 20 students and the teacher-student ratio shall be kept at 1:20.

These are not commiserating with the attitude of the students, lack of commitment and laxity of lecturers in their quality of teaching and availability of E-learning resources to help students in solving academic problems is affecting the students. Existing research on the use of E-learning resources reveal that E-learning improves students' achievements and performance (Johnson, 2015). Therefore, this paper investigates the accessibility, availability and attitude of students towards E-learning resources for teaching electrical installation and maintenance in technical colleges in Kaduna State.

E-learning is defined as a system based on technology, organization, and management which bestows upon students the ability to learn via internet and facilitates their learning (Levy, 2016). E-learning makes use of telecommunications technology to get information to achieve the teaching and learning objectives (Bowles, 2016). Also Wanting *et al.* (2018) define E-learning as acquisition of the

disseminated knowledge using electronic devices. it can be said that e-learning refers to the use of systems of electronic education such as computer, internet, multimedia disks, electronic magazines, virtual newscasts, and so on whose purposes are to reduce time and expenses and achieve better, faster, and easier learning (Zare*et al.,* 2015). Employment of information and communication technologies in education has created a new mode of learning which does not require physical attendance; hence, learning has been made possible in environments other than classrooms (Gholamhosseini, 2016).

According to Sinha *et al.* (2016) e-resources can be defined as those resources which contain documents in electronic format that can be retrieved via the internet in a library environment. In other words, e-resources are those electronic artefacts that provide a collection of documents, be it text, image and other multimedia artefacts like statistical, graphical mode which are available for library and information centres. These may be delivered on CD-ROM over internet. The availability of e-resources helps students to find e-journals, e-books, e-magazines, e-database, e-subject guide, e-newsletters, e-white paper, e-audio, e-exhibitions, e-conferences and web search tools on a range of topics or disciplines.

The advent of e-resources has cut the obstacle of valuable information difficult by students in the developing countries. In the same vein, Issa *et al.* (2016) emphasized on the popularity of e-resources, flexible in searching rather than the paper based and they can access in a remote area or in an academic library. Similarly, Ojedokun and Okafor, (2015) described the academic library as: A collection of full text and bibliographic information source which joins human services (such as electronic publishing, personal management and distance information use) and information technology tools (such as those to support browsing, authorizing and communication. Therefore, the academic libraries have a physical space ICT facility of different types used for production, storage and dissemination of information.

Several studies have been conducted on the availability of E-learning resources in higher institution of learning, research centres and organization. Reitz (2014) asserted that they are resources consisting of data and/or computer programs encoded for reading, learning and manipulation by a computer connected to the internet. Similarly, Appleton (2016) described E-learning resources as those kinds of documents in digital format which are made available to users through computer-based information retrieval systems. The category includes electronic texts, bibliographic databases, e-newspapers/magazine, e-books, and e-journals theses/dissertations collections and so on. There are online electronic resources available free of charge and some are fee based that requires licensing and authentication before users can access it.

Ahiauzu (2016) defined e-learning resources as a collection of electronic journals, books and other study materials available through the computer and the internet. Some can be accessed free of charge, while others are subscribed to by universities or organizations before users can have access to these resources online. Hundies (2015) said that most of this information in the databases are accessible free of charge while some are fee-based. Libraries need to pay subscription fees in order to have access to these resources. But there are large numbers of databases that can be searched for at no cost an example of this is the Directory of Open Access Journal and many others. Some universities in developing nations, foundations and international organizations provide free access to e-learning resources to higher institutions and research centres in developing nations to support teaching, learning and research work. The World Health Organization (WHO) is one of such international agencies that subsidize payment of online databases such as HINARI, AGORA and OARE to research centres, hospitals, non-governmental organizations, colleges, universities and government ministries (Researchlife, 2016).

Technical and vocational education (TVE) aims at equipping individuals with knowledge and skills that will make them functional members of the society. However, John and Adeyemi (2019) argued that in technical/vocational education, skills are not just acquired in a vacuum or without facilities, tools, and equipment. John and Adeyemi (2019) stressed that the tools and equipment and other facilities make up the learning environment, conducive for skill acquisition. Effective use of those facilities, according to them, is of paramount importance. Consequently, available tools and equipment must be functional as to be effectively put to use. The non-functioning of tools and equipment in workshops and laboratories of schools in Nigeria explains why many TVE programmes suffer or waste away (John and Adeyemi, 2019).

Obafemi (2015) attributed this development to lack of proper planning and arrangement of equipment and materials and the mal-functioning of available equipment and machinery, stressing that sometimes even when tools and equipment are available, they are somewhat underutilized. Okwenu (2016) held that the non-use or underutilization of available facilities in our schools is attributable to the teacher, explaining that resource materials in education do not achieve any meaningful values. Their importance depends on what the teacher is able to make of them. Okwenu (2016) stressed that "One of the reasons why available materials are not used by many teachers in schools and colleges is that they lack the necessary skills to operate them." Buttressing this point, Buba (2018) and Aggarwal (2016) argued that the manipulative skill of technical teachers is indispensable in the effective utilization of facilities for implementing programmes in technical/vocational education.

For effective instructional delivery, (Mamman (2017), Aggarwal (2016) and Sampath, Pannelselvan and Santhanam, 2016) are unanimous in their views that technical teachers need to adopt the following methods, among others: selection of facilities in line with behavioural and instructional objectives, presentation in which teachers themselves are familiar with instructional facilities and their use, and physical control in which teachers carefully handle instructional materials such as to guarantee re-use in the next lesson. In fact, instructional facilities have been discovered to be very effective in enhancing students' performance (Alio, 2015; Akpa, 2016). On the other hand, problems relating to availability, adequacy and skills in utilizing workshop and laboratory facilities in our technical schools have led to a decline in students' performances. Most of the schools are unable to meet acceptable standards of performance (Abubakar, 2015; Okoro, 2016). Because there is a close link between students' performances and facilities, the availability, adequacy and level of utilization of facilities for the Electrical Installation and Maintenance Works programme require evaluation as is currently being done in this study.

The research design is descriptive survey; as a result, the study attempts to seek an understanding in other to document current condition that exists at the moment. This study therefore discovering current situations as they relate to the Accessibility, Availability and Attitudes towards E-learning resources for teaching Electrical Installation and Maintenance in Technical Collages of Kaduna State. The data collected for the study were analyzed using mean and standard deviation.

The availability of e-learning resources in Technical Collages was investigated, Table 1 shows the rate at which the E-learning resources are available. It was observed that websites has the mean value of 1.73with the standard deviation of 0.85 which signifies it's highly available followed by Reference databases with mean score of 2.45 and standard deviation of 1.05 which implies that

it's medium available while OPAC with the mean value of2.95 has the standard deviation of 0.91,CD-ROMs with the mean value of 2.97 and standard deviation of 0.77 , E-images with the mean value of 2.77 and standard deviation of 0.97, E- journal with the mean value of 2.55 and standard deviation of 1.07 signifies that they are less available respectively. It was also observed from the table that Institutional Repositories (IRs) has the mean value of 3.11and the standard deviation of 0.99, Full text databases has the mean value of 3.01 with the standard deviation of 0.83 which are not available in colleges of education as investigated by the respondents.

Table 1: Availability of E-learning Resources

ITEMS	N	HA	MA	LA	NA	Mean	Std Deviation	Remarks
OPAC	319	30	51	141	97	2.95	0.91	Less Available
E-journals	319	62	99	77	81	2.55	1.07	Less Available
Search engines	319	19	44	166	90	3.02	0.81	Not Available
Full-text databases	319	22	43	163	91	3.01	0.83	Not Available
Websites	319	161	93	55	10	1.73	0.85	High Available
E-images	319	43	66	129	81	2.77	0.97	Less Available
CD-ROMs	319	19	44	183	73	2.97	0.77	Less Available
Reference databases	319	77	82	99	61	2.45	1.05	Medium Available
Institutional Repositories (IRs)	319	29	55	86	149	3.11	0.99	Not Available

Highly Available (**HA**), Moderately Available (**MA**), Less Available (**LA**), and Not Available (**NA**)

Accessibility of E-learning Resources

The analysis in Table 2 shows the rate at which the E-learning resources are accessible. It was observed that website with the lowest mean value of 1.91 and standard deviation of 0.91 signifies that it's a highly accessible e-learning facilities followed by E-journals with mean value of 2.09 and standard deviation of 0.93 which is a moderately accessible. It was further observed that Search engines with the mean value of2.64 and standard deviation of1.11,Full-text databases with mean value of 2.92 and standard deviation of 0.97, Reference databases mean value of (2.95) and the standard deviation of 0.99 while Institutional Repositories (IRs) with the mean value of (2.69) standard deviation of 1.09 implies that they are Less accessible e-learning resources respectively. The table further shows that OPAC with the mean value of 3.11, standard deviation of (0.93) CD-ROMs with the mean value of 3.21 and standard deviation of 0.93 are non- accessible e-learning facility in the colleges of education.

Table 3: Accessibility of e-learning resources

ITEMS	N	HA	MA	LA	NA	Mean	Std. Deviation	Remarks
OPAC	319	19	67	92	141	3.11	0.93	Not Accessible
E-journals	319	97	123	71	28	2.09	0.93	Moderately Accessible
Search engines	319	59	96	63	101	2.64	1.11	Less Accessible
Full-text databases	319	33	66	111	109	2.92	0.97	Less Accessible
Website	319	131	101	71	16	1.91	0.91	Highly Accessible
E-images	319	21	66	93	139	3.09	0.94	Not Accessible
CD-ROMs	319	19	53	89	158	3.21	0.92	Not Accessible
Reference databases	319	31	73	95	120	2.95	0.99	Less Available
Institutional Repositories (IRs)	319	61	73	88	97	2.69	1.09	Less Available

Highly Accessible (**HA**), Moderately Accessible (**MA**), Less Accessible (**LA**), and Not Accessible (**NA**)

Students attitude towards E-learning resources

Based on the analysis in the table above it was observed that "I believe using e-learning will improve the quality of my work" with the lowest mean value of 1.93 and standard deviation (0.88) is strongly agreed by the respondents, it was also observed that those who find it interesting working with computers has the mean value of 2.07 and standard deviation of 0.92, I like reading magazines on new technology innovations having the mean value of 2.05 and standard deviation of (0.86), Communicating through social network is fun has the mean value of 1.99 and the standard deviation of 0.84, I believe using e-learning technologies will improve my learning ability with the mean value of 2.03 and the standard deviation of 1.06, those who prefer reading articles online has the mean value of 2.23 and the standard deviation of 1.13 which were Agreed upon respectively. The table further shows that E-learning increases learners' social isolation with the mean value of 2.17 and the standard deviation of 1.01 followed by I believe e-learning is very economical for educational institution to adopt has the mean value of 2.15 and the standard deviation of 1.04 were disagreed upon respectively. It was also observed that "I feel comfortable reading a textbook on a computer screen than a physical text book" with the mean value of 3.05 and standard deviation of 1.18, Interaction with the computer system is often frustrating with the mean value of 3.22 and standard deviation of 0.85 were strongly disagreed respectively.

Table 4: Students attitude towards E-learning resources, k9e
Strongly Agree (**SA**), Agree (**A**), Disagree (**D**), and Strongly Disagree (**SD**)

ITEMS	N	SA	A	D	SD	Mean	Std. Deviation	Remarks
I believe using e-learning will improve the quality of my work	319	121	112	71	15	1.93	0.88	Strongly Agree
I prefer reading articles online	319	109	93	51	66	2.23	1.13	Agree
I feel uncomfortable reading a text book on a computer screen than a physical text book	319	33	53	98	135	3.05	1.88	Strongly disagree
Interaction with the computer system is often frustrating	319	19	32	125	143	3.22	0.85	Strongly disagree
I believe using e-learning technologies will improve my learning ability	319	123	113	31	52	2.03	1.06	Agree
Communicating through social networks is fun	319	93	159	44	23	1.99	0.84	Agree
I like reading magazines on new technology innovations	319	91	141	66	21	2.05	0.86	Agree
E-learning increases learners' social isolation	319	89	131	52	47	2.17	1.08	Disagree
I believe e-learning is very economical for educational institutions to adopt	319	101	121	45	52	2.15	1.04	Disagree
I find it interesting working with computers	319	96	131	63	29	2.07	0.92	Agree

The results show that students believe using e-learning will improve the quality of my work" with the lowest mean value of 1.93 and standard deviation (0.88). This assertion concurs with Ajzen (2001) as well as Ajzen and Fishbein (2005) that familiarity can lead to positive feelings and when such positive feelings are activated; their effect would be expected to influence an attitude, which, in turn, has an impact on actions. The assertion is also in line with the theory of the *mere exposure effect*, which holds that exposing an individual repeatedly to a particular stimulus enhances the individual's attitude towards the stimulus (Burgess & Sales, 1971; Young & Claypool, 2010).

Conclusion and Recommendations

Based on the findings of the study, it was concluded that e-learning facilities are moderately available in the study area but it can be seen from the findings that E-learning facilities that will improve the academic performance of students and bridge the gap that exist between theories and practical are not effectively available. E-learning facilities are good way of learning to complement the lecturers' effort in the learning situation. The study also showed that e-learning facilities are been used occasionally forteaching and learning of electrical Installation and maintenance in technical colleges in Kaduna State. In the light of this, Technical colleges should know that e-learning and various ICT tools as real potential technologies that will transform teaching and learning. This will assist the students, and serves as a prerequisite for getting employment and compete with their counterparts in the world of work.

With regard to the findings, the following recommendations are drawn from the study:

1. The college authority should give priority in the provision of E-learning facilities through collaboration for effective teaching and learning to take place.
2. The college should not relent on their own efforts through the use of memorandum of understanding with international bodies and multinational organization in the provision of e-learning facilities in order to achieve educational goals as stated in national policy of education.
3. Usage of e-learning facilities will assist the lecturers to shifts from traditional methods of teaching to new pedagogy which will enable the students to see themselves as knowledge generator and active participants and lecturers as facilitators of students learning process.
4. Colleges should encourage their teachers in the use of e-learning facilities for teaching and learning of management and business courses through regular training and institutional policy e-learning to promote global competitiveness.

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Effects of Digital-Game and YouTube Instructional Strategies on Achievement and Interest of Chemistry Secondary School Students' in Bida Local Government

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Abstract
This study investigated the Effect of Digital Game and YouTube Instructional strategies on Achievement and interest of chemistry secondary school students' in Bida local government area of Niger State, two research questions were answered. The research design adopted for this research is pretest posttest control (equivalent, randomization control, experimental research design). A total number of one hundred and fifty student (150)(81 males and 69 females)for the study were purposively selected for this study from three (3)co-educational schools out of twenty three (23)schools in Bida local government were randomly assign to control and experimental groups. Chemistry achievement test and chemistry interest inventory was adapted and validated by expert in the field of chemistry and educational technology with the reliability index of 0.861 and 0.947 respectively. The chemistry achievement test was administered to students in the pretest, posttest upon treatment of test instrument and interest inventory was administered immediately; the data obtain from pretest and posttest were statistically analyzed using mean, standard deviation and analysis of variance (ANOVA) using statistical package for social sciences (SPSS) version 20.0. The result indicates that student in youtube have interest in chemistry than student in digital gamewith p value 0.464>0.05 and male students have more interest than the female student in chemistry with p value of 0.352> 0.05. It concluded digital game and YouTube instructional strategies should be employ to teach senior secondary school student in Niger State and beyond, it is recommended that prospective teachers should be expose to digital game and YouTube form of instructional strategy in the course of their training in universities and college and curriculum planners and relevant government agencies should incorporate this approach into secondary school curriculum and thus implemented

Introduction
Technology is a body of knowledge devoted to creating tools, processing actions and the extracting of materials. The term Technology is wide, and haseveryone way of understanding its meaning. We use technology to accomplish various tasks in our daily lives. In brief; we can describe technology as products and processes used to simplify our daily lives. We use technology to extend our abilities, making people the most crucial part of any technological system. Technology also means an application of science to problemsolving. But it is vital to know that technology and science are different subjects which work hand-in-hand to accomplish specific tasks or solve problems. (Franklin 2017).

Technology is applied in almost everything we do in our daily lives. We use technology at work, we use technology for communication, transportation, learning, manufacturing, securing data, scaling businesses and so much more. Technology is human knowledge which involves tools, materials, and systems. The application of technology typically results in products. If technology is well applied, it benefits humans, but the opposite is true, if used for malicious reasons. (Franklin 2017).

Educational technology is the use of physical hardware and software to facilitate learning and improve performance by creating, using, and managing appropriate technological processes and resources, it encompasses several domains including learning theory, computer-based training, online learning, and mobile technologies in m-learning. Accordingly, there are several discrete aspects of describing the intellectual and technical development of educational technology. It has been found useful in the field of mathematics, physics, biology, chemistry where these technologies have been found to enhance learning. (Robinson *etal*., 2016).

Chemistry is the study of matter, its properties, how and why substances combine or separate to form other substances, and how substances interact with energy. Many people think of chemists as being white-coated scientists mixing strange liquids in a laboratory, but the truth is that we are all chemists. Doctors, nurses and veterinarians must study chemistry, but understanding basic chemistry concepts is important for almost every profession. Chemistry is part of everything in our lives (Bagley 2014)

The role of chemistry in the development of the scientific base of a country cannot be overemphasized and Nigeria is not an exception. Yet with the increasing importance of chemistry to the unfolding world, the performance of Nigerian students in the subject at the secondary school remains poor. However it is disappointing to note that the students performance in chemistry at internal and external examination has remained considerably poor despite teachers effort to make it better because of its relative importance. (Chief Examiners Report 2015, 2016, 2017, 2018).
Digital game based learning is a strategic and tactical guide in learning process combining content with video games to engage learners (Prensky 2011). Digital game-based learning is a research field within the wider context of technology-enhanced learning that has attracted, during the last few years, the interest of both the research and educational community (Kirriemuir and McFarlane, 2014;Sandford and Williamson 2015;Van Eck 2017;Chen and Chan, 2010;Connolly and Stansfield 2017) define digital game-based learning as "the use of a computer games-based approach to deliver, support and enhance teaching, learning, assessment, and evaluation", whereas Prensky (2017) also stress the additional educational value of digital game-based learning by defining it as an approach based on the integration of educational content into digital games and leading to the achievement of the same or better results, in comparison to traditional instructional approaches.

Incorporation of YouTube videos into the instruction has been shown to support multimedia learning, capture students' attention, make learning more interesting and enhance the overall learning process (Eickand King 2012; Buzzetto and More 2014;Duvenger and Steffes 2012;Greenberg and Zanetis 2012;Hilner 2012;Jones and Graham 2013;Tan and Pearce 2012). More specifically, well selected, YouTube videos have been found to help students engage more deeply with subject matter, and recall the information they've learned longer and expand access to information, promote critical thinking, foster active and flexible learning environments (Burke and Snyder 2008;Buzzetto and More 2014;Duvenger and Steffes 2012;Roodt and Peier, 2013;Snelson 2011;Burke and Snyder 2008;Logan 2012;Liu 2010;Roodt and Peier, 2013).

Interest is a feeling of curiosity or concern of subject, topic (in this case chemical reaction) that makes attention towards it. It has been argued that interest is one of the factors that influence students' academic achievement. Renninger and Hiddi (2011) put interest as a critical cognitive and affective motivational variable that guides attention, facilitates learning in different content

areas, for all students of all ages, and develops through experience. Interest is significantly correlated with teaching methods to enhance students' achievement in chemistry (magwilang 2016). Espinosa et al.,2013) ascertained that the aim of teaching is to secure the students attention through arousing and maintaining interest in lessons of multidimensional instructions. Students' interest in learning is linked with their anxiety to learn. It consists of feelings and tendencies towards a concrete matter (Raymond 2016). A characteristic feature of interest is a manifestation of different preference toward actions, events or plans. A student's interest in academic achievement will induce him to behave and act in a certain way towards his studies (Ogbunanya andOwodunni 2013).

Gender has been found to affect students' achievement in chemistry. There has been contrasting opinions on gender related issues on students' achievement in chemistry by scholars. Some scholars observed that gender affects students' achievement in favour of the male. However some researchers observed no gender difference in students achievement (Hassan*etal*., 2016;Fatoba and Aladejana 2014;Olasheinde and Olatoye 2014;Fatokun and Odagboyi2010) viewed gender as a significant factor in students' achievement in chemistry due to interaction patterns. another study reveals that there is a high manipulating skill of males towards digital games than that of females because generally males are attached to gadgets which give them an edge over the female students (Chado*et al.,* 2016), findings shows that 64% of teens are on YouTube instructional platform where males are more incline than females and used it more often than females 39% vs 25% (New Pew Research Center Survey, 2015).

Statement of the Problem

Writing and balancing of chemical equations, knowing the types of chemical reactions are confusing concepts in chemistry because of its mathematical nature. It is the foundation on which the understanding of chemistry is built (WAEC chief examiners report 2019). In view of the usefulness of chemistry in nearly all fields of human endeavour, the poor achievement and interest of students in chemistry at the secondary school level has been a source of concern to education stake holders and government at different levels. Most of often than not, poor achievement and interest have been attributed to poor teaching methods used by chemistry teachers. In view of these, researchers in science education have been searching for better teaching methods that will enhance students' achievement, promote their interest, achievement and interest in chemistry. Although several instructional strategies have been used to teach chemistry, poor performance of students still persists, but no study have been conducted on the use of YouTube and digital game in chemistry teaching in Nigeria. Therefore there is need to employ instructional strategies that involve the use of game and YouTube video which promote active learning, such as digital game-based learning, and YouTube instructional package. Therefore this study will determine the Effect of Digital Game and YouTube Instructional strategies on the Achievement of interest in Chemistry Secondary School student in Bida local Government.

Research Questions

This study will provide answers to the following research questions:

i. What is the effect of digital game and YouTube instructional strategies on student interest in chemistry?
ii. What is the difference in gender of students' interest taught chemistry using digital game?

Research Hypotheses

HO_1: There is no significant difference in the interest of students taught chemistry using digital game and YouTube

HO_2: There is no significant difference between the interest of male and female students taught chemistry using digital game.

Methodology

The research design adopted for this study is pretest posttest control (Equivalent, Randomizationcontrol, experimental research design).

The population for this study is made up of all Senior Secondary School chemistry students in Bida Metropolis; the target population is eleven public Senior Secondary School two (2) students with total population of two thousand and fifty-one (1580) for 2019/2020 session.

A multistage sampling technique was employed in selecting the sample for this study. Firstly a purposive sampling technique was used to select two (2) Secondary Schools which will be randomly assigned into experimental groups, and then a simple random sampling technique was used to select a school which is assign into control group. The schools were selected because of their co-educational nature, and the presence of functioning computers in their computer lab(for experimental group). The sample for the study consisted of 150 learners who were randomly picked from the sample schools, with experimental group 1(Digital game) having 50 students, experimental group 2(YouTube) having 50 and control having 50 students, which is made up of 81 male and 69 females.

The instrument used for data collection is; treatment instrument and test instrument.

Treatment Instrument: The independent variable of the study is the digital game (DGI) and YouTube instructional strategy (YIS). The game that was selected to support the proposed educational activities was "chemical lab for chemistry", simulation game which engages players in activities requiring the use of laboratory apparatus to take out reaction, strategic thinking on the element that can react putting them in the selected apparatus, heating if necessary, to have a product. The game allows players to test various reactions between element from different groups, The digital game covered the following topics in chemistry, chemical reaction and balancing of chemical equation, which was adopted by the researcher from (Boyan MIHAILOV). The YouTube instructional strategy is a video instruction aim at engaging weak and slow learners for pace learning, the video adopted for the study is (unit 1 chemical reaction equations CBSE class X by Digital teacher).

Test Instrument: The instrument used for data collection was Chemistry Achievement Test (CAT) which was adopted from past WAEC questions. The test items has thirty (30) multiple choice test questions were set on the topic taught with five optional answers (A-E) in which there is only one correct answer. The chemistry interest inventory (CII) made up of 20 items covering student's interest in Chemistry was of five-point Likert scale.

Face and content validity was done by three experts, from Federal University of Technology Minna and Government Girls' Secondary School Minna. Two of them were in science education department and one from chemistry department.

To determine the reliability of the test instrument chemistry achievement test (CAT) and chemistry interest inventory (CII) was pilot- tested on ninety SS2 students from the study population. Scores generated from their responses were used to establish the internal consistency of the test items using Pearson Product Moment Correlation (PPMC)and Cronbach's Alpha Reliability Coefficient method. Thus an internal consistency estimate of 0.861 and 0.947 respectively.

The pre-test, post-test scores collected and interest inventory answered were analyse using mean, standard deviation and analysis of variance.

Result

Research Question One: What is the effect of digital game and YouTube instructional strategies on student interest in chemistry?This research question was answered using mean and standard deviation. Summary of the analysis is presented in below

Table 1: Mean and Standard Deviation (SD) of Effect of Digital Game and YouTube Instructional Strategies on Student Interest in Chemistry

Treatment	N	Mean	Std. Deviation	Mean Difference
Digital game instruction	50	4.17	.90267	0.142
Youtube instruction	50	4.03	1.02355	

Table 1 shows the effect of digital game and YouTube instructional strategies on student interest in learning chemistry. The result shows that students taught chemistry using Digital game and YouTube instructional strategies have the mean scores above 3.0 which indicated that the treatment has effects on the students' interest in learning chemistry. The mean difference between the strategies is 0.142. Figure 3.0 below show the graphical representation of mean scores onthe effect of digital game and YouTube instructional strategies on student interest taught chemistry.

Research Question Two: What is the gender difference between the interests of student taught chemistry using digital game? This research question was answered using mean and standard deviation. Summary of the analysis presented in the table below

Table 2: Mean and Standard Deviation (SD) between Male and Female Students' interest taught chemistry using digital gameinstructional strategy.

Gender	N	Mean	Std. Deviation	Mean Difference
Male	25	4.05	.98992	-0.24
Female	25	4.29	.80848	

Table 2. shows the gender difference between the interests of student taught chemistry using Digital game instructional strategy. There is an indication that male students' exposed to digital

game instructional strategy have the mean score of 4.05 while, female students exposed to digital game instructional strategy have the mean score of 4.29. Therefore, female students exposed to digital game instructional strategyhave the highest interest compared to the male students with meandifference of 0.24.

Hypotheses One

There is no significant difference in the interest of students taught chemistry using digital game and YouTubeinstructional strategies.

Table 3: ANOVA on the interest of students taught chemistry using digital game and YouTube instructional strategiesin senior secondary schools.

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.504	1	.504	.541	.464
Within Groups	91.261	98	.931		
Total	91.765	99			

Table 11 shows the ANOVAresult of students' interest using digital game and YouTube instructional strategies in senior secondary schools. The result shows the mean square between the treatment = 0.504 and within Groups to be = 0.931, F value (1, 99) = 0.541 with P value = 0.464. The p-value was greater than 0.05 alpha value of significance. This hypothesis is therefore not rejected.

Hypotheses Two

There is no significant difference between the interest of male and female students taught chemistry using digital game instructional strategy.

Table 14: ANOVA of male and female students' interest exposed to digital game instructional strategyin senior secondary schools.

Gender	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.720	1	.720	.882	.352
Within Groups	39.206	48	.817		
Total	39.926	49			

There is no significant difference between the male and female students' interest exposed to Digital game instructional strategy. The result shows the mean square between the treatment = 0.72 and within Groups to be = 0.82, F value (1, 49) = 0.882 with P value =0.352. The p-value was greater than 0.05 alpha value of significance. This hypothesis is therefore not rejected.

Discussion of Results

Findings of the study showed that student from YouTube instruction group have more interest than those from digital game group. This implies that students from YouTube group find more learning time than those in the digital game group, this may be attributed to the fact that students in YIS learn the concept chemical reaction at their own pace, and were able to do that at home even from their cell phones. This is in agreement with the findings of (Eick and King 2012).

The finding of this study showed that the male students have more interest in chemistry than the female student in DGI, this implies that male student have high ability to manipulate digital game and know the use of internet than the female due to the fact that male students generally are been attached to gadgets which give them an edge over the female student. This is in agreement with the findings of (Silna 2015) which says at upper primary level, boys had higher interest in chemistry than girls; by higher secondary level girls are significantly higher on it than boys. Students' interest in chemistry falls by ¼, from upper primary to high school

The major findings

1. There was a main mean difference of student interest in chemistry. The YIS have more interest than the DGI
2. There was a main mean difference of gender on student's interest in chemistry, the male have more interest than the females

Conclusions

In light of the Research discoveries as identified with the speculations formed and tried, the accompanying conclusions were made: Exposing Learners to digital game and YouTube instruction will enhance easy assimilation and recall of student's memory in chemistry which will enhance their interest.

Recommendations

In view of the findings of this research work, the accompanying proposals were made for the study:

- Teachers should be sent on in service training to study educational technology where they can learn the design and the use of instructional materials
- School principals ought to support and give fundamental backing to teachers for powerful utilization of additional instructional materials in showing and learning.
- Schools ought to teach the mentors and gathering patrons on the impact that digital game instruction have on understudies' live.
- There should be reinforcement of tutors dedicated to work through prize giving, scholarship awards.

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Effect of Microsoft Office PowerPoint Presentation and Internet on students' Academic Achievement among Senior Secondary School Biology Studentsin Minna, Metropolis of Niger State, Nigeria

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Abstract
The study investigated the effect of Microsoft office PowerPoint presentation on the academic achievement and interest of biology students on concept of digestive system. Two research objectives with corresponding two research questions were set to guide the study. A quasi experimental design was adopted with two intact classes,grouped into experimental and control group. The target population of the study consists of the consists of all the SS2 Biology students from all the secondary school in Minna Metropolis of Niger, total number of student population during 2019/2020 academic session is 5,382. The sample size of this study was 135 students captured from two intact classes in public co- educational schools in Minna metropolis. The instrument used in the study was a researcher developed Biology Achievement Test (BAT). The BAT was based on the topics in Digestive Concept. Data were analyzed by using Standard deviation to answer research questions while inferential statistics which as ANCOVA was used to analyze the hypotheses at 0.05 level of significance. Findings onhypothesis one revealedif "there was significant difference in the mean achievement scores of students taught Biology using Microsoft Office PowerPoint presentation and those taught using Lecture method". Based on the F-value of revealed F (1, 88) = 169.648 p=0.00. With p <0.05 on table 4.9 hypothesis One was rejected. Findings on Hypothesis tworevealed that "there is no significant difference in the mean achievement scores of male and female students taught Biology using Microsoft Office PowerPoint presentation". Based on the findings of the study the following recommendation were made:1. The Ministry of Education should encourage the use of PowerPoint presentation in teaching Biology in Senior Secondary School.School Authority and teachers should be enlighten on the importance of PowerPoint instructional package in teaching and the student should also be enlighten on the importance PowerPoint instructional package of learning to their study.

Keyword: PowerPoint, achievement, interest and digestive system

Introduction
Education is the major tool for tacking the problems and challenges of a rapidly changing and complex global society (Bagley, 2019). Learning is the act or experience of one that learns or knowledge or skill acquired by instruction (Abudu and Gadamosi, 2014). While teaching is to impact knowledge of or skill in: give instruction in: to inform, enlighten (Wartinbee, 2017). The importance of teaching and learning cannot be overemphasized this is because it is seen as a tool used for national development. Education is indispensable for a successful living in the modern science world. The important role of teaching and learning in the society can never be adequately described.

Biology is a branch of natural science that deals with the study of living organisms, their structures, functions, evolution, distribution and interrelationships (Bagley, 2019). Biology occupies a unique position in the secondary school education curriculum because of its importance as science of life. In Nigeria, the secondary school Biology curriculum is designed to continue students' investigation into natural phenomena, deepen students' understanding and interest in biological sciences and to encourage students' ability to apply scientific knowledge to everyday life (Federal Ministry of Education, 2017). Besides the importance of Biology as the science of life, it is one of the science subjects that are mostly preferred by many students in secondary schools. For this reason, Biology has a very high enrolment of students in the external examination (West African Examination Council, 2017).

The objectives of the Biology curriculum according to the National Policy on Education is to prepare students to acquire: adequate laboratory and field skill in Biology, meaningful and relevant knowledge of Biology, the ability to apply scientific knowledge to everyday life in matters of personal and community health and agriculture and reasonable and functional scientific attitude. In pursuance of the above stated objectives of biology curriculum, the contents and context of the curriculum place emphasis on field studies, guided discovery, laboratory techniques and skills along by conceptual attitude (Federal Ministry of Education, 2017).Biology students and teachers are expected to be meaningfully involved in the teaching-learning processes in order to make the set educational objectives of the National Policy on Education in biology realizable and achievable (Omoifo, 2016).

The importance of Biology in the development of any nation cannot be underrated especially as it is the key subject in as well as pharmaceutical development of the nation (Adesoji & Olatunbosun, 2019). Biology has often proven to be a difficult subject for many students (Johnstone and Otis, 2016), containing many technical concepts which are central to further learning among these are digestive system, respiration and photosynthesis, cell division (mitosis and meiosis), hormone regulation, oxygen transport, nervous system, and genetic manipulation (Taber, 2012). These abstract concepts are important because further biology concept or theories cannot be easily understood if these underpinning concepts are not sufficiently grasped by students. The root of many difficulties that students have in learning chemistry is traceable to inadequate instructional approach or instruction material. The chief examiner's report of the West Africa Examination Council (WAEC 2017 - 2019) shows that most biology candidates fail in most of responses on concept digestive system, genetic among others. This is because students were not properly taught with adequate instructional material and strategy.

The poor performance may partly be due to the manner in which biology is taught. Many learners experience difficulties when learning abstract chemistry concepts because the concepts are taught at a theoretical level with no visual mental representations (Gabel, 2015). Consequently, learners fail to understand concepts and therefore develop a negative attitude towards chemistry. These attitudes may account for the reduced number of learners studying chemistry after the mandatory O-level, when compared to other subjects. Computer simulations are seen as a possible intervention which could improve the teaching and learning of school chemistry as well improve learners' attitudes towards chemistry.

There is need to develop more effective and scientifically aligned strategies to teach Senior Secondary School Biology students the key concepts and principles of Biology. Thus, the need to consider an alternative approach to the teaching and learning of chemical bonding. Research findings have shown that computer could be used in the classrooms to improve students' acquisition of basic skills. These can be achieved by blending text with multimedia, curriculum objectives through the use of computer based instructional materials, animations and simulations to aid in demonstration (Pierce and Stacey, 2014; Adyum, 2015; Abdullahi, 2017).

The increasing use of computer has led to modification of learning and teaching curricula. The present era being called "The Computer Age" Microsoft Power point could be used to teach any topic this will reduce abstractness and motivates students thereby enhancing better understanding on the part of learners (Segundo and Salazar, 2016). Information Technology (I.T.) is concerned with the handling of information. The technology employed in modern systems makes full use of the digital computer and the microprocessor. This is an electronic form of presenting learning materials through teaching of some topics, where the student can view all that is embedded in the topic and they learn and fast when see with interest. With the computer system gradually replacing man in his day to day activities, the steps carried out using Microsoft Power point application in this regard is being highlighted in this write up.

Microsoft Office PowerPoint Instruction Strategy is one aspect of computer based instruction. it helps any educational level to convey information better and allows students to proceed at a comfortable learning rate (Osigwelem, 2005). According to Bayrktar (2001), PowerPoint is a slide show presentation programme currently developed by Microsoft Office PowerPoint initially named presenter. Power point special effects and features can be used to make an outline presentation exciting and complete. Such things as slide transitions, timings, movies, sounds animation and hyperlinks can be used for this purpose. This presentation can be made to self-run.

The issue of gender and students' academic achievement especially in biology has been inconclusive. Some researchers are of the view that male students perform better than females, others disagree with this view, arguing that achievement is a factor dependent on several factors such as socio – economic background, and teaching method among others. Therefore, one sees that the issue of gender has not yet been resolved particularly in relation to students' achievement in biology, hence the need for further study on that regard, especially when trying out new teaching strategies. In this study, the researcher is interested in using the Microsoft office PowerPoint instruction strategy to design learning activities in Biology and find out its effect on achievement and acquisition of multiple intelligences of students. In addition, this study will find out the influence of gender on students' achievement in biology when exposed to PowerPoint presentation.

Statement of the Research Problem

Over the years, the interest of students in Biology in Nigeria secondary schools has been very poor. Students' achievement in Biology in internal and external examination is on the decline. The WAEC Chief Examiner Report of 2013 - 2018 indicated poor achievement of students in biology West AfricaExaminationCouncil 2017. The students' poor achievement in biology could be

attributed to so many factors such as poor instructional strategy, inadequate integrate computer based instructional, use of gender biased instructional material among others (Wichuda*etal.*, 2015).

Biology as a science subject is so verse and activity based; it therefore, needs a virile teaching method that can take care of learning styles of the students. In other to overcome the problems of poor achievement by students in biology, some researchers have suggested the use of diverse computer based instructional strategies, which may help to enhance students' performance in biology.

Isman (2005), Liao (2007) and WiseGeek (2013) had pointed out that lecture method of teaching used by teachers of biology had not been effective in classroom delivery. Numerous studies had shown that student's achievement in Biology are bedeviled with poor performance. This notion of poor achievement has been attributed by researchers to the continual use of uninspiring method of teaching adopted by teachers of Biology in Nigeria Senior Secondary School. Some innovative methods have been suggested which include programmed instruction strategy, concept mapping strategy and Microsoft office power point presentation.

Researches had shown that gender is a predictor of academic achievement, and also the effect of gender on academic performance of students exposed to problem-based learning which showed that sex was a determinant of academic performance irrespective of the pattern adopted. The effects of gender would be considered in this study. Gender as a factor in academic achievement has for sometime generated a lot of concern for teachers. A number of researchers have divergent opinion on male and female performance. Therefore, an investigation of gender influence as intended in this research would shed more light on the issue. Consequently, there is need to shift to other innovative teaching strategies such as Microsoft PowerPoint instruction strategy. Hence, the research intends to investigate the effect of Microsoft Office PowerPoint on students' academic achievement and interest of Biology Student among Senior Secondary School in Minna metropolis of Niger State, Nigeria.

Aim and Objectives of the Study

The main aim of this study was to investigate the effect of Microsoft Office PowerPoint presentation on the academic achievement and interest of concept of digestive system by biology students.

Specific objectives of this study are to:

i. determine the effect of Microsoft Office PowerPoint presentation and conventional teaching on academic achievement of students in Biology.
ii. determine the influence of gender on academic achievement of students taught Biology using Microsoft Office PowerPoint presentation.

Research Questions

The following research questions were posed to guide this study

i. What are the mean achievement scores of students taught Biology using Microsoft Office PowerPoint presentation and those taught using conventional teaching method?
ii. What is the interaction effect of Microsoft Office PowerPoint presentation on male and female achievement scores in Biology?

Research Hypotheses

The following null hypotheses were formulated and were tested at alpha level of 0.05.

HO_1: There is no significant difference in the mean achievement scores of students taught Biology using Microsoft Office PowerPoint presentation and those taught with conventional method.

HO_2: There is no significant difference in the mean achievement scores of students taught Biology using Microsoft Office PowerPoint presentation.

Research Methodology

The research design used for this study is quasi-experimental design. The study adopted non-equivalent Pre-test - post-test control group design. The Quasi-experimental design was considered appropriate for the study because intact classes were used to avoid disruption of normal class lessons in the various schools involved in this study. The pre-test was used to find out initial differences in the two groups and to control selection bias, which is a trait to internal validity. The study design is demonstrated in the table below:

Table 2.1 Research Design Outline

Variables	Pre-test	Treatment	Post – test	Moderating Variable
Experimental	O_1	X_1	O_2	O_3
Control	O_4	X_o	O_5	O_6

O_1, O_1= pre-test scores of experiment and control groups
O_2, O_5= post-test scores of experiment and control groups
O_3, O_6 = Retention scores of experiment and control groups
X_0= Conventional method
X_1= Microsoft PowerPoint presentation

The population of the study consists of all the SS2 Biology students from all the secondary school in Minna Metropolis of Niger, total number of student population during 2017/2018 academic session is 5,382. The targeted secondary school are co-educational because of the population characteristics (gender – male, female) considered in the study. They also have the same environment condition such as teachers, syllabus, remuneration and class size.

The sample size of this study was 135 students captured from two intact classes in public co-educational schools in Minna metropolis. Two intact classes randomly selected were also randomly assigned by balloting and categorized into experimental and control groups. The experimental group was taught using the Microsoft PowerPoint presentation and the control group

was taught using conventional method. Simple random sampling techniques was used to select the schools and also randomly categorized into experimental and control respectively.

The instrument used in the study was a researcher developed Biology Achievement Test(BAT). The BAT was based on the topics in Digestive Concept. This achievement test consists or two sections, A and B. Section A seeks personal information on the students with respect to name of student, name of school, gender and age while the section consists of the achievement test made up of items. Each of the test items is followed by option A – D. The respondent is expected to pick an answer by ticking the correspondent alphabet. Each correctly answered option carried 3marks, which was then counted to percentages.

The achievement test question was trial – tested in Government Day Secondary School Minna, Chanchaga, which is not selected for the main study. The result computed in the test to the class was analyzed using Pearson Product Moment Correlation formula and reliability coefficient of 0.78 was obtained, showing that the items are reliable according to thumb print of (Frankel and Wallen, 2014).

The instrument was validated by the supervisor of this work and two senior lecturers from Science Education Department. The questions were also validity using the following criteria: (i) subject matter coverage (ii) adequacy of language (iii) stemming of the questions. Corrections, suggestion given by experts were used to modify the content of BAT.

A letter of request forpermission was written to the school principals seeking for permission to use the school, Biology Teachers and Students for the study. The researcher also established interactions in other to enlighten them on the purpose of the visit.

The instrument containing 20; items was administered on 135 senior secondary school (SS 2) students offering Biology in Bosso Local Government Area of Niger State. At the time of giving the test, the researcher ensures that the students read the instruction before answering the questions on the Biology Achievement Test (BAT). They were also guided by a lesson plan prepared by the researcher based on the biology topics for assessment. Conventional teaching method was used for teaching the control group and Microsoft PowerPoint presentation for experimental group. Pre-test was given to all the Biology students in the four schools using BAT before treatment. After the pre-test, students (experimental group) in their classes of two were taught the Biology topics using Microsoft PowerPoint presentation method while the control group were taught Biology topics using conventional method.

Data were analyzed by using descriptive statistics of mean, Standard deviation to answer research questions while inferential statistics such as ANCOVA was used to analyze the hypotheses at 0.05 level of significance. The Statistical Package for the Social Science (SPSS) version 25.0 was used.

Results and Discussion

Answering of Research Questions

To answer the research questions, mean and standard deviation were used and the findings is as presented: research question 1-8 were answered using mean and standard deviation.

Research Question One: What is the mean achievement score of biology taught using Microsoft Office PowerPoint presentation and those taught with conventional method.?

To answer research question one, mean and standard deviation of students in experimental and control groups were analyzed as shown in table 4.1.

Table 1: Mean and Standard Deviation of Pretest Score of Control and Experimental Groups

Variable	N	Pre-test Score ($\bar{x}$)	SD	Post test Score ($\bar{x}$)	**SD**	**Gain Score**
Experimental Group	44	21.70	3.84	35.36	3.62	13.66
Control Group	36	21.49	4.26	28.90	5.33	7.41

Table 4.1 above revealed that the students who were taught using PowerPoint instructional packagehigher achievement than those who were taught using conventional method. The observed variability was reflected before and after the test but the proportionate increase among students who were taught using PowerPoint instructional packageis higher than that observed among students in the conventional method with mean gain score of 13.66 and 7.41. This would imply that the using Microsoft Office PowerPoint presentation in the teaching of Microsoft Office PowerPoint presentation concepts has a relative edge over the use of convention method.

Research Questions Two: What are the mean achievement scores of male and female Biology students taught using PowerPoint instructional packagein Bosso Local Government Area of Niger State??

To answer research question two, mean and standard deviation of students in experimental and control groups were analyzed as shown in table 4.2.

Table 2 Mean Score Gain of Male and Female Students Taught Biology UsingPowerPoint instructional package

Variable	N	Pre-test Score ($\bar{x}$)	Post-test Score ($\bar{x}$)	Mean Gain Score	Gain Difference
Male	26	22.35	36.06	13.71	0.13
Female	18	20.78	34.36	13.58	

Table 2 shows the mean achievement score of male and female students taught Biology usingPowerPoint instructional package, the outcome of the result shows that the mean gain score of 13.71 and 13.58 for male and female respectively. The gain difference in score of the male and

female is 0.13. This implies that male perform better than female while taught usingBiology PowerPoint instructional package.

Hypothesis One: There is no significant difference in the mean achievement scores of Biology students taught using Microsoft Office PowerPoint presentation and those taught with conventional method.

Table 3: Summary of t- Test Analysis forsignificant difference in the mean achievement scores of Biology students taught using PowerPoint instructional package and those taught with conventional method.

Variable	N	df	$\bar{x}$	SD	t-val	p-value	Decision
Experimental Group	44	78	35.36	3.62	2.68	0.02	S
Control Group	36		28.90	5.33			

Table 3 shows the significant difference in the post-test gain scores in the performance of students taught Biology using PowerPoint instructional package and those taught with conventional method. The outcome of the result shows that the means score of those students taught conventional method is 28.90, SD = 5.33, while those taught using PowerPoint instructional package is 35.36 and the SD=3.62, df = 78, with p-value of 0.02 which less than alpha significance level of 0.05 that is p-value 0.02 < 0.05. The null hypothesis is thereby rejected. Hence, that there is statistical significant different between the mean achievement score of students taught using PowerPoint instructional package to conventional method

Hypothesis Two:
There is no significant difference in the mean achievement scores of male and female students taught Biology using Microsoft Office PowerPoint presentation.

Table 4: t-Test Analysis of mean achievement scores of male and female taught Biology using PowerPoint instructional package

Variable	N	Df	$\bar{x}$	SD	t-val	·value	Decision
Male	26	42	36.06	3.04	1.36	0.89	NS
Female	18		34.36	4.21			

*NS = Not Significant

Table 4 shows the significant difference in the post-test gain scores in the achievement of male and female students taught Biology using PowerPoint instructional package. The outcome of the result shows the male means score is 36.06 and the SD=3.04, df = 42, with p-value of 0.89, while the female mean scores of those taught without materials is 34.36, SD = 4.21, therefore the null hypothesis of no significantly difference in mean score achievement of male and female student

taught using Microsoft offices power presentation was not rejected. Hence, that there is no statistical significant different between male and female students' achievement score on exposure to instructional model.

Conclusion

Based on the findings of the study, on the Microsoft offices PowerPoint instructional packageon the academic achievement ofBiology students. Itcould be concluded that PowerPoint instructional package help the performance of student, this may be attributed to the use demonstrative, call for thinking and interactive section the instructional model brings to teaching. The study further highlighted the positive influence of PowerPoint instructional package on academic performance of student in Biology.

The finding s of the study revealed the significant difference in the post-test gain scores in the performance of students taught Biology using PowerPoint instructional package and those taught with conventional method

Finally, the result revealed that there is no statistical significant different between male and female students' achievement score on exposure to using PowerPoint instructional package

Recommendations

Based on the findings of the study the following recommendation was made:

1. The Ministry of Education should encourage the use of PowerPoint instructional packagein teaching Biology in Senior Secondary School.
2. School Authority and teachers should be enlighten on the importance of PowerPoint instructional package in teaching.
3. The student should also be enlighten on the importance PowerPoint instructional packageof learning to their study.

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Assessment of Learners' Satisfaction and Needs on E-Learning Platforms in Senior Secondary Schools in Kaduna State.

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Abstract
This study investigated the satisfaction and needs of e-learners in senior secondary schools in Kaduna State. The study adopted a descriptive survey using questionnaire to elicit needed information from 450 senior secondary school students from twelve public senior secondary schools in three educational divisions who actively subscribed to the e-learning via radio and television in Kaduna state. The instrument named "Questionnaire on Learners' Satisfaction and Needs on e-learning Platforms (LSNEP)" was used for data collection after its face and content validity and pilot testing respectively. Descriptive statistics of simple percentage and mean were used for the analysis of data. The results from analyzed data indicated that majority of the students (69.41%) were satisfied with using the e-learning platforms via radio and television. Also, a good number (74.2%) of the participants were either rarely or never assessed on learning needs, objectives, teaching styles and preferences before or during the lessons and a higher percentage (77.18%) of the respondents were able to provide their learning experiences and preferences after the lessons to the instructors and collaboration with other students. Based on these findings, it was recommended that E-learning should be used as a valuable supplement in teaching to enhance the learning process.

Introduction
Information and Communication Technologies (ICTs) and connectivity of internet and networks improve man's opportunities ingenuity in virtually all spheres of life. Given that societies consciously depend on real-time information to be proactiveand to discount the effects of environmental changes (Zhang et al., 2010; Bates & Jenkins, 2017; Al-Gahtani, 2016; Eze&Chinedu-Eze, 2018). entities attempt to copewith disruptive technologies; they make huge investment in the state of the art ICTplatforms owing to the need to build competitive advantage amidst decreasing cost oftechnologies in the contemporary information systems (IS) market (Chuang et al.2009; Bhuasiri et al., 2012; Maldonado et al., 2011; Eze et al., 2013; Awa et al., 2011).ICT is an agent of socio-economic changes (Al-Gahtani, 2016) and a force for creativedestruction in human existence (Wang, 2009; Kotler, 1984), especially in the educationalmilieu, where the academia and consultants progressed from providing simpleteaching aids to interactive e-learning environments.

E-learning is one of the most significant educational innovations driven by expanding array of technology enabled platforms that offer potential learners an alternative and innovative learning

environment compared with traditional learning and, thus, represents ICT-based innovation in education (Bates, 2012; Wang, 2009). Some scholars refers to e-learning as pieces of content packaged using technical infrastructures, others consider it an on-line self-study, and yet others see it as encompassing on-going learning and joint effort. E-learning is a learning process that involves the connection of digitally conveyed content, system-based administrations and mentoring bolster (Zhang et al., 2010; Markus, M and Robey, D. 1998). However, in spite of the obvious advantages of e-learning, in the developing economies like Nigeria, its adoption is rather too low because of the high illiteracy rate and poor educational funding by the Federal and State government. With the devastation caused by the corona virus pandemic, several states and institutions in Nigeria embarked on the use of e-learning platforms for effective contactand online teaching and learning and for developing cognate skills needed to makesocio-economic contributions in the knowledge world.

Statement of the Problem

The educational system all over the world was worst hit by the impact of the corona virus pandemic; schools in Nigeria were shut for several months, learners were not opportune to have their traditional lessons for a long time. Although some schools employed the use of ICT in teaching and learning but majority of Nigerian students could not participate in the classes due to the inability of both the teachers and learners to access these facilities or utilize them properly where they are available. Schools in several states in Nigeria are bedeviled with challenges of limited resources, inadequate manpower and training, instability in energy, and poor Internet. Barriers such as poor awareness,poor infrastructures and abysmal management commitment to interactive knowledgeenvironment (Bukhari, 2014) have been hindering most instructors from usinginnovative teaching methodologies in delivering lectures and undertaking rigorous researchwork (Bukhari, 2014; Singh and Hardaker, 2014; Ahmed, 2013; Hu and Hui,2012). This narrative was altered due to the corona virus pandemic. Kaduna State, whose slogan is the 'Centre of Learning' introduced an e-learning program for students preparing for the Senior School Certificate Examinations and other classes to keep them abreast with studies and further prepare them for the examination. The programmewhich commenced at the peak of the nationwide lockdown was transmitted in various Radio and Television Stations in the state in different subjects twice daily with the different teachers delivering their lessons on the respective subjects or areas.This paper therefore seeksto access the satisfaction and needs of the learners on e-learning platforms in Kaduna state.

Research Questions

The following research questions were raised to guide the study:

(i). Are learners satisfied with the e-learning platforms used to teach them in Kaduna state?
(ii). Are learners assessed on their learning needs before the start of the e-learning course?
(iii). Two what extent are e-learners in Kaduna state able to provide their learning experiences and preferences.

Methodology

The study adopted a descriptive type of survey research which entails the use of questionnaire to elicit needed information from senior secondary school students based on their opinions and views regarding the satisfaction level, assessment, experiences and preferences of e-learning platforms via radio and television. The study population consists of senior secondary school students in

Kaduna State, North West Nigeria. For the purpose of this investigation, a total of 450 senior secondary school students who actively subscribed to the Kaduna State e-learning via radio and television were purposively selected from twelve public secondary schools in three educational divisions in Kaduna. Learners Satisfaction and Needs on e-learning Platforms (LSNEP) questionnaire was used for data collection. It consists of four sections (Section A, B, C and D). Section A was designed to collect respondents' demography, Sections B, C and D were respectively designed to collect data regarding the satisfaction level, assessment and preferences attributes of the learners. There were 25 items in all and a 4-point scale was used in weighing experts responses in which Strongly Agree (SA), Agree (A), Disagree (D) and Strongly Disagree (SD)or Very Often (VO), Often (OF), Occasionally (O) and Rarely (R) were awarded 4, 3, 2 and 1 points respectively. A decision rule was set, in which mean score of 2.50 above was considered Agreed while a mean score below 2.50 was considered Disagreed.

The face and content validity of the questionnaire was done by two e-learning experts, an educational technologist and two senior secondary school teachers to provide their judgments on the items. Positive feedbacks were received and some minorrevisions were made to the instrument according to their suggestions. The reliability of the constructs(the extent to which the items in the questionnaire were related to each other were examined using Cronbach's alpha formula, reliable coefficients ranging from 070 – 0.75 were obtained. The instrument was pilot tested using 100 students who are part of the population but not in the sample of the study. The researchers personally visited the school during the senior school certificate examinations conducted by West African Examinations Council (WAEC), stated the purpose of the study to the administrators and the students and solicited for their cooperation. The students writing the examination were given questionnaire to fill, the duly completed questionnaire were collated and analyzed to answer the three research questions. Specifically, descriptive statistics of simple percentage and mean were used for the analyses which are presented in Tables 1, 2 and 3 with their interpretations and discussion of findings following.

Results

Research Question 1:

Are learners satisfied with the e-learning platforms used to teach them in Kaduna state?

Table 1: Satisfaction level of learners on e-learning platforms in Kaduna State.

Item	Statement	Responses				Mean
		SA	A	D	SD	(X)
1	I was able to use the radio and television stations for learning with ease.	182 (40.4%)	208 (46.2%)	21 (4.7%)	39 (8.7%)	3.18
2	The e-learning system used was useful to fulfil my learning needs.	175 (38.9%)	186 (41.3%)	10 (2.2%)	79 17.6%	3.02
3	The e-learning system was organized to satisfy my learning objectives	128 (28.4%)	220 (48.9%)	61 (13.6%)	41 (9.1%)	2.97
4	It was easy for me to always connect to the e-learning platforms i.e television and radio	245 (54.4%)	84 (18.7%)	111 (24.7%)	10 (2.2%)	3.25

5	The e-learning system provided the precise course content that I was looking for.	143 (31.8%)	127 (28.2%)	56 (12.4%)	124 (27.6%)	2.64
6	The e-learning classes covered all the contents in the various subjects as I expected	38 (8.5%)	152 (33.8%)	204 (45.3%)	56 (12.4%)	2.38
7	The e-learning classes and the instruction media were attractive	126 (28.0%)	153 (34.0%)	163 (36.2%)	8 (1.8%)	2.88
8	The amount of time allocated to each course is appropriate	131 (29.1%)	262 (58.2%)	43 (9.6%)	14 (3.1%)	3.13
9	The lessons taught boosted my confidence in all my subject areas.	131 (29.1%)	242 (53.8%)	52 (11.5%)	25 (5.6%)	3.06
10	I was able to reach the instructor via phone call or sms to get further clarification after the classes	34 (7.6%)	157 (34.9%)	202 (44.9%)	57 (12.7%)	2.37

The results in Table 1 show that 69.41% of surveyed learners were quite satisfied in using e-learning platforms. The mean score of this factor is 2.89 which shows majority of contemporary learners were able to easily access the lessons via radio and television and the lessons and media were attractive.Majority of the factors displayed in Table 1 recorded a mean greater than 2.5 of which the factor of reaching the instructors via sms or phone calls for further clarifications was the lowest with a mean of 2.37 on a 4-point scale. 42.3% of the surveyed learners opined that the course contents in the various subjects were not covered by the instructors as expected.

Research Question 2:
Are learners assessed on their learning needs before the start of the e-learning course?

Table 2: Learning needs and assessment of learners on e-learning platforms in Kaduna State.

Item	Statement	Responses				Mean
		SA	A	D	SD	(X)
1	I am always assessed on learning objectives before the start of all e-learning classes.	39 (8.7%)	122 (27.1%)	201 (44.7%)	88 (19.6%)	2.25
2	I am usually assessed on my personal learning needs and context before the start of the e-learning courses.	112 (24.9%)	60 (13.3%)	188 (41.8%)	90 (20.0%)	2.43
3	Questions on personal learning preferences are asked before the start of the e-learning courses.	86 (19.1%)	74 (16.4%)	187 (41.6%)	103 (22.9%)	2.32
4	Learners are asked on their personal learning habits before the start of an e-learning course.	55 (12.2%)	16 (3.6%)	188 (41.8%)	191 (42.4%)	1.86

5.	E-learning instructors enquire about the preferred teaching styles of learnings before the start of an e-learning course.	28 (6.2%)	50 (11.1%)	261 (58.0%)	111 (24.7%)	1.99
6	Prior knowledge required to learn a course is usually examined before the start of an e-learning course.	36 (8.0%)	198 (44.0%)	121 (26.9%)	95 (21.1%)	2.39

It can be observed from the data in Table 2 that the mean scores of all factors are below 2.5 on a 4-point scale, the average mean score of the factors is 2.21. It is evident from the table that 74.2% of the surveyed students were either rarely or never assessed on learning needs, objectives, teaching styles and preferences. While 52% of the learners agreed that prior knowledge required to learn a course is usually examined, only 15.8% were asked about their learning needs before the start of the lessons.

Research Question 3:

Two what extent are e-learners in Kaduna state able to provide their learning experiences and preferences.

Table 3: Preferences and Experiences of e-learners in Kaduna State.

Item	Statement	Responses				Mean
		VO	OF	OC	RA	(X)
1	Questions and quizzes were given at the end of each lesson.	241 (53.6%)	92 (20.4%)	61 (13.6%)	56 (12.4%)	3.15
2	The assignments questions given were related to the lessons taught.	331 (73.5%)	89 (19.8%)	30 (6.7%)	0 (0%)	3.67
3	The assignment questions given covered the content of the topics taught during each lesson.	267 (59.3%)	79 (17.6%)	95 (21.1%)	9 (2.0%)	3.34
4	I was able to attempt all the quiz and assignment questions before the next lesson or topic.	274 (60.9%)	116 (25.7%)	87 (19.3%)	32 (7.1%)	3.67
5	All the courses taught boosted my confidence level in the subjects	155 (34.4%)	246 (54.7%)	21 (4.7%)	28 (6.2%)	3.17
6	The lessons were all arranged in a clear and logical way.	181 (40.2%)	194 (43.1%)	43 (9.6%)	32 (7.1%)	3.16
7	The time allocated for each lessons was enough.	161 (35.8%)	178 (39.5%)	75 (16.7%)	36 (8.0%)	3.03
8	I was opportune to interact with other students on the taught courses after the classes	98 (21.8%)	201 (44.7%)	66 (14.6%)	85 (18.9%)	2.69
9	I was able to interact with the teachers after the lessons.	157 (34.9%)	66 (14.7%)	43 (9.5%)	184 (40.9%)	2.43

The results in table 3 reveals that most of the factors are above 3 on a 4-point scale, the average mean score of the factors is 3.15; with the lowest mean score of 2.43 for opportunity to further interact with the teachers and the highest as 3.67 for being able to attempt all quiz and assignment questions even

as they were related to the lessons taught. It is clear from the table that 77.18% of the respondents were able to provide their learning experiences and preferences.

Findings

Data from 450 respondents to the questionnaires were analyzed using descriptive statistical techniques. All students were in the senior secondary classes and participated in the West African Senior School Certificate Examination (WASSCE). A good number of the students (69.41%) were satisfied in using the e-learning platforms via radio and television, even though some (42.3%) of the respondents felt the course contents in the various subjects were not covered. This may be due to limited time.

It was also deduced that a large number (74.2%) of the surveyed students were either rarely or never assessed on learning needs, objectives, teaching styles and preferences before or during the lessons. The teachers had no opportunity to assess the learning needs of the learners.The research findings further showed that 77.18% of the respondents were able to provide their learning experiences and preferences after the lessons. This is via interactions with the instructors through phone calls or sms, collaboration with other students, attendance to assignment and quiz questions among others.

Discussion

E-learning requires a holistic approach to be considered. Socio-technical and organizational factors are crucial to its effective implementation. Inadequate and ineffective facilities limit its adoption and limitation. This agrees with the study by Anene et al (2014) who found that infrastructure deficienciesis one of the obstacles to the use of ICT; most Nigerian educational institutions do not have adequate e-learning facilities.

On the research objective that sought to determine the satisfaction level of learners on the e-learning platforms used, the finding revealed that majority of the learners are satisfied with the e-learning platforms (radio and television) used to teach them. The finding supported that of Fayomi et al (2015) which provides evidence of significant impact of e-learning in facilitating academic studies and self-development resulting to improved learning process and high academic performance. The finding also disagrees with that of Aboderin (2015) who found out in his study that lack of ICT facilities and access to the available ones are major setback to its effective use by learners, hence there were not satisfied with its usage.

On assessment, learning needs, experiences and preferences of the learners, it was discovered that most of the learners were not accessed on their needs or preferences before the commencement of the lessons but they were able to share their learning experiences and preference during and after the lessons.This conforms tothe findings of Shraim and Khlaif (2015) who found out that both students and teachers have positive attitudes towards the usefulness of e-learning methods but that they might not yet be ready to adopt them because of its virtual nature.

The study has demonstrated that recent changes in the world have led students and teachers in secondary schools to explore and adopt the use of e-learning and the results showed that there is a positive attitude towards its adoption.The analysis of the quantitative data indicates that learners are satisfied with the use of the radio and television media for e-learning because most of them

can easily access these media. Although, there were some hitches and setbacks such as power failure, access to radio and other related devices, this is being overcome with the use rechargeable phones and radios which use solar technologies. Most learners have a preference for face-to-face teaching methods, perhaps because they want direct contacts with the instructors or they have limited access to the e-learning platforms.

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Phases Involved in the Development and Evaluation of an Interactive Mobile Application for Learning Undergraduate Educational Technology Concepts

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Abstract
The purpose of this study was to design, develop, and validate an interactive mobile application for learning undergraduate educational technology concepts. This study reveals the tools, phases and model involved in the development and evaluation of a mobile learning application. Design and Development Research (DDR), was employed for the study and qualitative method was used for the analysis. Three research questions were raised and answered. JavaScript, HTML, CSS, Cordova, PHP, Articulate 360 and Moodle platform were the tools used in the development of the package, validation of the package was done three times by educational technology experts and computer experts, and the ADDIE model was used for the development of the mobile learning package.Therefore the developed interactive mobile application is recommended for use in tertiary institutions as a means for delivering learning content and assessing students in other to improve their performance.

Keywords: Mobile Technology, Instructional Package, Design and Development Research.

Introduction
Educational technology is not restricted to high technology but is anything that enhances classroom learning in the utilization of blended, face to face, or online learning. The phrase 'educational technology', a composite meaning of technology + education, is used to refer to the most advanced technologies that are available for both teaching and learning in a particular era (Micheal, 2015). One of the advanced and pervasive technology available in this era is mobile learning (mlearning), which is an extension from electronic learning (e-learning) (Khalil, 2017).

Despite the fact thatmobile technology is no longer new to Nigerian youths as they possess smartphonesand demonstrate high level usage skills for successful implementation (Chibuogwu, 2016). This opportunity remains untapped by most of our tertiary institutions. As pointed out by (Aniah & Queen,2018), lecture method of teaching is the most practiced method in tertiary institutions and as such, the increase in the population of students, poses a challenge to the teachers as the available human resources are inadequate to cope with the growing population. Also, numerous researchers has come up with different approach to salvage the situation.

Innovative approaches like Computer Based Instructions (CAI), Authoring Tools (I.eeXeLearn, Articulate, Adobe Captivate), Learning Management Systems (LMS) like Modular Object Oriented Dynamic Learning Environment (MOODLE), Illias and Blackboard, Inquiry-based Learning Systems like WebQuest, Learner-Centred approach like Flipped Classroom utilizing several media like Textbooks, Audio, Audio-Visuals and Multimedia still have constraints like expensive hardware that is fragile, heavy and kept in tightly controlled settings, erratic power supply, frequent breakdown of ICT facilities which can be resolved using a true mobile device like a smartphone for learning content delivery. As pointed out by (Omotosho, *et al.* 2015), the advent

of m-learning devices has brought about the redundancy in some computer devices. Research has been conducted in many Nigerian Universities with prove of readily and available computer systems that can host most of the innovations as stated above, but students and teachers are refusing to utilize them for teaching and learning.

Prove on the availability of infrastructure to support M-learning as a mode of teaching in tertiary institutions is pointed by(Statista, 2021)discovery that 67% of his respondents has used either a tablet or smartphone for teaching or learning, 33% reported not to have used mobile device for teaching or learning and surprisingly, the respondents owned mobile devices as there was a 0% report on individuals not owning a mobile device.Also, the data consumed by this smartphones is provided by major telecommunication companies operating in Nigeria such as MTN, AIRTEL, GLOBACOM, and 9MOBILE. These internet service providers (ISP) also referred to as Mobile or Telecommunication Operators over the years has continued to provide internet services at a competitive rate as shown below:

Table 1: Data Subscription rate

	MTN	**ETISALAT**	**GLOBACOM**	**AIRTEL**
DAILY		100Naira	300Naira	200Naira
WEEKLY	1000Naira	500Naira	900Naira	1000Naira
MONTHLY	3000Naira	3000Naira	2,800Naira	3000 Naira

Source: Adopted from Adedoja*et al.* 2012

Table 2: Data subscription as at 2021

	MTN	**9Mobile**	**GLOBACOM**	**AIRTEL**
DAILY	₦50/40Mb	₦50/50Mb	₦50/50Mb	₦50/40Mb
WEEKLY	₦300/ 350Mb	₦300/ 350Mb	₦200/350Mb	₦300/ 350Mb
MONTHLY	₦1000/1.5Gb	₦1000/1.5Gb	₦1000/2.9Gb	₦1000/1.5Gb

Source: Researcher

Table 1 andTable 2, reveals that there is a significant drop in the cost of data rates between 2012 and 2021. With the drastic drop in the cost of data due to the competition among telecommunication operators in Nigeria, the education sector cannot turn a blind eye to the potentials and huge benefits presented through the use of mobile devices for instructional purpose. Therefore, this study capitalises on the affordability and availability of smartphones and the ready infrastructure to support M-learning.

M-learning Application

Mobile operating systems also known as the system software are programmed software specifically designed for mobile devices. They can be referred to as the foundational software to

house the application software. There are different mobile operating systems for smartphone devices namely; Google's Android, Apple's IOS, Microsoft's Windows, Symbian and Blackberry (Ozturk, 2017).

This study utilizes the android mobile operating system. Android operating system was preferred since its affordable and it is frequently used. Most of the mobiles use android and IPhone operating system in this current generation (Alfarsi*et al.* 2018). According to IDC (2015), Android and IOS mobile operating systems account for 96.3% of all smartphone shipments. Android has an 86.8% share of the smartphone market and IOS has a market share of 12.5%. IDC data also clearly shows that the Android mobile operating system is the most common operating system in the world. One of the most important reasons of this is that Android devices have a wide range of prices that everyone can buy (Kocakoyun&Bicen, 2017). Below is a diagram that illustrates the system architecture of the developed Interactive mobile application.

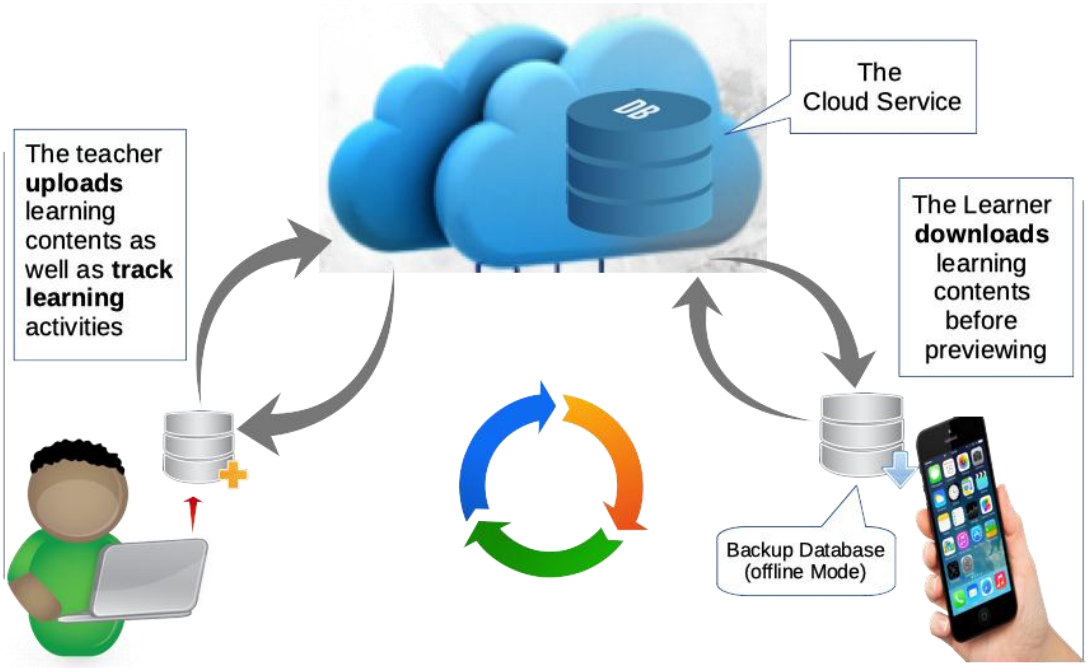


Figure 1: System architecture of an Interactive Mobile App

Source: Researcher

This M-learning technology consist of three parts; the Teachers device, the cloud services and the learners device (smartphone device) all facilitated by the internet. Its designed using a cloud based mobile technology which reflects a redundancy plan to reduce loss of information. Three databases are involved (the teachers device, the cloud database and the learners mobile app). This M-learning technology involves two principal actors: the teacher and the student.

The teacher creates the learning content and assessments using an authoring tool on a computer device and uploads the learning content to the cloud. The students access and engages with the

learning contents through the interactive Mobile application installed on their smartphones. Downloaded learning contents are available to the learner on offline mode. Every content that was accessed via the mobile app can be seen without the use of the internet on a later basis. This is as a result of the databank in the learners' mobile app.

The teacher can track learning activities of the students based on the cloud based mobile application technology as it provides instant feedback to the teacher on Students activities like logging time, time spent on courses, percentage coverage of course content which can be fetched from the learners smartphones. This study focuses on supplementing the traditional classroom with the use of an interactive mobile application as a means of delivering and assessing learning contents.

Purpose of the Study

This study was carried out to develop, validate and evaluate an interactive mobile application for learning undergraduate Educational technology concepts. Specifically, the research was carried out to determine:

1. The tools used in the development of the interactive mobile application;
2. The stages involved in the validation of the interactive mobile application; and
3. The phases involved in the development and evaluation of the interactive mobile application.

Research Questions

The study provided answers to the following research questions:

1. What are the tools used in the development of interactive mobile application for learning undergraduate Educational technology concepts?
2. What are the stages involved in the validation of aninteractive mobile application for learning undergraduate Educational technology concepts?
3. What are the phases involved in the development and evaluation of interactive mobile application for learning undergraduate Educational technology concepts?

Research Design

This study was a Design and Development Research (DDR), which revealed stages of developing the interactive mobile application.

Research Question One: What are the tools used in the development of interactive mobile application for learning undergraduate Educational technology concepts?

The interactive mobile application was built using JavaScript, Html, CSS, Cordova, and PHPprograming language to create an interactive environment to suit teaching and learning. While the Graphic User Interface (GUI) was created using Articulate 360. Moodle platform was used to manage the learning content andlinks from YouTube channels with creative common licenses where deployed for the video tutorials.The entrance menu of the package consisted of student's registration/Login page. The Dash boardcontains four learning materials namely: Video tutorial; folders containing text document; final assessment; and external links for further studies.The Video section, enables the learner to stream tutorials. The folders provides the learner with text on educational technology concepts. Self-assessment exercises are embedded in each unit to check

the level of cognition. Upon successful completion of the Self-assessment exercise the learner progresses to the next unit. A poor performance returns the learner to the beginning of the current learning content. Ensuring mastery and attainment of the learning outcomes in the learning content.

Research Question Two: What are the stages involved in the validation of an interactive mobile application for learning undergraduate Educational technology concepts?

The validation of the Interactive mobile applicationfor learning undergraduate educational technology concepts was done in three phases.

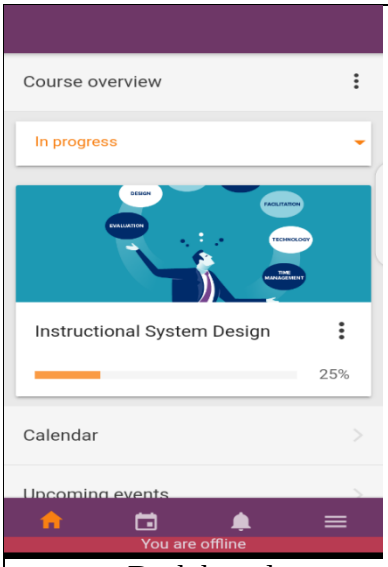
First Validation: After completion of the initial development of the mobile app, it was validated by five computer programmers one from MaiTai Technology, Tel-Aviv, Isreal, one from the school of information and communication technology (SICT) and three (3) from the Centre for Open Distance and e-Learing (CODeL) in Federal University of Technology, Minna, Nigeria. These experts observed some weaknesses in the package which could affect its suitability and utilization by students in the learning of the selected educational technology contents. They observed that the deploying of the learning content using pdf format was not screen friendly. It was not possible for the text to adjust and fit into smaller phone screens. Hence, they suggested the need to improve on the text font to make it suitable for learning.

Second Validation: Based on experts' suggestion after first validation process, the authoring tool was changed to articulate 360, and the learning content was deployed using Moodle platform. This enabled the learning content fit into any viewing screen and learners could change the text font to the preferred sizes. The package was thereafter subject to expert's validation. These experts suggested that the contents in the interactive mobile app should possess formative evaluations that will only allow progress when a student scores 60 percent and above, and the learning contents should be arranged according to the learning objectives.

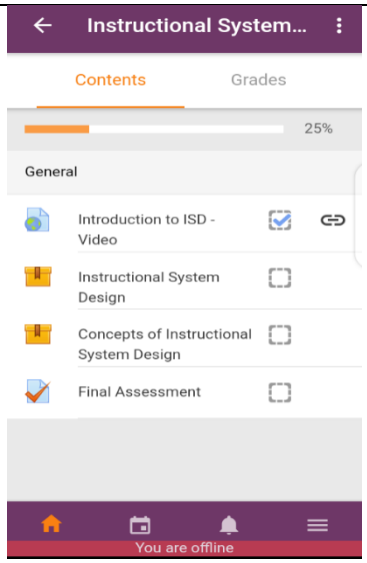
Third Validation: Based on experts' suggestion during the second validation process, multiple-choice self-assessment exercises were added, introductory page was provided for each unit as well as the learning contents arranged in-line with the stated learning objectives. The experts that were involved in the second validation process were asked to validate the package again. At, this point, the interactive mobile application was certified suitable for learning undergraduate educational

technology concepts.

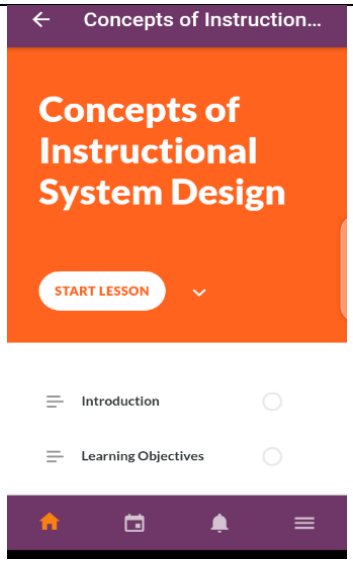
Figure 2: Screenshot of the developed Interactive Mobile Application



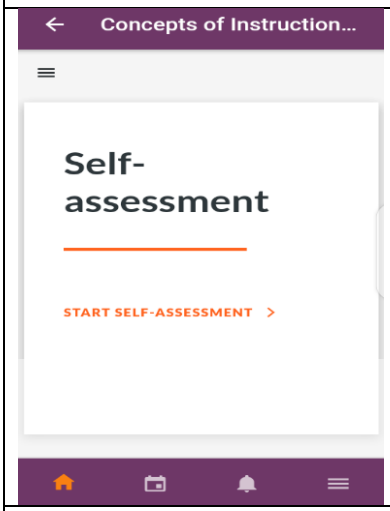
Dash board



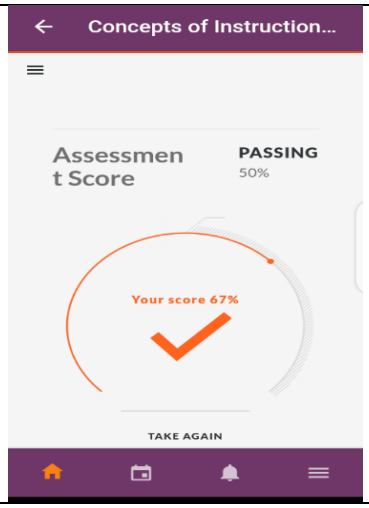
Learning content



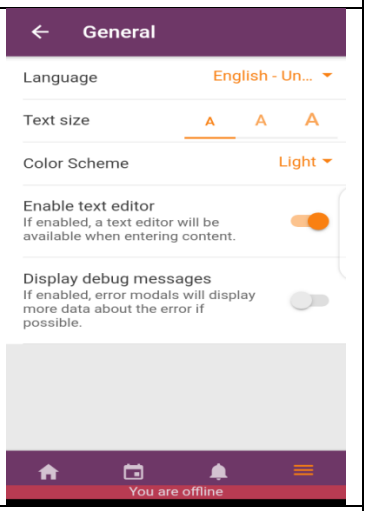
Unit page



Assessment page



Grading page



Settings Page

Research Question Three: What are the phases involved in the development and evaluation of interactive mobile application for learning undergraduate Educational technology concepts?

The development and evaluation of an interactive mobile application for learning undergraduate educational technology concepts was carried out based on the 5 phased ADDIE (Analysis, Design, Development, Implementation and Evaluation) Model. The phases are:

Analysis Phase: At this phase, the need for developing the interactive mobile application on the concepts of Instructional system design concepts were identified and analyzed by educational technology experts.

Design Phase: At this phase, three experts; a computer programmer, two educational technology expert were involved in the design of the package. The learning contents inclusive of the formative and summative evaluation were created. The educational technology assessment test (ETAT), Software development expert validation assessment report (SDEVAR), Course expert validation assessment Report (CEVAR), Educational technology expert validation assessment report(ETEVAR) and an Interactive mobile application were created. These instruments weredesigned based on the needs identified and analyzed as seen in figure 3.

Development Phase: this phase witnessesthe validation of all the research instruments, merging of the learning contents, formative and summative assessments, uploading of the video files and external reading links. Also, the developed interactivemobile application was validated by the experts involved in the determination and identification of needs at analysis Phase.

Implementation Phase: At this phase, the validated ETAT was administered to the test sample (pre-test), one research assistant was trained, and the interactive mobile application was deployed on the android phones of the research participants as well as an orientation on how to utilize the interactive mobile application was conducted.

Evaluation Phase: At this phase, the researchers evaluated theeffectiveness of theinteractive mobile application in the teaching and learning of instructional design development by administering the ETAT (Post-test). The fetched data was analysed and findings reported.

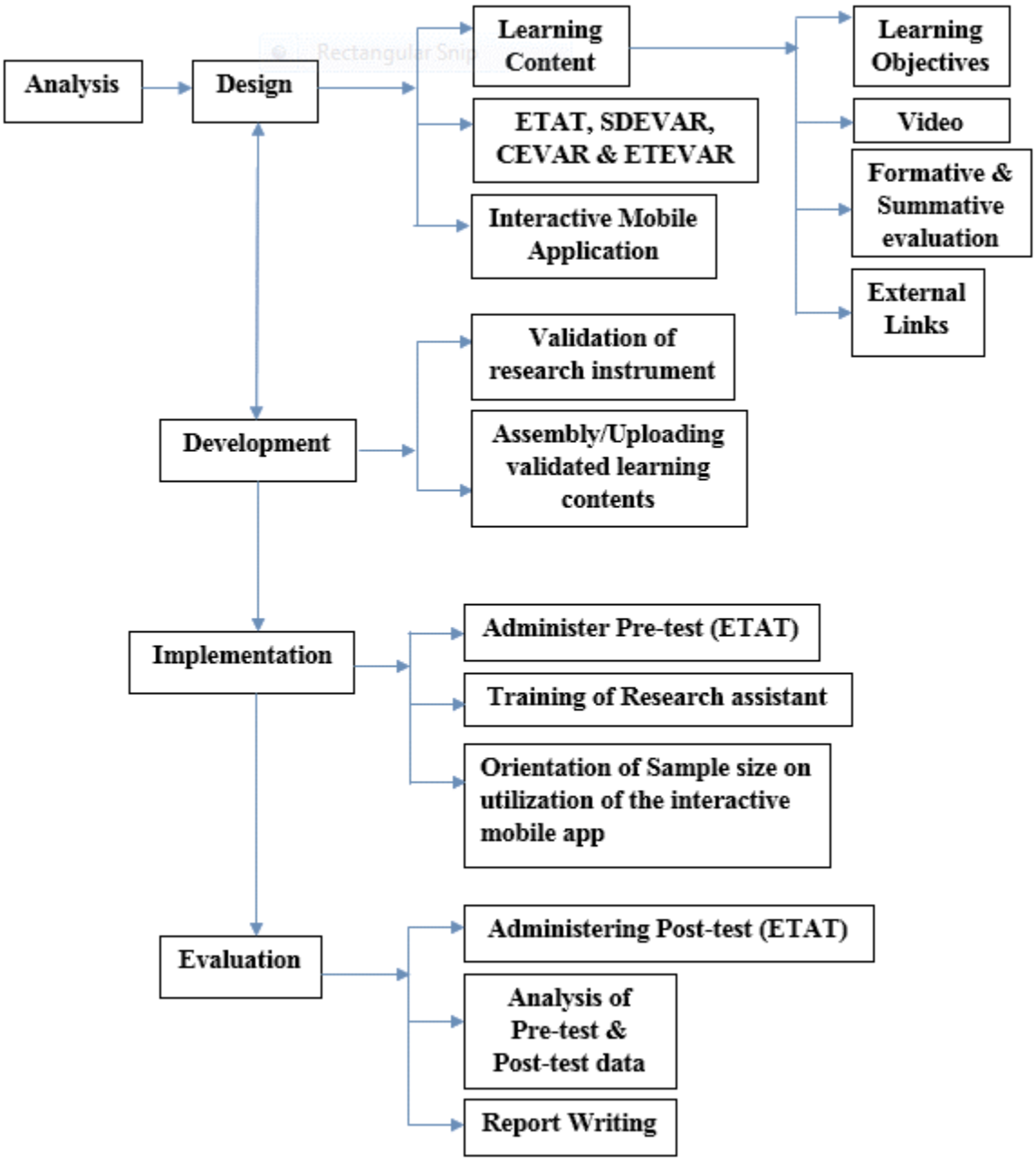


Figure 3: Model for the Development and Evaluation of an Interactive Mobile Application for learning undergraduate educational technology concepts

Conclusion

This study has revealed that development and evaluation of an interactive mobile application is best carried out in stages starting from analysis of needs, to design, development, implementation and evaluation stage, and that, a team of experts is usually required in such process. The developed interactive mobile applicationcan be deployed among undergraduate students as there is prove of available mobile smartphone infrastructure. Also, the utilization of an interactive mobile application for learning is capable of improving undergraduate students' performance, in learning of undergraduate educational technology concepts.

Recommendations

It is recommended that the developed interactive mobile application should be used by tertiary institutions as a means for delivering learning content and possibly assessment of students in other to improve their performance, as well as meet up with the needs of other types of learners (audio, visual and introverts).

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Telegram: A Social Media Tool for Fostering Collaborative Learning

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Abstract
This review paper takes a look at the social media platform, Telegram, as a tool for fostering collaborative learning in teaching and learning. There is no doubt that technology has permeated almost all facets of life including the education sector.Technological advancement has led to the proliferation of many social media platforms that are now massively integrated in teaching and learning. Instruction on telegram is fully student-centred where learners collaboratively interactive with their peers and tutors in order to construct their own knowledge. Instruction on Telegram makes learning interactive, flexible and interesting. Telegram has groups and channels that can accommodate up to 200,000 participants for active engagement and collaboration. Interestingly, unlike other social media platforms, with Telegram, educational files of up to 2 gigabytes,and in different formats, can be sent and be accessed by a wide range of audience within a small period of time.These educational files could either be exchanged synchronously or asynchronously. With the aforementioned features, Telegram is very useful for collaborative learning because it fosters student-student interaction as well as student-teacher interaction. Students can learn together in Telegram groups and channels, thereby forming the ability to construct their own knowledge through observation, imitation and behaviour modelling.

Introduction
Technology has permeated almost all facets of life with the education sector not an exception as well. Technological advancement has led to the proliferation of several social media platforms which facilitate online collaboration. One of such social media platform is Telegram, which has become one of the major tools for education in the aspect of social media learning. Denysiuk *et al.* (2018) labelled instruction on Telegram to be a learner-centred method where learners have unlimited access to information. Telegram as a social network is becoming one of the major tools for education especially in the aspect of social media learning. The rapid development and enormous advancement in computer technologies have been affecting all aspects of life for more than three decades. Moreover, studies found a positive association between the use of internet and social media and academic performance of the students. Students using internet frequently, scored higher grades (Hakim, 2019). Integrating Telegram into existing learning practices can provide an interactive, flexible learning where students can learn new things and perfect some skills. By learning on Telegram, the interactions with peers and teachers can be maximized and this promotes better learning compared to a traditional classroom situation.Telegram enables active collaboration between peers as well as their tutors.

Teaching and Learning on Telegram
One of the main advantages of Telegram is that it fosters collaborative learning, and eases some of the burden on teachers thereby making learning flexible, interactive, and interesting. As a result, Chang and Hsu (2011) stated that learners, in a collaborative learning environment like Telegram, could help each other without any inhibitory feeling. Moreover, they could be engaged in different

features of the App for many hours and it is a wonderful tool to develop learner-centred pedagogy. In addition, the application provides an opportunity for instructors to continuously monitor learners' progress.As a student-centred asynchronous platform, Telegram is considered as a great teaching platform that uses online learning resources to facilitate information sharing outside the constraints of time and place among a network of people. Asynchronous learning is based on a student-centred approach that emphasizes the importance of peer-to-peer interactions. This approach combines self-study with asynchronous interactions to promote learning, and it can be used to facilitate learning in traditional on-campus education, distance education and continuing education (Adesope & Nwaizugbu, 2018).

In a similar regards, Hakim (2019) highlighted some of the key features that make Telegram very useful especially in teaching and learning. These features include:

1. **Safety and Security:** Telegram ensures the cyber security of users since messages are encrypted and the app has the capability of self-destruction, the secret chats can be self-destructed without any interference. This allows learners to be more extrovert and cooperative in doing the tasks because users should no longer be worried about the mistakes they might make since the exchanged messages can be easily rectified. This allows learners to express themselves freely because the messages can be corrected at any time.
2. **Access to channels and group**: Telegram users have access to a wide variety of channels and groups that could accommodate up to 200,000 participants. The channels and groups can either be searched or accessed by having an invitation link. Unlike some other virtual societies and websites, access to channels, discussion groups, and online classes can be made much easier with a little search about the topic of interest. Moreover, joining channels and groups is free of any premium charges. Every teacher or learner can construct their own channels and groups and invite their students to start interacting in an online environment.
3. **The seamless network**: It is possible to use Telegram on different devices simultaneously, for example, on both a smartphone and a laptop. This helps the continuation flow of getting the information from different resources without any interruption. In other words, a learner can start getting the information on their laptop and continue doing so on their mobile phone if they want to get out of the house.
4. **Supporting files with various extensions and size:** Telegram has the capability of supporting all file formats. This is very important for online collaborative learning since teachers and learners need a robust and dynamic environment to send and receive files with different extensions. Moreover, there is no restriction over the size of files which are exchanged. Files up to two gigabyte (2GB) can be exchanged in any discussion forum. Selecting a file from the gallery or saving a file to the hardware requires a single touch or click. For example, the teacher can send a multimedia file with any extension and upload it to a group. All group members can download it for free and share their opinions about it. Learners can also express their own opinions by sharing files. All this maximizes interaction among learners and encourages them to do the tasks collaboratively.
5. **It makes students chat with any one**: students can communicate with someone by just searching them through their usernames and not necessarily through the phone number saved in their contact list

6. **Telegram is a versatile multifunctional online application:** with its channels and groups catering for most purposes of their users, every individual user can create unlimited groups for up to 200,000 members and channels with an unlimited number of members. A group is a combination of email service, text messaging app, multimedia messaging app, online forum discussion, and systematic educational robots. Therefore, it can take care of personal, educational, and business needs all at the same time. Once the members are added to a group, they can be guided by the admin users of the group (usually the online instructors or the researchers and their assistants) to accept the rules of the group. Depending on the purpose of the group, members are briefed on how to make use of the presented materials within an already determined framework.
7. **Assigning tasks to learners:** By using a group, a wide range of meaningful and challenging tasks can be presented to learners. The application endorses podcasts from a wide range of domains like video podcasts for teaching various concepts.

Telegram and Collaborative Learning

Collaborative learning is defined by Dilenbourg (1999) as a situation in which two or more people learn or attempt to learn something together. This can occur in the form of groups or as individuals. Collaborative learning, as observed by Srinivas (2014), is based on the idea that learning is a naturally social act in which the participants talk among themselves. It therefore means that learners need a social environment where they will interact, communicate, share and construct knowledge with peers for effective learning to take place. Under the collaborative learning environment, students are challenged to participate because they listen to different perspectives, and are required to articulate and defend their ideas. Collaborative learning which is embedded from primary schools to tertiary level institutions is among the most explored learning method in the 21st century (Mahbib*et al*., 2017). Collaborative learning is an acceptable method of teaching and learning where students work together in groups to create, complete and enhance given tasks. Students in a social media collaborative learning environment exploit smart devices to collaborate typically in informal learning outside of normal classroom or instructor supervision.

Collaborative social media platforms like Telegram have been frequently used over the years to encourage active participation in classroom learning. Under this system, students interact asynchronously with their colleagues as well as tutors in order to exchange ideas and get in contact with course contents. The social media collaborative platform supports a wide range of documents where learning contexts in the form of multimedia can be dropped for students to download and read. One of the major advantages of social media collaboration is that feedback can be given immediately. Online collaboration allows the collection of data for the comparison, discussion, analysis and feedback of knowledge among students, being an effective way to obtain experimental data that demonstrates the power of technology in group projects which generate reports of its practices (Luna &Sequera, 2015). Through active collaboration on Telegram, students can learn by interacting with one another on groups and channels since the aforementioned can contain up to 200,000 members and files of up to 2GB could be sent and be downloaded which shows its robustness in terms of content sharing.

Conclusion

Given the importance of Telegram through its channels and groups as well as the ability to send files of up to 2 gigabytes, teachers need to seize that opportunity to incorporate the use of social media learning to create a collaborative learning environment where students can learn through interaction with their peers as well as tutors in order to construct their own learning. This will help them to learn better and also toease the burden on teachers since Telegram is flexible, engaging, interesting and asynchronous.

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Lecturers' Awareness and Self-Efficacy Towards Biology Skype Instruction in Colleges of Education During Covid-19 in Niger State

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Abstract
This study investigated lecturers' awareness and self-efficacy towards biology skype instruction in Colleges of Education during covid-19 in Niger State. Descriptive survey research design was used for the study. Four research questions were raised and two correspondingnull hypotheses were formulated and tested at 0.05 level of significance. The sample of the study comprised of 234 biology lecturers in Federal College of Education Kontagora and Niger State College of Education Minna, (Male = 163 and Female= 71). The instrument used to collect data was named Questionnaire on Awareness and Motivation toward Skype instruction in Secondary School (QAMSISS).Pilot study was carried out and the following reliability coefficient were obtained awareness 0.761 and self-*efficacy 0.813. Data collected was analyzed using mean and standard deviation while ANOVA was used to test the two null hypotheses. The findings of the study indicated that there was no significant difference between mean response of awareness male and female biology lecturers towards Skype instruction in colleges of education. Also the study indicated that there was no significant difference between mean response of self-efficacy of male and female biology lecturerstowards use of Skype instruction in Colleges of Education. Since p> 0.05, H02, was accepted. respectively. It wasrecommended that training should be organized on . COVID-19 is causing a series of transformations in the different spheres of social, political, labor, and economic life. Different governments have launched emergency policy initiatives how biology lecturers can make use of Skype for instructional purpose in Biology.*

Keyword: Skype Instructional Platform, Awareness and Self-efficacy

Introduction
Nigeria education has witness dramatic change as results of teaching and learning through the use of mediabased on the suspension of classes and the closure of educational centers to continue teaching activities from homes through the use of Information and Communication Technologies to be able to stop the number of infections (Zhang, *et al* 2020). Specifically, there seems to be paradigm shift that is assuming the transfer from face-to-face teaching to online teaching and how education professionals must face adaptation to the new global context through the online modality, a movement that has occurred and is occurring in a frantic and abrupt way. Consequently, education professionals are carrying out a process of assimilation toward new circumstances with a few difficulties, causing situations of high levels of stress. One of the social media tools that can be used in education transformation during covid-19 pandemic is Skype.

Skype is online Social Media tool mostly used for the audio video call. It is an online source of communication and a user can do his communication, both in audio and video form. Skype is one of the most important tools of communication used for both audio and video calls over the internet.

The most important benefit for Skype user is that Skype calls are free and it offers a computer to landline service for both local and international calls, as a fee-based service. First of all the user account is necessary in order to receive calls, and then when you receive the user account and save it as a contact then it can be used for next time contact without searching for user account again and again. Similarly, so for as the educators are concerned, educators have been incorporating Skype into their classrooms for a number of years now (Ramaraj, 2015).

Skype, a software application for online communication, has been applied in classes at various levels, providing many possibilities for teaching and learning (Foote, 2008, Harrison and Thomas 2009). Skype is a communication media allowing users to make written, audio and video materials over the Internet applying power point, word, mp4, and so on. Although Skype is a technical tool, its free version is being used progressively among teachers and schools interested in world education propositions (Foote, 2008). Skype is being used to promote academic research ideas exchange. Faculty members in different parts of the world are paired off, each is a native speaker of the language with unique research concepts that the other wishes to be informed. According Macharaschwiliand Coggin (2013) lecturers apply Skype in unique manners to satisfy educational goals. The videoconferencing section of the software is valuable in that it offers a method to connect faculty members speaking different languages, hold virtual field trips, and reach out to professionals in different fields of study. These experiences may allow faculty members a chance to apply what they learn in the classroom to real-life experiences and achieve further learning objectives. Skype in the classroom is a free tool having set up its website. It presents teachers with a way to make their classrooms more communicative and attractive. Skype in the classroom is a service teachers can sign up for that will allow learners to meet others.

Davis (2006) postulated that educators have been using Skype in their classroom for several years with a high level of success and convenience. Smethurst, (2009) cited that an Australian educator has used Skype for inter-school debates with the absence of the face to face interaction. Skype provides many free services, including voice and video calls among persons from different geographical location. Thus the use of Skype is very important for developing countries education system and can be used for the following; lives lectures, guest lectures, videoconferencing, tutoring, students' presentation, assessments (oral examination), announcement and virtual field trips when lecturers are aware of it for biology instructional purpose.

Biology is one of the science subjects that occupy a unique position in secondary school curriculum. It is a subject offered in all the senior secondary schools in the country and globally. Biology is relevant to several science courses like Biochemistry, Agriculture, medical sciences such as nursing, medicine and pharmacy. Any student that wants to offer these courses must offer Biology at the secondary school level. This is why researchers and curriculum planners' attention have been drawn to Biology as a science subject. In secondary schools (Okoye&Okechukwu, 2010). The importance of Biology is enormous.

The importance is most noticeable in genetic engineering, blood transfusion, food production, hybridization, marriage counseling and in-vitro fertilization (Ajala, 2011). In spite of the relevance and importance of Biology to human lives, research findings have continued to give evidences which showed that the achievement of students in Biology is nothing to write home about (Okoye&Okechukwu, 2010). The study of Biology can provide solutions to food scarcity, environmental pollution, population density, radiation, epidemic and terminal diseases, poor

hygiene, family life, management and conservation of natural resources as well as biotechnology and ethics with lecturers' awareness on the use of Skype.

Awareness as the conditions of being aware and able to understand what is happening around one. In the context of this study and in agreement with the above views, awareness implies understanding, attitude and knowledge of the activities and events going on around one's environment (Chinedu, 2008). Looking at the self-efficacy as one of the variable in this study is also crucial factor towards use of Skype Instructional Platform.

Self-efficacy is a key contributing factor to lecturers and learners' success, because self-efficacy "influences the choices teachers and learners make and the courses of action they pursue" (Pajares&Schunk, 2001). Generally, self-efficacy is influenced by four main sources: enactive mastery experience-that is, hands-on experience; vicarious experiences-that is, other people's experience; verbal persuasion-that is, appraisal or feedback from others; and physiological and affective states-that is, stress, emotion, mood, pain, and fatigue (Hodges, 2008). Once self-efficacy is established, it can be applied to similar teaching and learning situations.

The closer these situations are to those in which self-efficacy has been improved, the stronger the effect (Baddeley, 2002) these sources are selected, interpreted and integrated into a total estimate of self-efficacy that in turn influences subsequent, cognitive, motivation, emotional and selective processes. Kan and Akbaş (2006) showed that students and teachers with high self-efficacy beliefs tried to come over challenging tasks more and longer than the students and teachers with low self-efficacy. Several empirical studies have shown the reason for lecturer's awareness and self-efficacy in the use of media for instructional purposes.

Khalid (2016). A study was carried out to evaluate English teachers' awareness and perceptions in using e-learning tools. In that study, the result of the study showed that English teachers are aware and familiar with popular e-learning tools and perceived its usefulness in teaching and learning.

Alah*et al* (2012) identified the influences which lead to self-efficacy in Montessori teacher. The research indicates that the Montessori teachers with high level of self-efficacy have strong mastery experiences that support their attitudes and desired professional goals. The quantitative results also show that an emotion state associated with past experiences is the second best contributor to self-efficacy.Landaniand Hassan, (2013) whose research was on investigating factors affecting the intention to use blog and ease of its use at secondary and tertiary educations. The results suggest that only one factor such as academic benefits was found to have a significant influence on the intention to use blog. In addition it was also found that there is a significant difference between perceived academic benefits of blogging at school and university levels of education.

Statement of the Research Problem

The challenge of Colleges of Education in Niger State during pandemic was their in-ability to maintain social distance and the in ability for students to have access to classroom lectures in order to curb corona virus pandemic. In spite of the use of technological devices in the 21st century classroom instructions, the problems that have been identified with the conventional method of teaching were lack of awareness and self-efficacy of lecturers towards biology Skype Instruction

Platform, which has been affecting Colleges of Education syllabus coverage by their lecturers due to covid-19 social distance. It is in the light of this that the researcher intended to investigatelecturers' awareness and self-efficacy towards biology Skype Instruction in colleges of education during covid-19 in Minna, Niger State Nigeria.

Aim and Objectives of the Study

The aim of this research is to investigated lecturers' awareness and self-efficacy towards biology Skype instruction in secondary schools during covid-19 in Minna, Niger State Nigeria. The specific objectives are to:

1. Find out mean response of lecturers' on awareness to use Skype Instructional Platform for instructional delivery in Colleges of Education in Niger State.
2. Examined the mean response of male and female lecturers' awareness towards use of Skype Instructional Platform for biology instructional delivery in Colleges of Education in Niger State.
3. Find out the mean response of attitude of lecturers toward the use Skype Instructional Platform for instructional delivery in Colleges of Education**.**
4. Examined the mean response of male and female lecturers' self-efficacy towards use of Skype Instructional Platform for biology instructional delivery in Colleges of Education in Niger State.

Research Questions

The following research questions were raised to guide the study:

1. What is the mean response of lecturers' on awareness to use Skype Instructional Platform for instructional delivery in Colleges of Education in Niger State?
2. What are the mean response of male and female lecturers' awareness towards use of Skype Instructional Platform for biology instructional delivery in Colleges of Education in Niger State?
3. What is the mean response of attitude of lecturers to use Skype Instructional Platform for instructional delivery in Colleges of Education**?**
4. What are the mean response of male and female lecturers' self-efficacy towards use of Skype Instructional Platform for biology instructional delivery in Colleges of Education in Niger State?

Research Hypotheses

The following null hypotheses were formulated and tested at 0.05 level of significance:

H_{01}: There is no significant difference in the mean response of male and female lecturer's awareness towards use of Skype Instructional Platform for biology instructional delivery in Colleges of Education in Niger State.

H_{02}: There is no significant difference in the mean response of male and female lecturers on self- efficacy towardsthes use of Skype Instructional Platform for biology instructional deliveryColleges of Education in Niger State.

Methodology

The research adopted the descriptive survey design. The population of the study comprises 565 Lecturers of the two Colleges of Education in Niger State. The institutions are: Federal College of

Education Kontagora and Niger State College of Education Minna. The lecturers' population comprises of 430 males and 135 females. The target population for the study was made up 565 lecturers from both Federal College of Education and Niger State College of Education Minna. Thewhole population of the lecturers in both schools served as target population for the purpose of generalization of the study. The sample of this study was made up of 234 lecturers (163 males and 71 females) from the Colleges of Education in Niger State (FCE Kontagora and COE Minna). A random sampling technique was used for the study, the reason for using this technique was for every respondents to be given equal chance of been chosen for the study.

The Instruments for the study was namedQuestionnaire on Awareness and self-efficacy toward Skype instruction in Secondary School (QASSISS).' was employed for the study. The questionnaire is a close-ended questionnaire and it consists of three sections (Sections A, B & C). Section A was used to collect demographic data of respondents, Section B consists of statements on lecturers' awareness towards the use of Skype Instruction for academic purposes and Section C was used in collected data on lecturers' self-efficacy towards the use of Skype Instruction Platform for instructional delivery and gender was considered as moderating variable. All items was presented using a 5-point Scale in which Strongly Agree (SA) was awarded 5 points, Agree (A) was awarded 4 points, Undecided (U) was awarded 3 points, Disagree (D) was awarded 2 points and Strongly Disagree (SD) was awarded 1. The questionnaire (QASSISS), was validated by two Educational Technology experts and one science education lecturer from the Department of Educational Technology and Science Education Federal University of Technology Minna respectively. The reliability of the research instrument was determined after a trial testing using a simple random sample of 35 respondents (Lecturers) from school of Languages Niger State College of Education Minna, who are part of the population but not part of the sample for this study. The administration was done once and a reliability coefficient of 0.761 and 0.813 were respectively obtained for awareness and self-efficacy using Cronbach Alpha formula, which implies the instruments arereliable. The questionnaire wasadministered to the groups during three weeks of the study. Mean and standard deviation were used to answer research questions and ANOVA was used to analyze research hypotheses. Conclusion was established that there was significant difference between male and female lecturers' in the level of awareness on the use of Skype Instructional Platform for instructional delivery in Colleges of Education in Niger State. While there was no significant difference between self-efficacy of male and female lecturers' on the use of Skype Instructional Platform for instructional delivery in Colleges of Education.

Results

Research Question One: What is the mean response of lecturers on awareness to use Skype Instructional Platform for instructional delivery in Colleges of Education in Niger State?

Table 1: Mean and standard deviationof awareness of lecturers to use Skype Instructional Platformfor instructional delivery in Colleges of Education

		N	$\bar{X}$	Sd	Decision
1	Mobile phones can be used for instructional delivery for schools	234	3.44	1.313	Agree
2	The use of Skype Instructional Platform for instructional delivery will create awareness to the lecturers' as a mode of instructional delivery	234	3.37	1.230	Agree

3	Teaching through mode of Skype Instructional Platform yield more than conventional teaching.	234	3.44	1.259	Agree
4	Skype Instructional Platform is used for instructional delivery in higher institution of learning.	234	3.59	1.272	Agree
5	Am aware that Skype Instructional Platform is good for instructional delivery in tertiary institutions.	234	3.45	1.186	Agree
6	Am aware that Skype Instructional Platform for instructional delivery is vital form in education.	234	3.47	1.284	Agree
7	Teaching with Skype Instructional Platform saves time during instruction.	234	3.51	1.261	Agree
8	I am aware that Skype Instructional Platform supported can serve as supplementary learning tool	234	3.35	1.228	Agree
9	Use of on-line learning for instruction is feasible with the use of Skype Instructional Platform.	234	3.29	1.369	Agree
10	Am aware that Skype Instructional Platform can be used to access students results	234	3.22	1.268	Agree
			34.14	8.465	

Decision Mean= 3.0

Table 1 Indicate readiness of lecturers towards use Skype Instructional Platform for biology instructional delivery. It was agreed with the mean values ranging from 3.22 to 3.59, it was revealed that lecturers awareness promote use of Skype Instructional Platform for biology instructional delivery in colleges of education in the Niger State. With the grand mean of 34.14, the implication is that, the awareness of lecturers towards use Skype Instructional Platform for biology instructional delivery is favourable since all the items on awareness showed agreed based on decision mean 3.0.

Research Question two: What are the mean response of male and female lecturers' awareness towards use of Skype Instructional Platform for biology instructional delivery in Colleges of Education in Niger State?

Table: 2: Mean and Standard Deviation of male and female lecturers' awareness towards use of Skype Instructional Platformfor biology instructional delivery in Colleges of Education in Niger State

	N	$\bar{X}$	Sd	Mean Difference
Male	163	34.80	7.86	2.19
Female	71	32.61	9.60	

Table 2 shows the mean and standard deviation of the male and female lecturers on the awareness towards use of Skype Instructional Platform for biology instructional delivery in colleges of education in Niger State. From the result, it can be seen that mean and standard deviation values of the male and female lecturers are $\bar{X}$ =34.80, SD = 7.86 and $\bar{X}$ = 32.61, SD =9.60. Also the result reveals the difference of 2.19 between the mean of awareness of male and female lecturers in

favour of the male. To determine whether mean response have any significant difference, a corresponding null hypothesis was tested.

Research Question Three: What is the mean response of attitude of lecturers to use Skype Instructional Platform for instructional delivery in Colleges of Education**?**

Table 3: Mean and standard deviationon self-efficacy of lecturers towards use of Skype Instructional Platform for biology instructional delivery in Colleges of Education

SN	Items	N	$\overline{X}$	Sd	Decision
1	I can succeed in biology instructional contents to the students through Skype Instructional Platform.	234	3.61	1.138	Agree
2	If I practiced every day, I could develop more skill in my pedagogy through Skype Instructional Platform.	234	3.36	1.120	Agree
3	When I am confronted with academic problems, I can find all solutions through the Skype Instructional Platform.	234	2.25	.863	Disagree
4	I can solve most of biology problems if I invest effort in employing the appropriate Skype Instructional Platform.	234	3.32	1.177	Agree
5	I can use Skype Instructional Platform to enable students to developed problem solving skills.	234	3.37	1.155	Agree
6	I can manage biology instructional time effectively with the use of Skype Instructional Platform.	234	3.36	1.215	Agree
7	I can evaluating students' through the use of Skype Instructional Platform.	234	3.38	1.102	Agree
8	When I am confronted with instructional problems, I can find several solutions through Skype Instructional Platform always.	234	3.53	1.120	Agree
9	If I practiced every day, I could develop many skills in my pedagogy through Skype Instructional Platform.	234	3.55	1.068	Agree
10	I can develop collaborative work through the use of Skype Instructional Platform for biology instruction.	234	3.55	1.084	Agree
	Grand mean		**33.29**		

Decision mean 3.0

Table 3 Indicate self-efficacy of lecturers towards use Skype Instructional Platform for instructional delivery. It was agreed with the mean values ranging from 3.32 to 3.38, it was revealed that lecturers self-efficacy promote usage of Skype Instructional Platform for biology instructional delivery in colleges of education in the Niger State. With the grand mean of **33.29,** the implication is that, the self-efficacy of lecturers towards use of Skype Instructional Platform for biology instructional delivery is favourable since nine out of ten items on self-efficacy show agreed based on decision mean of 3.0.

Research Question Four: What are the mean of male and female lecturers' self-efficacy towards use of Skype Instructional Platform for biology instructional delivery in Colleges of Education in Niger State?

Table 4: Mean and Standard Deviation of male and female lecturers' self-efficacy towards use of Skype Instructional Platformfor biology instructional delivery in Colleges of Education in Niger State

Gender	N	$\bar{X}$	Sd	Mean Difference
Male	163	32.96	6.49	1.1
Female	71	34.06	5.08	

Table 4 shows the mean and standard deviation of the male and female lecturers' self-efficacy towards use of Skype Instructional Platform for instructional delivery in Colleges of Education in Niger State. From the result, it can be seen that mean and standard deviation of male and female are; male $\bar{X}$ = 32.96, SD = 6.49 and female $\bar{X}$ = 34.06, SD =5.08, the mean difference is 1.1 in favour of female lecturers self-efficacy**.** To determine whether the mean scores have any significant difference, a corresponding null hypothesis is tested.

Hypothesis One: There is no significant difference in the mean response of male and female lecturers' awareness towards use of Skype Instructional Platform for biology instructional delivery in Colleges of Education in Niger State?

Table 5: ANOVA analysis of male and female mean response of male and female lecturers' awareness towards use of Skype Instructional Platform for biology instructional delivery in Colleges of Education in Niger State

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	1805.007	1	1805.007	31.650	.000
Within Groups	13231.031	232	57.030		
Total	15036.038	233			

S 0.05 level of significant

Table 5 shows the hypothesis that stated that no significant difference between mean response of male and female lecturers' on level of awareness towards use of Skype Instructional Platform for biology instructional delivery in Colleges of Education in Niger State was tested. The finding in (table 5) showed f= 31.650 with p = 0.00. Since p< 0.05, H01, was rejected. Therefore there was significant difference between mean response of male and female lecturers' on level of awareness towards use of Skype Instructional Platform for biology instructional delivery in Colleges of Education in Niger State.

Hypothesis Two: There is no significant difference in the mean response of male and female lecturers' on self-efficacy towards use of Skype Instructional Platform for biology instructional delivery in Colleges of Education in Niger State?

Table 6: ANOVA analysis of mean response of male and female lecturers' on self-efficacy towards use of Skype Instructional Platform for biology instructional delivery in Colleges of Education in Niger State

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	238.948	1	238.948	3.368	.068
Within Groups	16458.676	232	70.943		
Total	16697.624	233			

NS 0.05 level of significant

Table 6 shows the hypothesis that stated no significant difference in the mean response of male and female lecturers' on self-efficacy towards use of Skype Instructional Platform for biology instructional delivery in Colleges of Education in Niger State was tested. The finding in (table 6) Showed f = 3.368 with p = 0.068 since p> 0.05, H03, was accepted. Therefore there was no significant difference in the mean response of male and female lecturers' on self-efficacy towards use of Skype Instructional Platform for biology instructional delivery in Colleges of Education in Niger State.

Discussion of Findings

There was significant difference between mean response of male and female lecturers' on level of awareness towards use of Skype Instructional Platform for biology instructional delivery in Colleges of Education in Niger State. This is in support of the study of Khalid (2016) who carried out to evaluate English teachers' awareness and perceptions in using e-learning tools. The result of the study showed that English teachers are aware and familiar with popular e-learning tools and perceived its usefulness in teaching and learning.

There was no significant difference in the mean response of male and female lecturers' on self-efficacy towards use of Skype Instructional Platform for biology instructional delivery in Colleges of Education in Niger State. This is in agreement with the findings of Alah*et al* (2012) who seek to identify the influences which lead to self-efficacy in Montessori teacher. The research indicates that the Montessori teachers with high level of self-efficacy have strong mastery experiences that support their attitudes and desired professional goals. The quantitative results also show that an emotion state associated with past experiences is the second best contributor to self-efficacy.Also concur with study ofLandaniand Hassan, (2013) whose research is on investigating factors affecting the intention to use blog and ease of its use at secondary and tertiary educations. The results suggest that only one factor such as academic benefits were found to have a significant influence on the intention to use blog. In addition it was also found that there is a significant difference between perceived academic benefits of blogging at school and university levels of education.

Conclusions

It can be concluded that lecturers' awareness and self-efficacy towards use of Skype Instructional Platform for supplementary learning is positive. The study reveals that Skype Instructional Platform can be useful for learning of biology in Colleges of Education. The use of Skype Instructional Platform in education can be extremely beneficial in supplementary teaching and learning of biology in Colleges of Education.

Recommendations

1. Enabling law on the use of Information Communication Technology should be enforce in order to make use of Skype Instructional Platform as supplementary teaching and learning tools in Colleges of Education in Niger State.
2. Lecturers should be encouraged to attend workshop/conference on how to develop self-efficacy on the use of Skype Instructional Platform in Colleges of Education.

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Effects of Scripted Images and Self-instructional Modules on the Learning Outcomes of Secondary School Biology Students' in Minna, Niger State

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Abstract
The study investigated the effects of scripted images and self-instructional module on the learning outcome of secondary school Biology students' in Minna Niger State. Quasi experimental design was adopted in the study, a sample of 171 Secondary School (SSII) from three senior secondary schools in Minna were used for the study. The instrument used for data collection was Biology Achievement Test (BAT). The instrument was validated by experts in Educational Technology, Science Education, Biological Science and Biology teachers. The instrument was pilot tested and the internal consistency was determined using Pearson Product Moment Correlation Formula to be r=0.83 for BAT. The results indicated that there was significant difference in the mean achievement Scores of Biology students taught using scripted images and self-instructional module, based on these findings, it was concluded that the use of scripted images and self-instructional module was more effective in enhancing students' achievement in Biology than the conventional method. It was recommended that re- training of teachers on the use of instructional material such as scripted images and self-instructional module to enhance the achievement and retention ofsecondary school Biology students' should be encouraged.

Keywords: Scripted image, Self-instructional module, Achievement.

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Introduction

One of the key problems in evolving a development strategy for a developing country like Nigeria is lack of the capacity for appreciation and application of science and technology through developmental efforts (Ayodele *et al.*, 2020). Adequate teaching especially through the use of instructional materials such as scripted images and self-instructional module at secondary and higher levels of development at any phase is always linked with technology and technology happen when there is advancement in science, hence, science and technology are proportional to each other (Pujari, 2014).Science and Technology are the bedrock of any structural and physical development in the contemporary world. Apart from the improvement in the standard of living, science and technology have facilitated the development leading to the improvement of their needs and desire to compete with the developed world in all spheres of life, education inclusive (Idris *et al.*, 2018).

Script writing is the art and craft of writing scripts for mass media such as future films, television productions, video games or scripted image, an image is the representation of something or copied and stored in electronic form. An image can be described in terms of vector graphics or raster graphics (Vasudevan *et al.*, 2019).

Self- instructional module is a form of active learning that gives learners an opportunity to work individually according to their special needs. It is effective for learning in the cognitive and psychomotor domains where the goal is to master knowledge and apply it into practice. With self-

instructional module, learners study by themselves using text books, scientific journals and hand out notes prepared by the teachers. It can also be effective for introducing principles and step by step guidelines prior to demonstration of professional skills. Moreover, it provides various strategies for self-assessment, that enables students to evaluate their progress frequently and provides immediate feedback. (Heba *et al.,* 2019).

Biology is a natural science concerned with the study of life and living organisms, including their structure, function, growth, evolution, distribution, taxonomy and cell. Modern Biology is a vast and elective field composed of many branches and sub- disciplines, however, despite the broad scope of Biology, there are certain general and unifying concepts within it that govern all study and research, consolidating it into single coherent fields. In general, Biology recognize the cell as the basic unit of life, genes as the basic of heredity synthesis and creation of new species (Ibrahim *et al.,* 2018) Also teachers think instructional material is time consuming and expensive, it is variable tools in enhancing students learning outcome such as achievement of the concept taught. Learning outcome is a description of what a learner will have learnt at the end of a period of study. Learning outcomes in theory can encapsulate a wide range of knowledge types, skills and behaviors. We can thus have learning outcomes that describe: particular skills, such as operating a microscope, ways of thinking, such as analyzing, ways of behaving, academic achievement, retention and interest (Proitz, 2010).

Academic achievement is a successful accomplishment or achievement in a particular subject indicating grades, marks and scores of learners in particular (Aghruwhe, 2013). In addition, Aghruwhe (2013). View academic achievement among student with hearing impairment as an accomplishment of different tasks of learning given to them within a stipulated time or academic year. Academic achievement is therefore an accomplishment, doing something successful with an effort and skill as a result of hard work. (Lay *et al*., 2014). Academic achievement in learning also translated into the retention of concepts learnt.

Retention, is seen as what is left after learning has taken place over a given period of time (Roediger and Butler, 2011). Retention refers to how much a person remember what he/she has learnt after an interval of time without practice. In other words, is the difference between what is initially learnt and what is later forgotten, it is important that what students learn remained with them beyond examinations and test. Mohammed (2015) retention is learning which last beyond the initial testing and is assessed with test administered two or more weeks after the information has been taught and tested. Based on these, the Nigerian Educational System have been modified severally by different administrations to achieve the educational goals and objectives of the country.

Gender is a socially ascribed attribute which differentiate feminine from masculine. The difference in biology achievement due to gender has caused a lot of concern to educationist, parents do not want to spend as much on female education as that of male children because of their social or cultural environment (Okoye, 2016).

Secondary education in Nigeria is of six years duration, divided into Junior Secondary School (3 years) and Senior Secondary School (3 years). The two stages are both vocational and academic in nature. The broad goal of secondary education according to the National Policy on Education

(NPE, 2004) is to prepare the individual for useful living within the society and preparation for higher education. One of the instructional materials are wide varieties of equipment and materials use for teaching and learning by teachers to stimulate self-activity on the part of the pupils (Jacobson *et al., 2010*). Kourea, *et al* (2019) conducted a research on guided notes intervention program on quiz and note taken and suggested that academic performances of students may be strengthened when guided notes are combined with systematic instruction methods and that teachers who use guided notes with their lectures may be more likely to stay on topic and provide pertinent information.

Despite the importance attached to Biology in National policy on education FRN (2009), students record poor achievement in the 2019 and 2020 Senior Secondary School Certificate Examination, where by over 58% of students fail and 42% of students' scores above average. Following this assertion, the researcher projected among other factors to be teaching method. In spite of application of various interactive packages to improve the teaching and learning of biology, the trend persisted. As a result, the researcher sought to investigate effects of scripted images and self-instructional module on the learning outcomes of Senior Secondary School Biology students in Minna Niger State Nigeria.

Ihejiamaizu and Ochui (2019) carried out study on utilization of modern electronic instructional materials and biology students' academic achievement. The study adopted expost facto-research design. A hypothesis was formulated to guide the study, and relevant literature reviewed in line with the purpose of the study. A sample of 490 students was used for the study. A checklist and achievement test were instruments used for data collection. Data generated were analyzed using one-way analysis of variance and tested at 0.05 level of significance. The findings showed that utilization of electronic instructional materials significantly influence students' academic achievement in biology. Based on the findings, it was recommended among others that government should ensure effective distribution of electronic types of instructional materials to all public secondary schools presenting candidates for SSCE and NECO to enhance effectual teaching and learning of biology.

Aims and Objectives of the Study

The aim of this study was to investigate the Effects of Scripted Images and Self-Instructional Modules on Learning Outcomes of Senior Secondary School Biology Students in Minna, Niger State.

The objectives of the study are: to

1. Examine the effects of scripted images, self-instructional module, and conventional method on the academic achievement of Senior Secondary School Biology Students'.
2. Find out the effects of scripted images, self-instructional module, and conventional method on the retention of Senior Secondary School Biology Students'.
3. Determine the influence of scripted images,self-instructional module and conventional method the achievement of male and female Senior Secondary School Biology Students'.

Research Hypotheses

The following null hypotheses were tested in the study.

1. There is no significant difference in the mean achievement scores of Senior Secondary School Biology Students' taught with scripted images, self-instructional module, and conventional method.
2. There is no significance difference in the mean retention scores of Senior Secondary School Biology Students' taught with scripted images, self-instructional module and conventional method.
3. There is no significant difference in the mean achievement scoresof male and female Senior Secondary School Biology Students' taught with scripted images.

Methodology

The research design adopted for this study was quasi-experimental design. It is a non-randomized, pretest-posttest control and experimental design. The design involves a control group and an experimental group using intact classes. The dependent variables of the study were achievement, and retention while the independent variables is scripted images and Self-instructional modules and gender as the moderating variable. Biology achievement test was administered on both group as pretest, posttest and post-posttest. The population for this study consisted of Senior secondary School Biology students in all the senior secondary schools in MinnaMetropolis of Niger State totaling 2,543 male and female and the target population was SS II students totaling (848) in 2020/2021 academic session.Multi-stage sampling was adopted for the study. Simple random sampling techniques was used to select three (3) senior secondary schools out of the ten (10) schools in Minna. The three selected schools wererandomly assigned; to as experimental group I, experimental group II and control group. Purposive sample techniques were used to select SSII intact classes of Biology students from the sampled schools totaling 171 the class was purposively sampled based on the experience, content and scheme of work/syllabus.

Four instruments were used in this study. The instruments were categorized into two namely; Treatment Instruments and Test Instruments: Treatment instruments; Scripted Images (S.I) Self-Instructional modules (SIM) Test instruments; Biology Achievement Test (BAT) Lesson plan for the conventional classroom instruction. The scripted images were developed by the researcher and computer graphic designer. The Scripted images is an image with text explanations on the stages of cell division in Biology. Self-instructional module was developed by the researcher and the content consisted of the study units, introduction, learning objectives, main content, self-assessment exercise summary/ conclusion and reference/suggestion for further reading. This is an individualized lesson where the students take the courseware with them to learn at their own pace and time. Achievement Test was used to assess students' achievement after the instructions. The students are to gain mastery of the content and the test instruments was administered. The test instrument was developed by the researcher and it was divided into two sections: Section A consist of Bio data of the students and B contained Questions on stages of cell division. Section A was Designed to obtain students' Personal data while B consist of 40-item multiple choice questions on Cell division with four options (A,B,C & D) which was used to collect data on students' achievement based on the concept taught. It was constructed to measure some cognitive domain level of the students. The required process for test development which includes preparation of table of specification, item construction, content validation and item analysis was followed.To determine the reliability of the instruments, pilot test was carried out by the researcher to find out

the reliability of the instruments. The reliability coefficient of Biology Achievement Test (BAT) was analyzed using Pearson Product Moment Correlation PPMC due to the use of test retest method. Thus, the coefficient of BAT was calculated to be 0.83 this shows that the instruments is suitable for the study.

The researcher visited the sample school authorities to get permission to use their schools. The researcher used the second week to train the research assistant on the operational guides on how to use scripted images and self-instructional module. Pretest was administered in the second week of the study from third to six week the treatment commenced. The students' in experimental group 1 and experimental group 2 were enlightened on how to use scripted images and self-instructional modules and the control group was taught with conventional method. Revision was given on week seven. On the eight-week Biology Achievement Test (BAT) was administered to all the groups. The test items were reshuffled to create an impression that the pretest, post-test and retention test differs from each other. The data collection process lasted for eight weeks.The data collected was analyzed using descriptive and inferential statistics. Analysis of Variance (ANOVA) was used to analyze pretest scores, it was established that significance difference does not occur in the pretest, therefore ANOVA was used to analyze posttest and retention scores of the group, where significant difference exists between the groups, then ANCOVA was used to determine where the statistical difference existed. Statistical Package for Social Science (SPSS) Version 20.00 was used to analyze the data obtained.

Results

Hypothesis One: There is no significant difference in the mean achievement scores of Senior Secondary School Biology Students taught with scripted images, self-instructional module, and conventional method.

Table 1: Summary of Analysis of Variance (ANOVA) Comparison of the Post-test Mean Achievement Scores of the Experimental and Control Group Taught Biology using Scripted Images, Self-Instructional Module, and Conventional Method

	Sum of Squire	DF	Mean Square	F	Sig
Between Groups	29186.674	2	14593.337	232.01	.000
Within Groups	10566.908	168	62.898		
Total	39753.582	170			

*Sig at P<0.05

Table 1 shows the results of the analysis of variance on achievement scores of students who taught biology using scripted images, self-instructional module, and conventional method. As shown in (Table 4.1) revealed F (2, 168) = 232.01 p=0.00. With P< 0.05, the null hypothesis (**H_{O1}**) was rejected. Therefore, there was significant difference in the mean achievement scores of students taught biology using scripted images, self-instructional module, and conventional method. Scheffe post-hoc was used to determined direction of differences.

Table 2: Scheffe Post-Hoc of Scripted Images, Self-Instructional Module, and Conventional Method.

Group	Dependent Variable	(I) Group	(J) Group	Multiple Comparisons Mean Difference (I-J)	Std. Error	Sig.
46	POSTTEST	SI	SIM	-27.0433*	1.4779	.000
			CM	-32.2713*	1.6364	.000
77		SIM	SI	27.0433*	1.4779	.000
			CM	-5.2279*	1.4585	.000
48		CM	SI	32.2713*	1.6364	.000
			SIM	5.2279*	1.4585	.002

Significant different at 0.05

Hypothesis Two: There is no significance difference in the mean retention scores of Senior Secondary School Biology Students' taught with scripted images, self-instructional module and conventional method.

Table 4.1.2 shows scheffe post-hoc of scripted image (SI), self-instructional module (SIM) and conventional method (CM) of teaching biology in SSII, significance difference was established between scripted image and self-instructional module with 0.00. Also significance difference occurred between scripted image (SI) and conventional method with 0.00. Between self-instructional module and scripted image significance difference of 0.00 occurred while between self-instructional module and conventional method significance difference of 0.02 exist. Finally between conventional method and scripted image significance difference of 0.00 occurred while between conventional method and self-instructional module 0.02 level of significance occurred.

Hypothesis: There is no significant difference in the mean achievement scores male and femaleof Senior Secondary School Biology Students' taught with scripted images.

Table 4.2: Summary of analysis of variance (ANOVA) comparison of the post-test mean Retention Scores of the Experimental and Control Group Taught Biology using Scripted Images, Self-Instructional Module, and Conventional Method

	Sum of Squire	Df	Mean Squire	F	Sig
Between Groups	37157.996	2	18578.998180.57	.000	
Withhin Groups	17284.841	168	102.886		
Total	54442.836	170			

NS=Significant at P<0.05

Table 4.2 shows the results of the analysis of variance on retention of students who taught biology using scripted images, self-instructional module, and conventional method. As shown in (Table 4.2) revealed F (2, 168) = 180.57 p=0.00. With P< 0.05, the null hypothesis (**H_{O2}**) was rejected. Therefore, there was significant difference in the mean retention scores of students taught biology

using scripted images, self-instructional module, and conventional method. Significance difference was established using scheffe post-hoc.

Hypothesis Three:

Table 4.3: ANOVA Analysis of Achievement of Male and Female Students Taught Biology using scripted image

	Sum of Squire	DF	Mean Squire	F	Sig
Between Groups	19.020	1	19.020	.237	.62
Within Groups	6012.149	75	80.162		
Total	6031.169	76			

NS= Not Significant at P>0.05

Table 4.3 shows the results of the analysis of variance on achievement of male and female students taught Biology using scripted image strategy as shown in (Table 4.3) revealed F (1, 75) = 0.23 p= 0.62 With P >0.05 the null hypothesis was accepted. Therefore, there was no significant difference in the mean achievement scores of male and female taught Biology using scripted image.

Discussion of the Findings

There was significant difference in the mean achievement scores of students taught biology using scripted images, self-instructional module, and conventional method. This is in agreement with findings of Adegoke (2010) who examined the effect of multimedia instruction on students' learning outcomes (achievement and interest) in secondary school physics. Results showed that students in the animation + narration + on-screen text group had highest post mean scores in physics achievement test and interest in Physics inventory than those of text-only and text-audio groups respectively. Also, students who learnt Physics in Computer-Based Multimedia (CBM) environment had better learning outcomes in Physics than the students who learnt Physics under teacher-based environment. This is contrary to the study of Jung-Chuan et al (2012) who examined effects of different teaching strategies (text-based concept mapping vs. image-based concept mapping) on the learning outcomes and cognitive processes of mobile learners. Their finding revealed that there was no significant difference in students learning achievement.

Recommendations

Based on the findings of this study, the following recommendations were made:

i. Scripted images and self-instructional module should be encouraged in schools for teaching Biology.
ii. Teachers should be trained on the use of scripted image and self-instructional module presentation that can bring better results in teaching and learning of Biology.
iii. Workshop seminars, symposia and conferences should be organized periodically to acquaint new biology teachers with recent research findings that would lead to effective and meaningful teaching and learning.

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Assessing the Attitude of Geography Teachers towards the Utilization of Selected Social Media for Learning Among Senior Secondary Schools in Bosso Local Government Area, Minna, Niger State

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Abstract
This study assessed a review of geography teachers' attitudetowards the utilization of Social Media, for learning. Social media has become a valuable source for development, communication, entertainment, companionship, and adventure. It is bound to affect profoundly almost all human activities including education, industry, governance, personal lives, and social lives around the world. This review summarizes relevant research on the meaning of social media, selected types of social media platform, importance of social media to education, Social media and academic performance Abuse of social media, public disclosure of personal information, and privacy concerns Social media and its perceived ease of use Social media and cultural factors Teachers Attitude towards Social Media Geography Teachers utilization of social media Social Media and Nigeria Education Relevance of Social Media as an Educational Tool in Geography. The paper concluded by advocating for Governmentorganizations, agencies and Non-Governmental Organizations to fund more researches in social media usage in Nigeria. School management should provide enabling environment for teachers and students to effectively use social media for teaching and learning process. More conferences, seminars and workshops should be organized for teachers and students to keep them abreast with the various use of social media to enhance teaching and learning.

Keywords: Awareness, interest, attitude, geography, social media

Introduction
The innovative, evolutionary and revolutionary growth and development of ICT in education has brought about the use of social media as a form of educational strategy to enhance teaching and learning of geography as a subject. Social media has a significant effect on learning of Geography (Eleyyan, 2021). Technological gargets are influential in nature since newer versions that supports the use of social media platforms for educational purposes are been manufactured year in year out. Social media is a major strategy to enhance teaching and learning of Geography as a subject. Social media refers collectively to all media technologies, including the internet and computer, which are used for communication (Dekker *et al.,* 2018). Social media has become a valuable source for development, communication, entertainment, companionship, and adventure. It is bound to affect profoundly almost all human activities including education, industry, governance, personal lives, and social lives around the world (Anandhan*et al.*, 2018). Media has become an essential part of life; people are spending their time on new technologies like internet, cell phones and computers to stay in touch with world events and entertainment(Leung, 2020). Social media has come to play a fundamental role in modern society. The five main functions of media are influencing, educating, informing, entertaining and providing market for goods and services (Zollo*et al.,* 2020). Social

media is very important in the fast moving world because without media society would be unaware of local and foreign affairs (Bergström*et al.,* 2018).

The Type and Use of Social Media in Education

The social media has been used widely in educational settings (Evans, 2014). The use of social media has transformed classroom, change the interaction between teacher and student (Warschauer, 2018). The emerging of social media in classroom activity should be followed by the innovation in learning process (Prestridge, 2019).

Website

Website can be used to communicate interactively by students and teachers or instructors who are more effective in the education and teaching process (Cole, 2020). This learning can optimize the teaching and learning process because it is no longer bound by time and space. In addition, website-based learning can be used as a provisioning advice and training on ICT utilization. This can maximize the ability of students to grasp, because teaching material is not only limited to text, but can be in the form of images, videos, or other interesting media. For teachers/lecturers/instructors, the use of the website can facilitate monitoring of student learning activities (Cholifah, *et al.*, 2020). Moreover, it can be used as a means of developing interactive teaching materials (Anwariningsih, 2013).

Blog

Blog features that contain document text, images, media and other supporting features can be accessed easily through an internet browser. Generally, a blog contains personal notes or journals. Blogs in learning can be used as interactive media outside the classroom (Chawinga, 2017). For example, a teacher at a school can create a blog where the contents of the blog contain teaching material taught by the teacher. Furthermore, students can be invited to access the blog, students are allowed to fill in the comment menu on the blog, so that communication occurs between the teacher and students. On the comments menu, students can write proposals, comments and share about the teaching system in the school, so the school and teachers can improve their performance as expected by students (Liou, 2019). In addition, the teacher can compile and resume learning material then put it in a blog. This really helps speed up teaching because students don't need to take notes anymore on the board. This can also help improve teacher creativity in presenting teaching materials through blogs, both in terms of content and presentation. With blogs the teacher can learn and improve the ability to make a scientific or written work. This is important because one of the demands for teachers is to produce scientific papers. Blog can also be used as a means of disseminating the results of research, training, workshops and various other scientific activities (Cholifah, *et al.,* 2020).

Face book

Facebook is the most widely used social media in the world. The application, pioneered in 2006 by Mark Zuckerberg, was originally only designed to allow students in the same class to see a list of classmates. But apparently it developed into an extensively network and can be used for various things, including teaching and learning. Facebook can be used as an alternative in controlling and delivering material in distance learning (Domingues, 2017). Some hobbies, and interests. This can build new online communities and carry out a variety of positive and beneficial activities (Kittur,

2014). The online community is certainly very useful for students. One of the benefits of online or online communities is exchanging information and expanding networks (Deng, 2013).

Effect of social media usage

a) Social media has a very big role to develop the skills possessed (Awasthi, 2020). As we know, the best talents can be found quickly through social media. For example, a child who can sing very well, record it with video, upload the video to social media, and share the video with his friends and the public can help him be found by leading producers and invite him to record to make an album or invite him to take part in the search event talent.
b) Social media is available in various forms. This allows students to explore creativity. For example, students who have the ability to write will create a personal blog and deepen their writing skills. As social media, blogs provide space for students or anyone to express their thoughts, views, or opinions about certain issues. Some social media have limited space to write complete words.
c) Students who actively using social media can reduce their attention to learning material (Babchuk, 2015). This is because students are too busy checking the latest status of others and then giving comments. This distracted attention can disrupt the learning process and have an impact on students' ability to concentrate which later leads to a drop in academic achievement (Dontre, 2021).
d) When interacting with other people in cyberspace, there is a lot of information that needs to be questioned. Inaccurate information and its distribution with no responsibility, is one form of ethical violations on social media (Kumar, 2019). The more time spent interacting with others through social media, the less time they have to search for and obtain the truth of information obtained during interactions.
e) Humans are social creatures and therefore need to socialize and interact with others to survive. Social media exists as a modern communication media that allows students or anyone to interact with others from all over the world (Cholifah, *et al.*, 2020
f) Students become unaware and not careful about the bad possibilities that can happen. The presence of social media in the universe of communication between people has had a major impact on patterns of communication between people, especially interpersonal communication. In other words, social media influences individual patterns of interaction and this is also an example of the effect of media in individual interactions (Hudson, 2016).
g) Social media is effective in helping shy students to communicate with other students or others. However, this can have an impact on communication skills face to face. If shy students often use social media to interact and express themselves, this can make them feel isolated in the real world and can even increase communication anxiety for fear of meeting other students or people (Cholifah, 2020).
h) Something that is excessive certainly will not have a good impact. Likewise, with excessive use of social media. The use of social media without limits and without remembering time can make students become addicted. Being addicted to using social media is one of the negative impacts of social media (Purba, 2020).

Social media and academic performance

An initial study by Tracy (2019) showed that students use social media for various academic activities such as research, communication, collecting evidence and so on. In spite of this, research shows that the use of social media does not translate to students' academic success. For example, Balakrishnan*et al.*(2017)found that Facebook could distract students, especially when the learning tasks are deemed less important. A similar sentiment was shared by Junco (2017).

Abuse of social media, public disclosure of personal information, and privacy concerns

One of the reasons for the privacy concerns is plausibly the abuse of social media by students. Such abuses may range from cyberbullying, stalking, and infringement of privacy (Bitherman & Frempong-Kore, 2021). Privacy issues may result in apprehension towards the use of social media in education (Chugh*et al.*, 2018). For example, Manca and Ranieri (2016) found privacy to be one of the factors that inhibit the use of social media for educational purposes. On the other hand, research has shown that students perceive academics with high self-disclosure in social media as more credible (Chen, 2019). Interestingly, the same study also found that academics who portray themselves as strict and formal in class, yet display a friendly and informal social media personality, confuse students. There are however, academics, parents, and students who believe that academics should not be deemed as friends with students, and that there should be a clear line drawn between faculty and students (Balakrishnan*et al.*,2017).

Social media and its perceived ease of use

Another factor that may affect students' use of social media is the perceived ease of use of these sites. Compared to other complicated e-learning sites, social media are arguably deemed rather user friendly. The perceived ease of use of social media has been suggested as a contributing factor to its popularity for educational purposes, and contributes to group communication success as well (Balakrishnan*et al.*,2017). Considering that there are over 198 social media providers listed by Wikipedia (Jin*et al.*, 2021) it is important to examine if users' experience in using social media will determine its success and popularity in higher education. However, few researches have looked at how social media's perceived ease of use affects online learning's success (Balakrishnan*et al.*,2017).

Social media and cultural factors

Cultural factors may also affect the use of social media for online learning. Many studies exist in the area of culture and its effects on learning. Some researchers reported that cultural differences between western and Asian students affect teaching philosophies, approaches and strategies (Christensen, 2019). Cultural norms affect the way students think, making it a vital influencing factor in their self-regulated learning process. For example, a study by Ali *et al.* (2018) showed that Japanese students learn by applying more memorization as opposed to Australian students. Similarly, Ho (2019) study of Australian and Asian students showed that Australians are more motivated to excel by competition while Asians are motivated by their social standards and expectations.

Teachers Attitude towards Social Media

Teachers' attitudes are paramount for the successful integration of technology in schools Arkorful et al. (2021). Ren et al. (2018) argue that earlier experiences highly influence teachers' attitudes and beliefs. It seems relevant to try to changestudent teachers' attitudes and beliefs towards

technology in education, following Freire*et al.* (2018) who say that these are defined even before the future teachers start their education, in order to avoid resistance to technology in their teaching.

Geography Teachers utilization of social media

Social media is not a passing fad—it is a new, versatile way of both information gathering and production. It is broadly defined as "networked tools that emphasize the social aspect of the Internet for communication, collaboration and creative expression" Aifan*etal.*,(2015). Although many courses have online components (e.g. WebCT or other learning management systems), it is arguable that we as educators are not taking advantage of mainstream (i.e. applications and sites that are not education specific) social media to its full potential in the classroom.

Woodward and Kimmons (2019) discuss the use (or alternatively, the avoidance) of social media platforms from the instructor's perspective. This is a useful article as it is the instructor who ultimately makes the decision about whether students will be using social media for the purpose of his or her course. The factors affecting an instructor's choice to use social media in the classroom include: current use of social media platforms and personal readiness; pressure to use social media in the classroom by others (peers, employers, students); expected benefits; and perceived risks of use. The consequences of using social media in the classroom can be measured by looking at the perceived student satisfaction and student learning outcomes.

Social Media and Nigeria Education

Many teachers are still apprehensive about using new technologies for instruction in Nigeria. The use of Google especially needs to be promoted in the country because of the vast amount of information that can be found through it, which can bring fun to geography classes. But teachers have been found to be apprehensive about improving and modifying instruction by incorporating new technologies (Sofowora & Egbedokun, 2010). Lack of appropriate skills has also been proffered as a reason for the low utilization of ICT among Nigerian geography teachers. In a survey of technological application in teaching geography in Nigerian secondary schools, Sofowora & Egbedokun (2010) found that even though 55% of geography teachers in a western state of Nigeria had access to computers, majority of them do not have the prerequisite ICT knowledge and skills needed.

Relevance of Social Media as an Educational Tool in Geography

This is useful as it indicates how students now 'learn on demand,' and this can be useful when thinking about how social media can fit into a course. A Personal Learning Environment is the student's 'place' of learning—an environment of self-directed and informal learning, involving both the production and use of material from the Internet. Using social media would allow learners to collaborate, share results, contribute to the collective knowledge of their class, and derive their own meaning from material. Faculty may use Twitter to stimulate student engagement in the classroom, Wiki software as collaborative projects, and blogs as assessments of understanding. Students benefit from using social media in the classroom by taking charge of their learning. However, the drawback (or requirement) is that students must be able to engage independently and self- motivate.

Conclusion

The utilization of Social Media for education in secondary schools is still at its amateur state. Hence, the need for Government organizations, agencies and Non-Governmental Organizations to fund more researches in Social Media in Nigeria. School management should provide enabling environment for teachers and students to effectively use social media. More conferences, seminars and workshops should be organised for teachers and students to keep them abreast with the global emerging technologies. Research institutes in Nigeria should focus on taking advantage of the various social media available for educational purposes.

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Assessing the Availability of Digital Technology and Usage among Staff of Federal Inland Revenue Service for Professional Development in their Training Schools in Nigeria

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Abstract
The study investigates the availability and usage of ICT tools that could enhance effective service delivery among staff of Federal Inland Revenue for their professional development in their training schools across Nigeria. The universal growth of information communication and technology has been linearly associated with professional development in Nigeria. As ICT use, continues its constant growth, its application among Federal Inland Revenue staff is inevitable. Its influence on professional development has important question to think about. Findings revealed that there were low software competence and habitual ways of conceptualizing what and how students should learn. Using a sample of 250 staff in two (2) Federal inland training schools in Abuja and Lagos, this study makes an effort on how to sensitize tax payer, access information materials and the use of digital technologies for FIRS staff professional. Questionnaire was used as an instrument for data collection. Two experts validated the instrument and the reliability coefficient index showed the instrument was reliable. Frequency counts and simple percentage was used to answer research questions. The results showed that there is need to equip the FIRS training schools with modern digital technological tools. It also demonstrated that the use of social media can negatively affect academic activities. It was recommended that the governments, policy makers should provide necessary technological tools in FIRS training schools, also to encourage and give necessary technological support to staff of FIRS training schools.

Keywords: ICT, Digital Technological Tools', FIRS, Availability, Utilization, Staff Usage.

Introduction
The emergence of Information and Communication Technologies (ICTs) in the FIRS, carrying out tax services or routines or information services was done manually. But the introduction of these ICTs has changed the analogue handling of tax services. This shift has broadly affected the acquisition, processing, storage and retrieval of tax collections and remittances to Federal Government of Nigeria. It is widely used that FIRS and information services of tax payers reduces cost, enhances operational efficiency, and most importantly, it improves service delivery and customer experience (Bhoi, 2017).

Information communication technology (ICT) is a universal term that has to do with all communication devices and its applications. ICT tools are the electronic gadgets which aids tax men in carrying out their services, they include: computer and its networks, computer hardware and software, fax, printers, copiers, and many security gadgets as well as various services and applications associated with them which includes: video conferencing, teleconferencing and many more. ICTs are often referred to in different context as; ICTs in education, sports, healthcare and

other spheres of life. Saleem *et al*. (2013) sees ICTs as tools as well as means used for collection, capture, process, store, transmit and disseminate information.

In another study, Rubina *et al*. (2011) posited that ICTs have been a means to bring quality services pointing out that, FIRS information centres at global level are able to provide access to online databases, comprehensive statistical data bases, and full text information sources with keyword searching, the researchers further buttressed that the internet as an ICT tool has transformed the ways and means of tax information services. With the collaborations of Nigeria Customs Services (NCS) and Corporate Affairs Commission (CAC), ICT tools are combined to form the 'networked world' as a massive infrastructure of interconnected telephone services, standardized computing hardware, the internet, radio, and television, which reaches to every corner of the globe (Talebian *et al*, 2014). "The use of digital technologies in computing resources has created a new method of training staff of an organization called e-learning" (Carlson and Gadio, 2018). The e-learning has made possibilities of digital technologies more effective to staff of the organization through computer based resources, teleconferences, audio conference, and web conferences.

Abedi (2015) mentioned that although using ICT tools in training of new approach in developing countries, the usage of those tools in the past few years have increased rapidly. The digital technologies are new in Nigeria industries, private organizations, training schools and educational centres, however, some existing organizations are already in use, but their staff complains about the internet speed and availability of online materials in this system (Java, 2015). The digital usage is still in its primary stages (Hossaini, 2015). In this study, the Federal Inland Revenue Service (FIRS) is an organizational agency of Government which is saddled with responsibility of revenue collection in Nigeria. It collects different types of taxes, includes Personal Income Tax (PIT), Capita Gain Tax (CGT), Petroleum Profit Tax (PPT), Education Tax (EDT) Value Added Tax (VAT), Withholding Tax (WHT), Company Income Tax (CIT), Stamp Duty (STD) and National Information Technology Development Levy (NITDL). They are splitted all over 36 states and Abuja in Nigeria. The primary aim of establishing the offices, are to collect the mentioned taxes above and to remit it to Federal Government of Nigeria.

The staff of the FIRS has the situations, that assessing the availability and utilization of digital technologies for professional development in their various training schools are investigated and appropriated recommendations are suggested to the management authorities. The training schools within the FIRS are basically two (2). The first one is situated at Durumi Training School, Abuja and the second is situated at Ikeja Training school, Lagos. The both schools are established in 2011 to train staff for professional development. The primary function of FIRS is to collect taxes and remit appropriately to Federal Government as at when due. It is in this functionality that FIRS deem necessary to train its staff for professionalism. It is on this basis that researcher fitted into this research work for the staff to better their career to improve on their profession for Federal Government to have versatile improvement on both gross domestic product (GDP) and revenues accessibility in Nigeria. Professional development, however, refers to all training certification and education that worker needs to succeed in his or her career. It is well known, that staff requires different skills for their professionalism. The training is part of professional development; this concept covers all forms of education and learning that's intended to help a worker succeed. Professional development has several benefits. It promotes and rates workers to high retention. Statistics has shown that the cost of employee's turnover is up to 16% of the employee's annual

salary. Professional development also signals competency on behalf of employer professional development opens door to new opportunities for employees. It is also acknowledged that, if employee is struggling to get promoted to higher or more lucrative position, professional development may help to achieve the success. It is on this note that the study investigates assessing the availability of digital technology and usage among staff of Federal Inland Revenue staff for professional development in their training schools, Nigeria**.**

Statement of the Problem

Introduction of digital technologies in the embodiment of ICTs, every aspect of human Endeavour has brought about a tremendous change in the services rendered by the staff of FIRS to the tax payers. These services include: sensitization of tax payers, accessibility to information materials, and usage of digital technologies for staff professionalism in the collection of Nigerian taxes. However, these technologies aided services cannot be carried out effectively, if there are no adequate skilled manpower, availability of ICT tools and their utilization. It is against this backdrop that this research intends to assess the availability of digital technology and usage among staff of Federal Inland Revenue service for professional development in their training schools in Nigeria**.**

Aim and Objectives of the Study

The aim of this study is to assess the availability of digital technology and usage among staff of Federal Inland Revenue staff for professional development in their training schools in Nigeria and specific objectives are to:

1. Ascertain the availability of ICT tools in Durumi Training School and Ikeja Training School Lagos.
2. Find out the types of ICT tools used for staff development in the FIRS services.

Research Questions

The following research questions were raised to guide the study:

1. What are the available ICT tools in the training schools?
2. What types of ICT tools are used for staff development in FIRS?

Scope of the Study

The geographical scope of the study covers Durumi Training School in Abuja and Ikeja Training School in Lagos. The content of this study was limited to the assessment of the availability of digital technology and usage among staff of Federal Inland Revenue staff for professional development in their training schools in Nigeria**.**The variables of this study include availability, utilization and digital technologies. The staff of FIRS will be used for the study.

Conceptual Framework

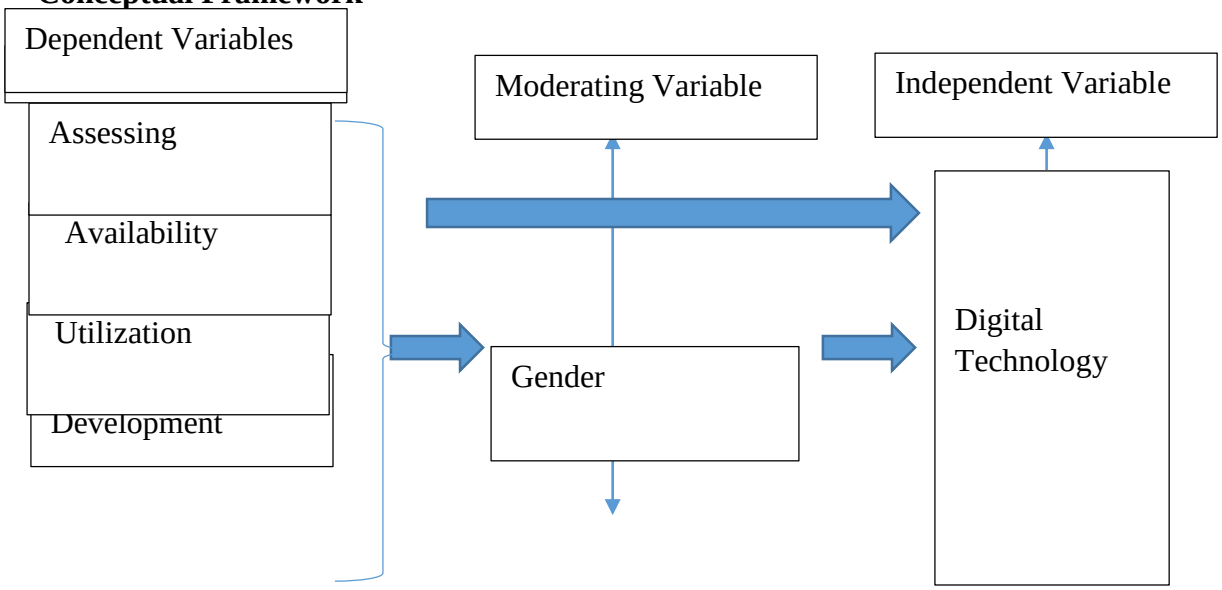

Figure 1: Conceptual Framework of Variables in the Study

Digital technologies have a profound impact on economies and societies and are changing the way we work, communicate, engage in social activities and enjoy ourselves. They also drive development in many different spheres of life. The developmental capacity of technology is very much conditioned by the level of digital skills of the population. No wonder there is a very strong correlation between education and skills and the uptake and use of digital technologies in various spheres of life. The role of education and skills in promoting development is critical. Yet, despite the huge potential of digitalization for fostering and enhancing learning, the impact of digital technologies on education itself has been shallower. Massive investments in ICT (Information and Communication Technology) in schools have not yet resulted in the hope for transformation of educational practices, probably because the overriding focus on hardware and connectivity has kept back equally powerful strategies for increasing teachers' ICT skills, improving teachers' professional development, reforming pedagogies and producing appropriate software and courseware. The potential of digital technologies in training of staff today, is increasingly place the issue as part of a more comprehensive approach to innovation in training staff. Training systems and institutions are not averse to change in themselves, but there seem to be very powerful barriers in place that prevent digital technologies from reaching their potential in development, institutions, teaching and learning practices. Professional development doesn't happen in a vacuum, but requires openness and interactions between systems and their environments. Schools cannot be left alone to make the difficult process of transformation, but need support not only through policies, but also from other actors and stakeholders. In recent years the emergent education industry has taken on a very important role. This role is not simply defined by commercial corporate interests selling products and services to schools, but is increasingly framed into a much wider concern for genuine development. In order to foster a dialogue aiming to identify the best policies and practices to foster digital development in education.

The use of digital technology for learning and teaching can support teachers, parents, children, and young people in improving outcomes and achieving our ambitions for educational development. There is conclusive evidence that digital equipment, tools, and resources can, where effectively used, raised the speed and depth of learning in science and mathematics for primary and secondary age learners.

There is indicative evidence that, the same can be said for some aspects of literacy, especially, digital technologies appears to be appropriate means to improve basic literacy and numeracy skills. Digital tools and resources generally, have positive effect on learners' science and confidence on training to improve development through the use of digital technologies in any organization or agency.

Methodology

The cross-sectional survey research design was adopted for this study. This is because it has the advantage of wider application as it allows data to be collected from selected individuals at a single point in time. This is considered important for this study to obtain current information about availability and utilization of digital technology for professional development of staff at Federal Inland Revenue training schools, Nigeria.

The training schools are FIRS Training School Durumi, Abuja and FIRS Training School Ikeja, Lagos. The target population consists of the 250 staff that are professional ICT inclined precisely computer graduates. The breakdown is shown in Table 1 below.

Table 1: Population of the Study

S/N	Name of FIRS Training School	Number of Staff
1	FIRS Training School Durumi, Abuja	130
2	FIRS Training School Ikeja, Lagos	120
	Total	**250**

The sample size of the population was 250. Popoola (2011) maintained that a researcher can study or adopt the entire population when the population size is not too large.

The instrument that was used for collecting data for the study is the questionnaire. Questionnaire is the most appropriate instrument that was used for the study because it is easy to administer to the respondents and data can be collected within a very short timeframe.

A self-designed closed ended structured questionnaire titled "Assessing the Availability and Utilization of Digital Technology for Professional Development of Staff at Federal Inland Revenue Service Training School, Nigeria" (AAUDTPDS) was developed for the study. Respondents were provided with options in order to choose the one that most closely represents their views.

The instrument was validated by two (2) experts in the Department of Educational Technology, computer science specialist in digital technology for their necessary inputs, observations and

comments so as to have a valid measure on all the relevant concepts of the study. Their criticisms will serve as improvement of items in the format of the research instrument in order to enable the questionnaire address urgent and emerging issues.

A pilot test was conducted to determine the reliability of the research instrument. A pilot study was conducted in FIRS Minna Branch Office where thirty (30) copies of the questionnaire was administered to staff who are part of the study population, but invariably not part of the study sample. Responses of the questionnaire were analyzed using Cronbach Alpha coefficient formula. The reliability co-efficient index was greater than 0.70 which shows the instrument was reliable. An introductory letter was attached to the copies of the questionnaire to be administered and the researcher administered the questionnaire to staff on training alongside with the help of two other research assistants who were selected from the two FIRS training schools under study. The duly completed questionnaire were retrieved immediately was treated with utmost confidentiality.

Survey research design was adopted for the study. The population of the study was 39 Officers who have acquired at least a first degree in the taxation. Purposive sampling technique was used for the study. Questionnaire was used as instrument for data collection. Data was analyzed using frequency and simple percentage.

Question One: - What are the available ICT tools in your school?

Table 2 Available ICT tools in Durumi Training School - Abuja

ICT tools	Available	NotAvailable	Total
Computers	25	3	28
	89.3%	10.7%	100.0%
Scanners	21	7	28
	75.0%	25.0%	100.0%
Fax	6	22	28
	21.4%	78.6%	100.0%
UPS	19	9	28
	67.9%	32.1%	100.0%
Printers	25	3	28
	89.3%	10.7%	100.0%
Photocopiers	24	4	28
	85.7%	14.3%	100.0%
Internet networks	24	4	28
	85.7%	14.3%	100.0%
Projectors	21	7	28
	75.0%	25.0%	100.0%
Audio tapes	11	17	28
	39.3%	60.7%	100.0%
Video tapes	8	20	28
	28.6%	71.4%	100.0%
Telephone networks	11	17	28
	39.3%	60.7%	100.0%
Power supply	13	15	28
	46.4%	53.6%	100.0%

Taxpayer data bases	16	12	28
	57.1%	42.9%	100.0%
E-books	23	5	28
	82.1%	17.9%	100.0%
E-tax publications	26	2	28
	92.9%	7.1%	100.00%
Total	**273**	**147**	**420**
	65.0%	**35.0%**	**100.00%**

Table 2 showed the high availability of ICT tools in Durumi training school indicating their level of availability, they include; E-tax publications, computers, printers, photocopiers, internet networks, E-books, scanners, projectors, UPS, Taxpayers data bases. It also indicates inadequacy or unavailability of some tools like fax machine, video and audio tapes, telephone networks and power supply.

Question Two: - What types of ICT tools do you use for tax services?

Table 3 Types of ICT tools used for tax services

ICT tools	**Available**	**Not Available**	**Never used**	**Total**
Computers	27	1	0	28
	96.4%	3.6%	0.0%	100.0%
Scanners	28	0	0.0%	28
	100.0%	0.0%		100.0%
Fax	2	9	17	28
	7.1%	32.1%	60.7%	100.0%
UPS	19	1	8	28
	67.9%	3.6%	28.6%	100.0%
Printers	25	2	1	28
	89.3%	7.1%	3.6%	100.0%
Photocopiers	22	5	1	28
	78.6%	17.9%	3.6%	100.0%
Internet networks	28	0	0.0%	28
	100.0%	0.0%		100.0%
Projectors	22	4	2	28
	78.6%	14.3%	7.1%	100.0%
Audio tapes	8	9	11	28
	28.6%	32.1%	39.3%	100.0%
Video tapes	7	10	11	28
	25.0%	35.7%	39.3%	100.0%
Telephone networks	21	4	3	28
	75.0%	14.3%	10.7%	100.0%
Power supply	18	3	7	28
	64.3%	10.7%	25.0%	100.0%
Taxpayers data bases	20	4	4	28
	71.4%	14.3%	14.3%	100.0%
E-books	26	1	1	28
	92.9%	3.6%	3.6%	100.0%

E-tax publications	26	0	2	28
	92.9%	0.0%	7.1%	100.00%
Total	**299**	**53**		**420**
	71.2%	**12.6%**		**100.00%**

Table 3 revealed the level of use of ICT tools in FIRS schools revealed that the use of internet networks, scanners, electronic books and electronic tax publications, computers, printers, projectors, telephone networks, photocopiers, taxpayer databases, UPS and power supply is high. It also revealed that fax, both audio tapes and video tapes are not highly used.

Question Three: - What are the challenges of utilizing ICT tools in your school? Table 3 Challenges of utilising ICT tools

ICT tools	Available	Not Available	Never used	Disagree	Total
Erratic power supply	12	16	0	0	28
	42.9%	57.1%	0.0%	00.0%	100.0%
Inadequate skilled staff	4 14.6%	15	0	932.7%	28
		53.6%	0.0%		100.0%
Lack of continuous	17	11	0	0	28
training and exposure	60.7%	39.3%	0.0%	0.0%	100.0%
Insufficient funds	20	8	0	0	28
	71.4%	28.6%	0.0%	0.0%	100.0%
Lack of maintenance	16	8	00.0%	4	28
culture	57.1%	28.6%		14.3%	100.0%
Outdated tools	12	6	0 0.0%	10	28
	42.9%	21.4%		35.7%	100.0%
Technophobia	26	9	4	1346.3%	28
	92.9%	32.1%	14.3%		100.0%
Total	**83**	**73**	**4**	**36**	**196**
	42.3%	**37.2%**	**2.0%**	**18.4%**	**100.00%**

Table 3 revealed that insufficient fund is the major bottleneck hindering effective utilisation of ICT tools in FIRS schools. It also indicated erratic power supply, lack of continuous training and exposure and lack of maintenance culture as challenges in utilising ICT tools in the office.

Question Four: - What are the strategies for solving these problems?

Table 4: Strategies for Solving the Problems

Strategies to solve the problems	**Agree**	**Strongly agree**	**Disagree**	**Total**
Constant power supply	16 57.1%	12 42.9%	0 0.0%	28 100.0%
Employing skilled Manpower	14 50.0%	12 42.9%	2 7.1%	28 100.0%
Continuous training and exposure	10 35.7%	18 63.3%	0 0.0%	28 100.0%
Availability of fund	8 28.6%	20 71.4%	0 0.0%	28 100.0%
Maintenance culture	8 28.6%	20 71.4%	0 0.0%	28 100.0%
Updating ICT tools	14 50.0%	14 50.0%	0 0.0%	28 100.0%
Total	**70** **41.7%**	**96** **57.1%**	**2** **1.2%**	**168** **100.0%**

Table 4 showed that availability of funds and maintenance culture among others are the outstanding strategies to solving the problems of ICT utilisation in federal Inland Revenue Services Abuja and Lagos followed by continuous training and exposure, updating the ICT tools, constant power supply and employing adequate skilled manpower.

Discussion of Findings

Research question one sought to find out the available ICT tools in FIRS school Abuja and Lagos. Findings showed that there are ICT tools in the FIRS except for some tools like fax machines, videos and audio tapes. These findings disagreed with the findings of Etebu (2010) who identified audios and video tapes as some of the ICT tools available in Institute of taxation.

Research question two sought to find out the type of ICT tools that are used for taxpayers services in FIRS school Abuja and Lagos. Findings showed that all the ICT tools including internet networks, scanners, e-books, e- tax publications, computers, printers, projectors, telephone networks, photocopiers, taxpayers databases, UPS and power supply are highly utilised for tax services while fax, audio and video tapes are not highly used. This finding agrees with the findings of Hussain, Khan and Zaidi (2013) who stated that the internet has transformed the ways and means of information services.

Research question three discussed the challenges faced in utilising ICT tools in FIRS Revenue House Hqtrs Abuja. The results showed that the major problem hindering the effective use of ICT tools in FIRS Abuja`and Lagosare fund. The findings also pointed out other problems like; erratic power supply, lack of continuous training and exposure and lack of maintenance culture as other factors hindering the effective service delivery in the FIRS Revenue House Hqtrs Abuja. These findings are in line with the findings of Awuor (2013) who noted that the adoption of ICT in the higher institutions in Kenya are experiencing a lot of setbacks resulting from several factors but majorly funding.

Research question four sought to find out the strategies adopted to solve these problems. The findings showed that availability of funds and maintenance culture are the outstanding strategies to solving the problems of ICT use in FIRS schools. It further revealed that continuous training and exposure, updating the ICT tools, constant power supply and employing adequate skilled manpower are also strategies to arrest the problems facing the use of ICT tools in FIRS schools. These findings are in conformity with the positions of Echezona in Ani et al. 2016) and Chinwe et. al. in Awuor (2013) that updating the skills of the taxmen staff and improving the funding of tax offices to enhance the purchase and maintenance of ICT resources will go a long way in solving the problems use of ICT tools, and that the use of ICT for tax operations and services requires tax practitioners who are highly skilled both in traditional tax operation practices and high level of computer literacy.

Summary of Findings

1. The availability of major ICT tools in FIRS Revenue House Hqtrs Abuja is very high It also shows the high level of utilisation of these tools but pointed out the low or underutilization of fax, audio and video tapes.
2. Findings showed that the use of internet among other ICT tools in the FIRS schools are very high.
3. The study also revealed that erratic power supply, lack of continuous training and exposure and lack' of maintenance culture are the problems hindering the effective utilisation of ICT tools but points out insufficient funds as the major problem.
4. It was also found that availability of funds and maintenance culture are the major strategies to solve the problems of ICT utilisation in FIRS schools Abuja and Lagos

Conclusion

Based on the findings, it was concluded that ICT tools are available in FIRS Abuja and Lago, and that they are highly utilised. Insufficient fund is the major problem that hinders the utilisation of ICT tools in the FIRS schools. Availability of funds and maintenance culture are the strategies for solving the problems of ICT utilisation.

Recommendations

Based on the findings of this study, the following recommendations were made: -

1. The Tax Controller through the FIRS management should make available other ICT tools like fax, video and audio tapes, telephone networks, and above all, constant power supply.
2. The FIRS management should ensure that all ICT tools in the offices are adequately utilised.
3. The FIRS management should as a matter of urgency, provide sufficient funds to enhance power supply, continuous training and maintenance culture among others.
4. The FIRS management should ensure the updating the ICT tools and also, the FIRS management should ensure that there is employment of adequate skilled manpower that could help in facilitating adequate use of ICT tools in the FIRS.

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Availability of E-Learning Facilities in Colleges of Education in Niger State, Nigeria

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Abstract
This study investigated the availability of e-learning facilities in colleges of education in Niger State, Nigeria. A total of 150 lecturers (90male and 60female) were involved in the study. Threeresearch questions and two hypotheses are drawn to guide the study. The instrument used in collecting data from the respondents was a researcher developed questionnaire. Data collected was analyzed using descriptive statistical methods. The instrument was validated by experts to determine its reliability coefficient. The results showed that, e-learning facilities like computers, projectors, printer, scanner, mobile phones, internets, radio, audio tapes, assistive software, digital camera/camcorder, public address system were more readily available than other e-learning facilities and are therefore, the most used by lecturers; significant relationship exist between the responses of male and female lecturers in availability of e-learning facilities for teaching and learning. The results also revealed that male and female lecturers does not differ significantly in their responses on the measures to be adopted for the enhancement of the availability of e-learning facilities for teaching in Colleges of Education in Niger State. Based on the conclusion from the study it was recommended among others that lecturers should be encouraged to adapt to the use of e-learning facilities and not shy away from it. Seminars, workshop and in-service trainings should be organized by the Ministry of education and technology experts should be available to guide and educate inexperienced lecturers to deepen strategic and effective adoption of e-learning facilities.

Key words: E-learning, facilities, availability and gender

Introduction
The 21st century is currently experiencing a widespread development in terms of Information and Communication Technology (ICT). The education sector is not left out in this technological development as the introduction of e-learning has helped in making the learning process more efficient. ICT can be defined as an electronic device for managing and processing information with the use of soft and hardware's to convert, store, manipulate, protect, transmit, manage, control and retrieve information for the enhancement and productivity of personal and organizational activities (Osakwe, 2012). Ofodu (2007) opined that ICT is an electronic or computerized device, assisted by human and interactive materials that can be used for a wide range of teaching and learning as well as for personal use. Accordingly, to Ajayi and Ekundayo (2009) posited that ICT is a process involving the sharing of information using all kinds of electronic device, an umbrella that includes all technologies for the manipulation and communication of information.

ICTs are said to help expand access to education, strengthen the relevance of education to the increasingly digital work place, and raise educational quality by, among others, helping to make teaching and learning an engaging, active process connected to real life (Ike, Iwu&Chimezie, 2006). The application of ICT to education has given rise to a new set of vocabularies used to describe new approaches to learning and curriculum delivery. Such terms include e-teaching, e-learning, and so on, which are facilitated via the internet (Atsumbe&etal 2012). E- Learning is the application of a whole range of technologies involved in information processing and electronic communications, such as computers, internet, e-mail, computer software, satellite, mobile communication gadgets, and other allied electronic devices for dissemination of knowledge and information (Amedu, 2014). It involves the application of computer and information technology in teaching and learning. In this technology-driven information age, every aspect of a country's economy is supposed to be properly networked with the global environment. This networking is particularly crucial in education that dictates the pace of development in other areas. E-learning, otherwise referred to as Computer-Based Training (CBT), Internet-Based Training (IBT) or Web-Based Training (WBT), includes all forms of electronically supported teaching and learning activities. As stated by Ushie, et al (2009), identified the information communication technology applied in instructional communication to include computers, internet, electronic mail (email), teleconferencing, worldwide web (www), electronic white boards and satellites. The availability of the internet provided the channel for the use of the electronic approach in education known as electronic learning or E-learning.

E-Learning is the process of teaching and learning with the use of the computer via the internet. It involves passing structured instructional materials from a repository to a learner. E-learning is a unifying term used to describe the fields of online learning, web-based training and technology delivered instructions (Alabi, et al., 2012). E-learning has become an increasingly popular learning approach in higher educational institutions due to the vast growing internet technology. E-learning has competitive advantages and many secondary schools have implemented it and this has impacted positively on students' performances. Today technology is a tool used to remove geographical barriers and to facilities learning for everyone to learn anytime and anywhere without the presence of the teacher. E-learning has increased accessibility to qualitative education reduced cost and time as well as improve students' academic performances. Nowadays, technology has become one of the best means for teaching and learning with or without school premises. This technology allowed the use of instructional methods to improve the quality of education and students' academic performances.

Different researches conducted have reiterated the fact that students that engaged in E-learning, generally perform better than those in face-to-face courses. The researchers also affirmed that students who participated in Electronic learning programmes achieve better grades than the students who studied by way of the traditional approach (Holley, 2012). Available literature also shows that many studies have been carried out on the availability and use of e-learning facilities in teaching and learning. Most of these studies however, were carried out mainly at secondary and primary school levels. Examples include Akpan, 2010; Okorieocha & Eronini, 2016; Nwana, 2010; Okoli & Osuafor, 2013). Results from these studies indicated inadequate facilities in schools as well as low utilization of those available materials.

In a study conducted by Penny (2011), it has also been observed that gender does not significantly influence the utilizations of E-learning facilities in schools. Shraim and Khlaif (2010) found that the utilization of E-learning facilities has a significant difference among the secondary school teachers based on their gender, age and qualification but not on their years of experiences. The availability of E-learning facilities in the teaching and learning process has been an issue that needs to be assessed in order to determine the extent in which E-learning facilities have impacted on knowledge delivery and how much of these facilities are available in Colleges of Education in Niger State, Nigeria.

The Colleges of Education Curriculum in Nigeria has been expanded with the inclusion of many science and vocational subjects. Use of appropriate modes of interactive technologies would ensure more effective and innovative lesson delivery towards internationalization and application of knowledge for technological developments. Considering the continuous and increasingly complex trend of this information age, the question is not whether education in Nigeria will move towards e-learning, but how? With computer education introduced at the pre- primary through a primary level of education, the appropriate level to introduce e-learning would be the secondary level ofeducation, to be perfected at the tertiary level. It is therefore paramount to know the level of e-learning facilities for teaching and learning at Colleges of Education in Niger Availability of e-learning facilities depicts the presence and accessibility of electronic devices that are applied in teaching and learning. These devices when applied offers powerful learning environment and can transform the teaching/learning processin a manner that students can manipulate them for active participation, even in a self-directed way. Ko and Rosen (2004) opined that instructors should be assisted with all the software required to deliver courses online using sites on the web that offerrecordings, document articles and photo essays. This implies that electronic learning facilities should be provided with the enabling environment and connectivity, that makes it accessible to users. Unfortunately, the availability and adequacy of e-learning facilities in Nigerian tertiary institutions aredoubtful (Wokocha, Elechi, Babalola, Agbagbue, Adanma and Umah, 2017); Osuafor and Emeji (2012) and Gabadeen, Alabi and Akinnubi (2015) discovered that these e-learning technologies are relatively available to the teachers and students in Nigerian universities. Evidence available also shows that the educators are seriously challenged in the use of available ones owing to such factors as poor awareness of electronic learning facilities available for instruction, irregular power supply, poor bandwidth connectivity and poor maintenance of available facilities for sustainability (Okoli, 2012). However, Chiaha, Eze and Ezeudu (2013) reported that there was no significant difference in gender with regards to students' access to e-learning facilities.

E-learning is widely used in many secondary schools in the world today and this, no doubt adds more value to the teaching and learning activities in such schools. Some secondary schools in Nigeria have electronic learning sites designed for teaching and learning with the use of module software packages but these are not fully utilized by both students and teachers (Holley, 2012). According to Nwana (2010), E-learning meant to transform the old methods and approaches of curriculum implementation in order to bring about certain changes in the behaviour of the learners as well as the extent in which the changes take place. Studies have been conducted by different researchers on the utilization of E-learning facilities in secondary schools and such research studies have discovered either the non-availability of Electronic learning facilities, their inadequacy or their ineffective utilization in most of the secondary schools (Suryani, 2010; Owulu, et al., 2016).

It is against this background, the researcher wants to investigate the availability of e-learning facilities in colleges of education in Niger State, Nigeria.

Research Questions

The following research questions formulated were answered:

1. To what extent are e-learning facilities available for teaching by lecturers in Niger State Colleges ofEducation?
2. What are the factors militating against the adoption of e-learning facilities in teaching and learning at Niger State Colleges of Education?
3. What are the measures to be adopted for the enhancement of availability of e-learning for teaching and learning by Niger State Colleges of Education lectures and students?

Hypotheses

The following null hypotheses will be formulated and tested at 0.05 level of significance:

HO_1. There is no significance difference between male and female lecturers on the factors militating against the adoption of e-learning facilities in teaching and learning at Niger State Colleges of Education.

HO_2. There is no significance difference between male and female lecturers on the measures to be adopted for the enhancement of the availability of e-learning for teaching and learning by Niger State Colleges of Education.

Research Methodology

This study adopted a descriptive survey research design. A descriptive survey research design is aimed at finding, describing and reporting events without manipulation. The design tries to find views of respondents through the use of questionnaire. Ajayi (2013) stated that, survey method tends to be quantitative in nature and aims to collect information from a sample of the population such that the results are representative of the population within a certain degree of error. This study involves the gathering of quantitative data using questionnaire for lecturers in selected colleges of education in Niger State on availability of e-learning facilities in colleges of education lecturers and students in Niger State, Nigeria. The moderating variable is gender. The population comprise of 150 lecturers (90 males and 60 female) in Colleges of Education in Niger State. The instrument used for data collection was questionnaire developed by the researcher from the literature review. The instrument was validated by three experts in Education Technology and test and measurement. The reliability of the instrument was found to be 0.73 using Cronbark Alpha formular. The instrument was administered by the researcher with assistance of two research assistants. Mean and standard deviation was used to answer the research questions while the hypotheses were tested using t-test at 0.05 level of significance.

Results

Research Question 1

What are the availablee-learning facilities for teaching in Niger State College of Education?

S/N	Items	Available		Not Available	
		Frequency	Percentage	Frequency	Percentage
1.	Computer	30	20	120	80
2.	Scanner	50	33.30	100	53.30
3.	Printer	20	13.30	130	87
4.	Projectors	15	10	135	90
5.	Digital Library	5	3.30	145	97
6.	Fax machine	25	17	125	83.30
7.	Computer Laboratory	28	19	122	81.30
8.	Internet	100	67	50	33.30
9.	Radio	80	53.30	70	47
10.	Audio tapes	120	80	30	20
11.	Assistive software	115	77	35	23.3
12.	Interactive whiteboard	40	27	110	73.3
13.	Digital Camera/Camcorder	130	87	20	13.3
14.	Mobile Phones	145	97	5	3.3
15.	Public Address system	130	87	20	13.3
16.	Webcam	48	32	102	68
17.	CD-ROMs	120	80	30	20
18.	Wide Area Network (WAN)	60	40	90	60
19.	Metropolitan Area Network (MAN)	75	50	75	50
20.	Local Area Network (LAN)	85	57	65	43.3
21.	Audio/Conferencing Hall	40	27	110	73.3

Table 1 revealed that majority of the teachers agreed that mobile phones 145 (97%), digital camera/camcorder 130(87%), public address system 130(87%), CD-ROMs 120(80%), assistive software 115(77%) Internet 100(60%), audio tape120(80%), radio 80(53.30%), Metropolitan Area Network (MAN) 75(50%), Wide Area Network (WAN) 60(40%), scanner 50(33.30%), webcam 48(32%), audio/conferencing hall 40(27%), interactive white board 40(27%), computer 30(20%), computer laboratory 28(19%), fax machine 25(17%), projectors 15(10%), digital library 5(3.30%) are available for teaching in Colleges of Education while majority also disagreed that digital library 145(97%), projector 135(90%), printer 130(87%), fax machine 125(83.30), computer laboratory 122(81.30%), computer 120(80%), interactive whiteboard 110(73.3%), audio/conferencing hall 110(73.30%), webcam 102(68%), scanner 100(53.30), wide area network 90(60%), metropolitan area network 75(50%), radio 70(47%), local area network 65(43.30%), internet 50(33.30%), assistive software 35(23.30%), audio tapes 30(20%), public address system 20(13.30%), digital camera/camcorder 20(13.30%), mobile phone 5(3.30%) are not available for teaching in colleges of Education in Niger State Nigeria.

Research Question 2

What are the factors militating against the application of e-learning facilities in teaching at Niger State Colleges of Education?

S/N	Items	X	SD	Remark
1.	The high cost of computer units has contributed immensely in reducing their availability and usage by lecturers and students	3.40	0.91	Agreed
	Lecturers and students hardly bring their computer units to school for fear of losing them	2.97	0.81	Disagreed
2.				
3.	Most students come into higher institutions without any prior knowledge on usage of computer systems and internets; hence they find it difficult to use the e-learning facilities	2.85	0.74	Disagreed
4.	Lecturers who have computers could hardly afford the monthly subscription for the internet usage	2.69	0.63	Disagreed
5.	The browsing speed in Nigeria is relatively low compared to the amount paid for the bandwidth, hence it discourages lecturers and students	3.45	0.55	Agreed
6.	Most parents consider computers as luxury instead of necessity thereby refusing to equip their children with such provisions	3.35	0.68	Agreed
7.	Due to availability of some pornographic sites, most parents rarely allow their wards the access to surf the internet or even use computer system	3.10	0.94	Agreed
8.	Underfunding from our Government budgeting has affected the availability of e-learning facilities in our tertiary institutions Irregular power supply	3.15	0.63	Agreed

Table 2 revealed that the respondents agreed with item 1, 5, 6, 7, 8 as factors militating against the application of e-learning facilities in teaching at Niger State Colleges of Education since their mean values are above the cut-off of 3.0. The respondents disagree with item 2,3,4, as factors militating against the application of e-learning facilities in teaching at Niger State Colleges of Education, since their mean values is below the cut-off of 3.0. The standard deviation ranges from 0.55 to 0.94which implies that the respondents are not too far from each other and from the mean in their response

Research Question 3

What are the measures to be adopted for the enhancement of the availability of e-learning facilities for teaching by Niger State Colleges of Education lecturers?

S/N	Items	X	SD	Remark
1.	There should be an awareness campaign on the benefits of e-learning within and outside institution	3.45	0.98	Agreed
2.	Students' examination should be conducted online under their lecturers' supervision	3.03	0.87	Agreed
3.	The students tutor marked assignment (TMA) should be online-based so as to encourage e-learning usage	3.25	0.79	Agreed
4.	The unit cost of computer should be subsidized to boost pr ocurement	3.50	0.84	Agreed
5.	Effort should be made by ministry of education in both federal and state levels to post ICT skilled teachers to tertiary institutions	3.40	0.66	Agreed
6.	Steady power supply should be provided to the colleges by the management	3.48	0.52	Agreed
7.	There should be virtual courses that are internet-based in the syllabus for science education programme	3.11	0.30	Agreed
8.	Government should provide tertiary institutions with adequate funds for ICT/e-learning facilities	3.26	0.41	Agreed
9.	Maximum internet security should be provided by experts to cut off the use of pornography/illegal sites	3.40	0.25	Agreed
10.	Regular in-service training of lecturers should be provided for them to upgrade their ICT knowledge/skills	3.30	0.88	Agreed
11.	Regulation of internet subscription should be enforced by the Nigerian Communication Commission (NCC) to encourage users	3.02	0.63	Agreed
12.	Network providers should make serious effort to improve the bandwidth sizes for more network speed	3.33	0.11	Agreed
13.	There is need for provision of WAN, MAN,LAN networks in all the colleges of education	3.05	0.54	Agreed
14.	The college should establish an online courseware open to student to download course materials when needed.	3.35	0.67	Agreed

Table 3 revealed that the respondents agreed with item 1-14as the measures to be adopted for the enhancement of the availability of e-learning facilities for teaching by Niger State Colleges ofEducation since their mean values are above the cut-off of 3.0. The standard deviation ranges from 0.11 to 0.98 which implies that the respondents are not too far from each other and from the mean in their response

Testing of Hypothesis

HO_1: There is no significant difference in the mean responses of male and female lecturers onthe factors militating against the adoption of e-learning facilities in teaching and learning at Niger State Colleges of Education.

Table 4:
z-test Analysis of mean Difference between Responses of male and female lecturers on the factors militating against the adoption of e-learning facilities in teaching and learning at Niger State Colleges of Education.

Respondents	N	Mean	SD	df	Z-cal	Z-crit	Decision
Male	90	3.42	0.59	158	.221	.531	Not Significant
Female	60	3.05	0.61				

Table 4 revealed that there was no significance difference in the mean responses of male and female lecturers on the factors militating against the adoption of e-learning facilities in teaching and learning at Niger State Colleges of Education. This was indicated by overall calculated Z-values of .221 which is less than Z-critical value of .531at 0.05 level of significance. As a result the hypothesis was retained. In other words, male and female lecturers does not differ significantly in their responses on the factors militating against the adoption of e-learning facilities in teaching and learning at Niger State Colleges of Education.

HO_2: There is no significant difference in the mean responses of male and female lecturers on the measures to be adopted for the enhancement of the availability of e-learning facilities for teaching and learning by Niger State Colleges of Education.

Table 5:
z-test Analysis of Difference between mean Responses of male and female lecturers on the measures to be adopted for the enhancement of the availability of e-learning facilities for teaching and learning by Niger State Colleges of Education. N1= 90, N2= 60

Table 5 revealed that there was no significance difference in the mean responses of male and female lecturers on the measures to be adopted for the enhancement of the availability of e-learning facilities for teaching and learning by Niger State Colleges of Education. This was indicated by overall calculated z-value of .612 at 0.05 level of significance. As a result, the hypothesis was retained. In other words, male and female lecturers do not differ significantly in their responses on the measures to be adopted for the enhancement of the availability of e-learning facilities for teaching and learning by Niger State Colleges of Education.

Discussion of Findings
Findings on the extent to which e-learning facilities are available for teaching in Colleges of Education reveal that majority of the lecturers agreed that majority of e-learning facilities such as mobile phones, digital camera/camcorder, public address system, audio tapes, CD-ROMs, assistive software and internet are available for teaching and learning in Colleges of Education in

Niger State. However, the lecturers also disagreed the following e-learning facilities such as digital library, projector, printer, fax machine, computer laboratory, computer, interactive whiteboard, audio/conferencing hall, webcam, scanner etc are not available for teaching in Niger State Nigeria Colleges of Education.

This finding were inline with Ko and Rosen (2004) that revealed that instructors should be assisted with all the software required to deliver courses online using sites on web that offer recordings, document articles and photo essays. This implies that electronic learning facilities should be provided with the enabling environment and connectivity that makes it accessible to users in Colleges of Education.

Findings on factors militating against the application of e-learning facilities in teaching at Niger State Colleges of Education revealed that some lecturers agreed that the high cost of computer units has contributed immensely in reducing their availability and usage by lecturers and students, the browsing speed in Nigeria is relatively low compared to the amount paid for the bandwidth, hence it discourages lecturers and students, most parents consider computers as luxury instead of necessity thereby refusing to equip their children with such provisions, due to availability of some pornographic sites, most parents rarely allow their wards the access to surf the internet or even use computer system, underfunding from our Government budgeting has affected the availability of e-learning facilities in our tertiary institutions Irregular power supply are the factors militating against the application of e-learning facilities in teaching at Niger State Colleges of Education while others disagreed that lecturers and students hardly bring their computer units to school for fear of losing them, most students come into higher institutions without any prior knowledge on usage of computer systems and internets; hence they find it difficult to use the e-learning facilities, lecturers who have computers could hardly afford the monthly subscription for the internet usage was the area some lecturers disagreed that is not among the factors militating against the availability of e-learning facilities in teaching at Niger State Colleges of Education.

The findings are in line with the findings of Achebe (2012), and Salawudeen (2008) which revealed that some higher institutions in Nigeria have started building ICT centres but the remoteness of these centres and non- connectivity to necessary internet facilities hinders access to e-learning. These findings leave no doubts that there are factors militating against lecturers' application of e-learning facilities in Colleges of Education, Niger State, Nigeria.

Findings on the measures to be adopted for the enhancement of the availability of e-learning facilities for teaching at Niger State Colleges of Education revealed that there should be an awareness on the benefits of e-learning within and outside institution, students' examination should be conducted online under their lecturers' supervision, the students tutor marked assignment (TMA) should be online-based so as to encourage e-learning usage,the unit cost of computer should be subsidized to boost procurement,effort should be made by ministry of education in both federal and state levels to post ICT skilled teachers to tertiary institutions,Steady power supply should be provided to the colleges by the management, there should be virtual courses that are internet-based in the syllabus for science education programme, government should provide tertiary institutions with adequate funds for ICT/e-learning facilities,maximum internet security should be provided by experts to cut off the use of pornography/illegal sites, regular in-service training of lecturers should be provided for them to

upgrade their ICT knowledge/skills, regulation of internet subscription should be enforced by the Nigerian Communication Commission (NCC) to encourage users,network providers should make serious effort to improve the bandwidth sizes for more network speed, there is need for provision of WAN, MAN,LAN networks in all the colleges of education, the college should establish an online courseware open to student to download course materials when needed are agreed by all the lecturers as the measures adopted for the enhancement of the availability of e-learning facilities for teaching at Niger State Colleges of Education.

The findings were in line with the findings of Nwana (2010), which carried out a study on measures to be adopted for the enhancement of e-learning and discovered that e-learning facilities are meant to transform the old/conventional methods and approaches of curriculum implementation in order to bring about certain changes in the behaviour of learners as well as the extent in which the changes take place.

Conclusion

This study determined the availability of E-learning facilities in Colleges of Education in Niger State. The study shows that the use of e-learning facilities just like any other new technologies improved the performance of lecturers and students and offers powerful learning environment and can transform the teaching/learning process in a manner that students can manipulate them for active participation even in a self-directed way. The study also revealed that adequate availability and effective use of appropriate modes of interactive technologies would ensure more innovative lesson delivery towards internationalization and application of knowledge for technological developments.

Recommendations

In view of discoveries of this study, the following recommendations are made;

1. Colleges of educations lecturers and should embrace the available e-learning facilities for teaching and learning.
2. Instructors should be assisted by the experts with all the software required to deliver course online using sites that offer recordings, document articles and photo essays.
3. Electronics learning facilities should be provided with the enabling environment and connectivity that makes it accessible to users.
4. Government should provide e-learning facilities needed for teaching and learning in Colleges of Education.
5. Ministry of education and administrators of Colleges of Education should always organize seminar, conferences and workshops to sensitize lecturers on the importance of using available e-learning facilities in teaching and learning.

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A Review on the Utilisation of Blended Learning in Higher Institutions

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Abstract
This paper presents a review on the utilisation of Blended learning in Nigerian Universities. Blended learning is used to present instruction that involves a mixture of face-to-face and online approaches which allows students to dictate their path and pace through online technologies while being supervised within an educational setting of face to face instruction. This review summarises relevant research on concept of traditional face-to-face learning which is the teaching and learning conducted in a face-to-face manner between teacher and students in a contact teaching situation, concept of online learning which is the education that incorporates electronic equipment and tools through the internet and the interactivity that occurs between these tools, the instructors and learners in the educational process, concept of Blended learning, Blended learning in higher institution, merits of blended learning. The paper concluded by advocating for Government organisations, agencies and Non-Governmental Organisations to fund more researches on ICT in Nigeria, procure ICT tools that can ease the demanding tasks of Nigerian lecturers. Universities management should provide enabling environment for lecturers and students to effectively use innovative teaching strategies and technologies. More conferences, seminars and workshops should be organised for Nigerian scholars to keep them abreast with the global emerging technologies in education.

Keywords: traditional face-to-face learning, online learning, Blended learning

Introduction
Information and Communication Technology has been integrated into every human endeavour especially in education. ICT is an infusion of computers and telecommunications which offer exciting and innovative ways to provide learners with global access to information, lifelong learning and support (Alagu&Thanuskodi, 2018). The advent of various ICT facilities has brought substantial changes globally within the educational system. This development has given rise to a lot of investment in various kinds of ICT facilities for teaching and learning. The availability of these facilities in higher institutions has proven to enhance teaching and learning

Concept of traditional face-to-face learning
The traditional face to face way of passing educational information from the teacher to the students remains a common teaching strategy in Nigerian institutions as the teaching and learning process is centred on attending classes day after day. Face-to-face learning is defined as the traditional environment where teaching and learning are conducted in a face-to-face manner between teacher and students in a contact teaching situation (Kaur, 2013). Similarly, Huang (2016) defines face-to-face learning as the traditional classroom setting where instructors and learners teach and learn face-to-face in physical classrooms. Face to face learning focuses on transferring materials and developing students' capabilities through classroom activities. Face to face learning is teacher-centred as the teacher usually controls the classroom dynamics and learners remain passive (Paul

& Jefferson, 2019). The teacher lectures and comments, while students listen, take notes, and ask questions, this way of learning do not allow self-paced learning. A study by Alam and Jackson (2013) revealed that a large percentage of students are absent from face to face lectures in higher education due to psychological, emotional and coping mechanisms. Hence, the need for online learning to augment this teaching pedagogical practice.

Concept of online learning

Technology has influenced education and redefined teaching and learning. Innovations and accessibility have led to an increased in the use of technologies in the classroom. Learning opportunities have expanded beyond the walls of the classroom and the school day (Murphy, 2019). The use of Information and Communication Technology in the teaching and learning process paved way for a new and innovative method of teaching and learning. Online learning is widely referred to as any electronically assisted instruction that is often associated with instruction offered via computer and the internet (Li *et al.,* 2014). Mahajan and Kalpana (2018) defined online learning as a means of education that incorporates electronic equipment and tools through the internet and the interactivity that occurs between these tools, the instructors and learners in the educational process.

Concept of Blended Learning

Blended learning can be defined as the organic integration of thoughtfully selected and complementary face-to-face and online approaches and technologies. Blended learning is described as one in which both face-to-face learning and online learning methods are collaboratively used to provide students with the benefits of both delivery styles (Lloyd-Smith, 2010). Blended learning is described as the combination of an instructional mode of delivery constituting face to face instruction with online learning (Hrastinski, 2019). Similarly, Graham *et al.*(2013) added that blended learning courses combine online and classroom learning activities and optimally uses resources to improve student learning outcomes and to tackle paramount issues that concern the institution. Blended learning is an effective combination of different modes of delivery, models of teaching and styles of learning which are practised in an interactive, meaningful learning environment.

Blended learning combines the online delivery of educational content with the best features of classroom interaction and live instruction to make learning personal, allow thoughtful reflection, and differentiate instruction from student to student as diverse learners are learning at vary pace (Kaur, 2013). According to Shantakumari and Sajith (2014) Blended learning is a way of meeting the challenges of tailoring learning and development to the needs of individuals by combining the innovative and technological advances offered by online learning with the interaction and participation offered in the best of traditional learning. Blended learning has been described as a pedagogical method that combines the effectiveness and socialisation opportunities of the classroom with the technologically enhanced active learning possibilities of the online environment (Ja'ashan, 2015). Alaidarous and Madini (2016) described blended learning as an enriched, student-centred learning experience made possible by the harmonious integration of various strategies, achieved by combining face-to-face interaction with ICT. Blended learning is an innovative instructional approach that combines several delivery strategies of online and face-to-face components (Ying & Yang, 2017). Wahyuni (2018) described blended learning as the combination of instruction from two historically separate models of teaching and learning that is,

traditional face-to-face learning systems and distributed learning systems. Figure 1 presents a diagrammatic illustration of blended learning

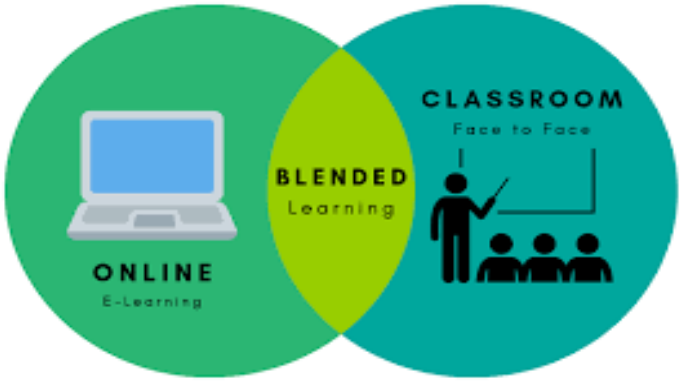

Figure 1: Diagram of blended learning.

Blended learning takes place as a result of the use of more than one approach of delivery usually face-to-face and e-learning approaches in the learning process with the intent of concentrating on the learners and increasing the learning outcome. Eisha and Pratomo (2019) opined that blended learning is a learning strategy that is intended to achieve learning objectives by integrating classroom or face-to-face learning with learning conducted online. Namyssova*et al.* (2019) also described blended learning as a course that integrates the online method of learning with traditional face-to-face classroom activities in a planned, pedagogically valuable manner. Blended Learning is the integration of traditional face to face with the use of web components in producing a course that utilizes both worlds of the teaching/learning process.

Blended learning is an approach in the education system that provides multi delivery modes to obtain or achieve quality and desired learning outcomes and cost of program delivery in institutions. This was buttressed by Nurasma and Jasber (2020) who considered blended learning as a combination of multiple deliveries with the objective of optimisation of the outcome of the learning together with the expenses. Consequently, blended learning is not targeted at interrupting the face-to-face teaching and learning environment by an instructor but combine with collaboration, technology, and human resource. Blended learning can be used to conduct learning activities outside the school with the use of Information and Communication Technology (ICT) without eliminating face-to-face learning activities at school.

Blended learning in higher institutions

Nigerian higher institutions are now implementing blended learning. The time spent, material conveyed for face to face learning and online learning is depending on the instructor. There is no fixed rule on the time duration of face to face learning and online learning. By implementing blended learning, higher institutions can still keep the high standards and accreditation while the extra flexibility can be made available to the students (Nurasma&Jasber, 2020).Blended learning as a mixture of face-to-face (F2F) and online learning, provide an opportunity for educators to create learning environments that extend beyond the traditional classroom, providing greater flexibility for students ((Nortvig*et al.*, 2018). Students can complete online activities when it suits them because students are typically balancing formal education with other competing commitments. As universities witness the emergence of new technologies that offer

unconventional approaches to teaching and learning, there is a need to offer classes that are unconventional as well (Johnson *et al.,* 2016).

In blended learning, students take advantage of the lecturers' presence and are assisted by the Internet in choosing the appropriate content of learning materials according to their specific needs, and arranging self-paced study with the guidance of teachers, to improve their all-around ability (Zhang & Han, 2012). Similarly, Gyamfi and Gyaase (2015) added that the blended learning environment is the mixture of instruction, methods and delivery mode from two archetypal learning environments, the traditional face-to-face learning environment and the ICT-mediated environment. In blended learning, face to face and online learning complement each other as lessons can be supported by discussion groups, chat platforms, ICT technologies and various content presentations thus enabling further social interaction. This is because the online learning environment enables time and location flexibility which is not possible within a face to face class environment. Blended learning which combines the advantageous aspects of these face to face environments and online environment have many advantages to students, instructor and educational institutions (Eryilmaz, 2015; Ibrahim & Nat, 2019; Jeffrey *et al.*, 2014; Ravioloa*et al.*, 2021; Shivam& Singh, 2015; Smith &Brame, 2014).

Both online and face-to-face delivery have the potential to facilitate learning environments where meaningful and genuine learning takes place, where construction of knowledge is promoted, where collaboration and interaction (between and among students and instructors) is supported and where student essentials interest may be significantly on the increased. When blended learning is compared to face to face learning, studies have revealed that the advantage of blended learning over the face to face learning is high in terms of success and attitude of students (Gherhes*et al.*, 2021; Solak&Cakir, 2014; Taghizadeh&Hajhosseini, 2020;Tzaflkou*et al.*, 2021). The teacher uses the classroom to create an environment of discussion with students and the internet as a means of preparing a lesson. In blended learning, the educator can prepare the videos and course materials related to the lesson and upload them to a server or chat room beforehand. The students can reach all the materials regarding the subject to be studied before coming to the classroom and joining the activities related to the lesson. Thereafter, when they come to the classroom they can discuss the points that have not been understood with the educator or they can ask him to revise them again.

Blended learning is a flexible education strategy that personalizes students' specific needs, giving all available resources toward utilizing the full potential of students (Varthis, 2016). The purpose of blended learning is for the learner to become more engaged, thus leading to more effective learning. Blended learning environment may offer a positive contribution and may reduce the risk of cognitive overload hence provide an opportunity for students to engage in a variety of delivery modes of instruction since face-to-face is not the only form of learning. Blended learning environments provide positive effects on students. This was emphasized by Eryilmaz (2015) who noted that the educational practices designed within blended environments are beneficial to the students in terms of contentment, learning, attention and motivation

Merits of blended learning

In many traditional classrooms, students are passive for long periods but this passiveness is not observed as often in blended learning environments (Yilmaz & Malone, 2020). Students enrolled in blended learning classrooms can listen to a significant portion of the course content online, more

time are gained for the creation of a face-to-face (F2F) learning environment in which active participation increased. Given the dynamic nature of blended learning, it considers the specific needs of students. Blended learning improves accessibility to a wider range of information as new technology and online resources not only make learning materials more widely available to more students but also can make those materials available to students in their local languages (Arkorful&Abaidoo, 2014).This will enable students to gain access to vast information globally as language will no longer become a barrier. Blended learning is student-driven as it provides students with more options regarding the subject matter and mode of instruction to cater for their backgrounds, needs, and interests. Students have convenient, on-demand access to course materials and lectures, which allows them to progress through the course at their own pace. With blended learning, educators can encourage students to reflect and think about how they learn and change their study habits to match their needs.

The use of blended learning enhances students' technological literacy, which is a necessary skill for the 21st century (Amimo, 2021). Hence, students are prepared to become lifelong learners. It is also easier for students to connect their lived experiences with technology to classroom materialswhen discussions can be integrated with social networking tools. By this learning approach, educators can make discussions more interactive, help create a borderless community of learners, and empower both lecturers and students to give immediate feedback to each other (Awad, 2014).

Blended learning approach can also result in the high academic achievement of students when compared to face-to-face learning (Le & Pham, 2021). Blended learning often contains software that is used to collects student data and measure academic progress, providing the students, teachers and parents with such data. Often, tests are automatically scored, providing immediate feedback. Student logins and work times are also measured to ensure accountability. Blended learning promotes personalised education, replacing the approach where a teacher stands in front of the classroom and the students are expected to stay at the same pace. Blended learning allows students to work at their own pace, making sure they fully understand new concepts before moving on. Blended learning environment naturally requires learners to demonstrate more autonomy, self-regulation, and independence to succeed. Proponents of blended learning argue that incorporating the asynchronous Internet communication technology into higher education courses serves to facilitate a simultaneous independent and collaborative learning experience (Kavanaugh, 2018). Blended learning contributes to student satisfaction and success in their courses. By using blended learning class projects have improved, communication between lecturers and part-time students has improved, and students were able to better evaluate their understanding of course material via the use of computer-based qualitative and quantitative assessment modules.

Blended learning represents a switch from passive learning to active learning. The focus of the classroom shifts from a presentational format to one of active learning. This involves putting learners in situations that compel them to read, speak, listen, think and share ideas either together or apart. In addition, a blended delivery system allows students to learn and access material in a variety of modes which is an important feature since students often have different learning styles. Research indicates that blended learning increases students' chances of meeting course outcomes compared with fully online and even fully face-to-face courses, by decreasing dropout rates, increasing test scores and increasing motivation on the part of students (Means *et al.*, 2013). The

interactive content enables the instructor to create a high level of interest, accountability, and real assessment. It enhances individualisation and adds relevance to instructional delivery. It lets the instructor tailor learning content to the unique needs of different learners.

Blended learning offers instructors and students the best of both face-to-face and online learning because instructors and students have greater flexibility and accessibility without sacrificing either online or face-to-face contact. A blended learning approach is an effective and low-risk strategy aimed at meeting the challenge of the transformational changes that technological developments bring to higher education (Kaur, 2013). Blended learning aims to provide interactive, participative, individualised, flexible and technologically-enabled learning environments to assist learners construct knowledge through deep intellectual engagement and dialogue with peers and the teacher with the use of synchronous and asynchronous web-based technologies. It leads to more personalized instruction, intellectual scaffolding, increased time on task (mastery learning), and opportunity for learners to pace their learning processes. Students with demanding schedules and various technology comfort levels, institutions with physical space constraints, and demand for more flexible scheduling options make blended learning one of the fastest-growing delivery modes in higher education (Graham *et al.,* 2013). Also, students with increasingly shorter attention span can benefit a lot from the blended learning approach, as it can increase student engagement beyond the four walls of the classroom, enhanced flexibility to learn, greater opportunity for both social and personalised learning and new opportunities for better forms of assessment are the key benefits of blended learning. According to Jiang (2020), blended learning permits more reliable assessment strategies to be utilised by the instructor as well as direct observation, class discussions, and oral questioning in the classroom. The potential of blended learning seems to be addressing the three main forces that call for a major change in the current higher education landscape: the unprecedented advances in ICT and the corresponding information and knowledge explosion.

In the blended learning approach, face-to-face learning becomes more effective because the boring aspects of basic instruction are moved to the e-learning environment, where technologies can make the learners more engaging and interactive. When students meet in the classroom with a tutor, they can focus on higher-level skills since the basics are known by all students and were even tested using the online assessment tool. In the process, students are empowered to assume increased responsibility for their own learning experience. Therefore, blended learning improves the quality of learning and student engagement, and reduces the usual passivity of students in face-to-face classrooms. A study conducted by Kjaergaard (2017) to examine how integrating recent technical developments with digital content will improve the learning experience of students revealed that blended has the potential to transform student learning experiences and outcomes. In a blended lesson, students can log in when it is convenient for them, and they can review lectures either in text or audio format if they miss them in the face-to-face classroom. Some students who rarely take part in classroom discussions feel comfortable and confident to participate online due to its asynchronous nature. For students with part-time employment, family commitments or who are shy to talk, blended environments offer extended opportunities.

Blended learning model is very appropriate in the context of a traditional institution as even those lecturers who may not be comfortable with the e-learning approach, get opportunities to improve their information technology skills and adequate time to develop online teaching skills gradually. Hrastinski (2019) viewed blended learning primarily as a strategy to start e-learning in

organisations. Paul and Jefferson (2019) reported that instructors hesitant to engage in totally online course delivery find blended learning delivery methods less controversial and adopt them more readily. A study done by Gomendio (2017) illustrates how important blended learning is for student teachers to get a balanced programme that upgrades skills and knowledge as it also enables them to reflect on past and future practice.In a study by Le and Pham (2021) to explore the benefits of blended learning in higher education from the perspectives of students, lecturers, and administration, students indicate that a blended learning model provided them with greater time, flexibility and improved learning outcomes, and further, it allowed them to take greater responsibility for their learning. Lecturers find blended learning as a means of enhancing teacher-student interaction, increasing student engagement in learning, and adding flexibility in the teaching and learning environment.

Conclusion

Despite the benefits of utilising Blended learning, the traditional face-to-face learning is still predominant in many Nigeria higher institutions. Hence, the need for Government organisations, agencies and Non-Governmental Organisations to fund more researches on ICT in Nigeria, procure ICT tools that can ease the demanding tasks of Nigerian lecturers. Tertiary institutions management should provide enabling environment for lecturers and students to effectively use innovative teaching strategies and technologies. More conferences, seminars and workshops should be organised for Nigerian scholars to keep them abreast with the global emerging technologies in education.

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Effects of Using Virtual Laboratory Package On Retention in Chemistry Among Senior Secondary Schools in Minna Metropolis

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Abstract
This study examined the effects of virtual laboratory instructional strategy on students' retention in chemistry practicals' among senior secondary schools II students. This study adopted quasi experimental design. Pretest, posttest experimental and control groups design was adopted. Two research questions and two hypotheses was formulated and tested at 0.05 level significance. The population for the study comprises of 3395 senior secondary school chemistry students in 2019/2020 academic session within Minna metropolis, Niger state. A multi-stage sampling technique was employed, which were clustered into A &B with a sample size of 120. Four schools were randomly sampled for the study of Balancing of Chemical Equation Retention Test (BOCERT). The instrument was validated bythree experts, one in Measurement and Evaluation and two science educators in theDepartment of Science Education of the Federal University of Technology, Minna for both face andcontent validation. Test, retest was administered to ascertain reliability index for BOCERTand the data collected from both the experimental and control groups for the reliability were statistically analyzed using t-test to calculatethe internal consistency which yielded 0.82. The data collected for the study were analyzed using meanand standard deviation to answer research questions and t-test to test the formulated hypothesis at 0.05 level of significance. Findings from the study showed that virtual laboratory instructional package impacted positively on students' retention in chemistry practical than traditional method. On the mean retention scores of male and female students taught balancing of chemical equations using virtual laboratory strategy, there was no significance difference between the gender. Based on the findings of the study, chemistry teachers should be encouraged to use virtual laboratory strategy whileteaching chemistry concepts especially balancing of chemical equation.

Keywords: Retention, gender, Virtual laboratory

Introduction
Chemistry is one of the science subjects offered in most of secondary schools in Nigeria and also a major requirement for admission into science based fields of studies such as Medicine, Engineering, Pharmacy and Agriculture in all institutions of learning (Azare, 2017). Chemistry has helped in the development of modern technology through the application of its principles to modern inventions (Asiyai, 2016).

The study of chemistry has been and will remain of tremendous importance to mankind as it is capable of explaining natural phenomena and everyday occurrences. In Nigeria, Chemistry is one of the important science subjects taught at all Senior Secondary School (SSS) level. It is one of the core science subjects that students are required to pass at credit level in order to qualify for admission into tertiary institutions to pursue science-based programmes. In spite of this central

and important position of chemistry among others science and related disciplines, studies have revealed that, academic performance of students in chemistry at Senior Secondary School Certificate Examination (SSSCE) has consistently been very poor and unimpressive (Njoku, 2015).

The outbreak of Covid-19 pandemic has no doubt affected every sphere of human endeavors from social, economic, educational and sporting activities around the globe. The consequences of this impact is mostly felt in education as many students were out of class for several months except those schools with high tech facilities who were able to engage their learners through an e-learning or virtual classes (Kuhfeld*et al.,* 2020).

Virtual laboratories provide simulated versions of traditional laboratories referring to a learner-centered approach in which the learner is provided with objects that are virtual representations of real objects used in traditional laboratories Virtual laboratories may contribute to teaching and learning processes by giving students the opportunity to learn by doing, providing them with intriguing and enjoyable activities urging them to discover, and guaranteeing an active classroom interaction by means of discussions and debates (Lkhagva*et al.,* 2015).

An alternative learning environment, called a virtual laboratory, can help to make this crucial educational applicationavailable to students (SAVVIS, 2010; Jeschke*et al.,* 2016). Virtual laboratories provide students with meaningfulvirtual experiences and present important concepts, principles, and processes. By means of virtual laboratories, students have the opportunity of repeating any incorrect experiment or to deepen the intended experiences.Moreover, the interactive nature of such teaching methods offers a clear and enjoyable learning environment (Jeschke*et al*., 2016). They are also beneficial to study advanced concepts such as relativity and experimentation that would not be studied or realized in traditional laboratory settings (Aldrich, 2016;Scheckler, 2015).They can be more easily assembled and more properly used than real laboratory equipment, and therefore are more time efficient than traditional hands-on laboratories (Reese, 2020).

Retention is the ability to hold information or store learned material for future use. The prevalent problem in secondary schools could also be linked to the poor retention of concepts among secondary students offering science subjects including Chemistry. Retention has been identified as one of the challenges that discourage students from learning science subjects such as chemistry. Several studies such as studies by Ajayi and Ogbeba (2017) have revealed unimpressive students' retention rate at the senior secondary school level in Nigeria. Abouand Ayoubi (2017) also revealed in his study that low retention rate of students particularly among gender is as a result of instructional modality adopted by teachers. In this regard, inappropriate teaching methods used by chemistry teachers invariably translate to students' inability to retain and put into practice what is learnt. In most cases what is taught in classroom cannot be transferred to real life situation by students. There is therefore, the need to explore innovative methods for effective teaching of chemistry specifically balancing of chemical equation so as to enhance students' retention in the subject.

Gender issues have been linked with retention of students in academic tasks in several studies but without any definite conclusion. Some studies revealed that male students performed better than the female in science courses. However, Akhigbe and Adeyemi (2020) reported that gender had

no effect on retention of students. Based on the foregoing, the researcher determined the effect of Virtual laboratory instructional package on retention in balancing of chemical equation among selected Senior Secondary School Students in Minna metropolis.

Statement of the Problem

It is noticeable among the secondary students having challenges comprehending the concept of Balancing of chemical equations which occupy a central position in understanding some concepts such as; stoichiometry, chemical arithmetic, Faraday's laws of electrolysis, volumetric analysis. Balancing of chemical equation is very fundamental and very important chemical skill in chemistry.

Chief Examiners report on the West African Senior School Certificate on students' weaknesses in balancing of chemical equations. For example, the WAEC Chief Examiners report on the May/June 2012, 2015 and 2018 reported that candidate's weakness included poor knowledge of symbols, formulae and equation and inability to balance equations correctly. It is in view of this that the study determined the effect of virtual laboratory instructional strategy on retention in balancing of chemical equation among senior secondary school students in Minna, Metropolis**.**

Purpose of the Study

1. The effect of virtual laboratory strategy and traditional method on students' retention in balancing of chemical equations.
2. The gender effect on students' retention in balancing of chemical equations using virtual laboratory strategy.

Research Questions

1. Is there any difference in the mean retention scores of students taught using virtual laboratory strategy and those taught using traditional method?
2. What is gender effect of virtual laboratory instructional strategy on retention of students taught balancing of chemical equations?

Hypotheses

The following null hypothesis ware tested at 0.05 level of significance:

H_{O1}: There is no significant difference in the retention scores of students taught using virtual laboratory instructional strategy and those taught using traditional method.

H_{O2}: There is no significant difference in gender retention score of students taught using virtual laboratory instructional strategy.

Methodology

This study adopted quasi experimental design. It is type of experimental research method used to estimate the causal impact of an intervention on target population without random assignment, using a pretest, posttest, control design. This research design sought to establish the cause-effect relationship between the independent and dependent variables.Multi-stage sampling techniques were employed for the study.Firstly, a cluster sampling technique was used to sample the schools in to A and B groups. Secondly, a purposive sampling technique employed to select two schools from cluster A, and two from cluster B. Thirdly, A Proportionate stratified simple random sampling technique was employed to catigorise the sample based on gender of the students (male

and female). Fourthly, S.S. II chemistry class sample size was randomly selected using simple random technique. One out of the four selected secondary school was used for pilot study and the other three secondary schools were used for the main study in minna metropolis.

From the total sample size, the students were randomly selected into the experimental group (virtual laboratory instructional strategy) and control group (traditional laboratory strategy) respectively for the study. Population of the study comprised of 3395 chemistry students (2002/2021) in the senior secondary schools within Minna metropolis. The target population of the study was 2090 SSII Chemistry students, made up of 986 male and 1104 female students. 120 sample population was drawn.

The research instrument, Balancing of Chemical Equation Retention Test (BOCERT). BOCERT was administered on the experimental group and the control group as a retention test, giving two weeks interval. The reliability of the research instrument was determined using t-test and the correlation coefficient of 0.82 was established for students' retention in chemistry practical among senior secondary schools in Minna metropolis. Data collected from the study were analysed using t-test statistics. The significant difference was ascertained at 0.05 alpha level.The Statistical Package for social Science (SPSS) version 23.0 was used for the analysis.

Results

Research Question One: Is there any difference in the mean retention scores of students taught using virtual laboratory strategy and those taught using traditional method?

Table 1: Mean, Standard deviation and Mean difference of students' retention score of students taught using virtual laboratory instructional strategy and those taught using traditional method

	Group	N	Mean	Std Deviation	Std. Error Mean
Retention	Conventional	60	11.40	2.871	.371
	Package	60	13.08	2.002	.259

Table 1 show mean and standard deviation of students' retention score of students taught balancing of chemical equations using virtual laboratory instructional strategy and those taught using traditional method. The findings show the computed mean score of 11.40 with standard deviation of 2.871 for the students taught using traditional method and mean score of 13.08 with standard deviation of 2.002 for the students taught using virtual laboratory instructional strategy. From the findings, it shows that students taught using virtual laboratory instructional strategy had higher mean score retention than students taught using traditional method.

Research Question Two: What is gender effect of virtual laboratory instructional strategy on retention of students taught balancing of chemical equations?

Table 2: Mean, Standard deviation and Mean difference of gender effect of students taught using virtual laboratory instructional strategy

	Gender	N	Mean	Std Deviation	Std. Error Mean
Gender	Male	30	6.93	3.140	.573
	Female	30	13.08	2.559	.522

Table 2 show mean, standard deviation and mean difference of gender effect of students taught using virtual laboratory instructional strategy and those taught using traditional method. The findings show the computed mean scoreof 6.93 with standard deviation of 3.140 for the students taught using traditional method and mean score of 13.88 with standard deviation of 2.559 for the students taught using virtual laboratory instructional strategy. This gives mean difference of 6.95 between the gender.

Hypothesis One: There is no significant difference in the retention scores of students taught using virtual laboratory instructional strategy and those taught using traditional method.

Table 3: Independent sample test for retention score of students taughtusing virtual laboratory instructional strategy and those taught with traditional method

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	T	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
RETENTION	Equal variances assumed	10.283	.002	-3.725	118	.000	-1.683	.452	-2.578	-.788
	Equal variances not assumed			-3.725	105..414	.000	-1.683	.452	-2.579	-.787

Table 3 shows the t-test result of student retention test. The result reveals that there is statistically significant difference between the test score since the sig (2-tailed) is less than 0.05 (i.e 0.000<0.05). From the group statistics table, we will see that when the retention test was carried out, the group that was thought using virtual laboratory strategy had higher score than those that were thought using conventional method i.e. (13.08>11.40)

Hypothesis Two: There is no significant difference in gender retention score of students taught using virtual laboratory instructional strategy.

Table 4: Summary of t-test on significant difference in the mean retention scores of male and female students taught balancing of chemical equations using virtual laboratory instructional strategy

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	T	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
SCORE	Equal variances assumed	.275	.602	1.385	58	.171	1.300	.939	-.579	3.179
	Equal variances not assumed			1.385	57.682	.171	1.300	.939	-.580	3.180

The table above shows the t-test result of student gender retention test. The result reveals that there is no statistical significant difference between the test score since the sig (2-tailed) is greater than 0.05 (i.e 0.171>0.05)

Findings of the Study

The findings of the study revealed that it is profitable that virtual laboratory instructional strategy has effects on students' retention compared to students taught balancing of chemical equations using the traditional method. This concurs with Brinson (2015) who opined that virtual laboratory provides students with opportunities such as enriching their learning experiences; conducting experiments as if they were in real laboratories; and improving their experiment related skills such as manipulating materials and equipment, collecting data, balancing of chemical equations, completing experiment process in an interactive way (with boundless supplies), and preparing experiment reports.Furthermore, some researchers even argue that performing experiments within a virtual environment is more effective than performing experiments in real laboratories (Browne, 2014).

The study also revealed that there is nosignificant difference in the retention score of male and female students taught balancing of chemical equations using virtual laboratory instructional strategy. This finding that the retention of male and female students show statistical difference contradicts the results of Giginna (2013), whoobserved that science education, is strongly influenced by gender in most but not all thecultures. This is also supported by Okeke (2014) who observed that females are grossly underrepresentedin science, technology and mathematics. Theauthors also stated that males are not superior to females intellectually, and anydifference is due to upbringing and cultural beliefs.

The female subjects performing betterthan male is in consonance with Giginna (2013) who observed that femalestudents are significantly better than their male counterparts and that there was significantdifference between the male and female students in their ability to solve quantitativeproblems. Giginna (2013)found that female students performbetter than their male counterparts in science. Similarly, Ahiakwo(2011)carried outresearch on cognitive style and students" problem solving behavior in chemistry. It wasfound that there was sex difference in performance using chemistry process skill test. Inthis study, girls performed better than boys.

Conclusion

From the findings of this study, it revealed that the group that was thought using virtual laboratory strategy had higher score than those that were thought using traditional method i.e. (0.000<0.05). On this basis, there is significant difference in the retention of students taught balancing of chemical equations using the virtual laboratory strategyand those taught balancing of chemical equations with the traditional method.

It also revealedfrom the group statistics table that the mean difference of the female and male group i.e. (0.171>0.05). This showed that there is no significant difference in the retention of male and female students taught balancing of chemical equations using virtual laboratory instructional strategy.

Recommendations

Based on the major findings of this study, the following recommendations are proffered.

(i) Chemistry teachers should be encouraged to use virtual laboratory strategy whileteaching chemistry concepts especially chemical balancing of equation.

(ii) Educational agencies and other stakeholders should organize workshops and seminars on the use of virtual laboratory strategy to enhance better performance of secondary school students particularly in Chemistry

(iii) The instructional designers, computer programmers, material developers should develop relevant virtual laboratory strategy packages for use within the Nigerian school systems.

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Assessing the Attitude and Motivation of Senior Secondary Schools Computer Science Students' Towards the Use of Internet for Education in Abuja

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Abstract
This study assessed secondary schools' computer science students' attitude and motivation towards internet usage for education in Abuja. Descriptive survey research design was used for the study. Four research questions were raised and two null hypotheses were formulated and tested at 0.05 level of significance. Three Hundred and Eighty-Two (382) computer science students in both private and public schools in FCT Abuja (public = 221 and private = 161) were randomly sampled for the study. The instrument used for data collection named "Questionnaire on Attitude and Motivation toward Internet Usage in Secondary School (QAMIUSS)". Data collected were analyzed using mean and standard deviation while t-test was used to test the two null hypotheses. The findings of the study indicated that there was no significant difference between attitudes of senior secondary school computer science students towards internet usage in public and private secondary schools (t-cal= 0.04, p = 0.89). There was significant difference between motivation of senior secondary school computer science students towards internet usage in public and private secondary schools (t-cal= 24.99, p = 0.01). It was recommended that Basic training should be organized on how students can make use of internet for educational purposes. Both students and computer science teachers should be motivated by providing adequate ICT infrastructure for effective and functional internet service in the school.

Keywords: Internet, Attitude, Motivation and School type

Introduction
The first decade of the 21st century witnessed dramatic changes due to the exponential proliferation of the Internet in all aspects of life. What has been called the digital culture has had an extensive influence on education. Internet use has become very popular in many areas as well as in education in recent years. It has affected the field of education at all levels (Noor ul Amin, 2017). The Internet has experienced vast expansion in recent years, leading to its extensive use by people from all generations.

For a generation of young people, technology has assumed a substantial stake in their social and educational lives (Nakel& Naval, 2015). With the present increased role of modern technology in the students' lives, the concern of people on how students might benefit from it positively in their area of study. Students accepted that the Internet is more informative, useful, less expensive, time saving and it has made a tremendous impact on their academic activities. Asfaw (2019),Ilo and Ifijeh (2010), and Amin and Mattoo(2015) opined that the Internet has many benefits in the academic cycle, including provision of round-the-clock access to a wide variety of information

sources globally and the ability to discuss and share experience. Syed and Mattoo (2016) asserted that some of the most important reasons why students go through technology include school assignments, e-mails and chatting.

Technologies such as the Internet might accelerate secondary school students' learning and thus enhance and democratize access to educational opportunities, and support interactivity and collaborative study (Krol, 2018; Saadati, 2014). Any kind of information on any topic under the sun is available on the Internet. It is a truly "open technology", allowing users with any hardware and software to derive the necessary information from the network, independently from the location of data and knowledge bases. Hence, Internet can therefore be described as a super highway of information carrier, where information seekers on any subject or area of discipline can obtain current and useful information and knowledge (Noor-ul-Amin, 2017). Some students strongly prefer using the Internet as their primary source of information (Tiozzo, *et al,* 2019). One reason student gives for preferring the Web over traditional print materials is that; they feel they can locate information faster when using the Internet. Closer examination of this studies, many of the studies actually convey a sense that not all students (male /female) are as inclined to integrate Internet use into their studies as might be assumed (Amin, &Mattoo, 2015; Noor ul Amin, 2017; Selwyn, 2008).

Recent innovations using the Internet, including particular aspects of telecommunications such as e-mail that capitalize on students' general interest in computers. According to Basri*et al* (2018) students who score higher grades in their studies are more interested in Information Communication Technology (ICT) than their colleagues who score lower grades. This is likely because ICT demands some basic knowledge for anyone to embrace it. Brighter students are therefore more likely to embrace ICT. Furthermore, ICT requires concentration of the participants, and this makes people to remain brighter to embrace the technology. It is therefore imperative to know the level of interest of male and female students of public and private senior secondary schools in Internet usage, most especially towards their studies, it might lead to good attitude towards Internet usage.
Adesina (2013) sees attitudes as what can be acquired through learning and can be changed through proper orientation. Attitude once built would help to shape the experience of an individual encounter with objects, subjects or persons. It can be said that people's attitudes are dynamic and constantly changing, thus new attitudes are formed and old ones are modified when an individual or group of individuals are exposed to new information and experiences in the process of teaching and learning. Abubakar (2015) further elaborated that all attitudes exhibited by people can be categorized into two major headings namely; the explicit which means characters of attitudes that are formed and the implicit which are the behaviours or pattern of attitudes registered in our subconscious minds, and that these attitudes affect people's behaviours or reactions to issues in different ways which can lead to motivation.

According to Cavas (2011) student motivation plays a crucial role in Internet and sciences, which targeting in promoting student's construction of his/her conceptual understanding of Internet and science. Motivation is a complex, multidimensional construct that influence learning and students' interest irrespective of school types (Taasoobshirazi& Sinatra, 2011).

School types mean the two major types of school in Nigerian educational system which are public and private schools. Private schools are more expensive in terms of school fees paid by the parents compared to public schools. Public schools are owned and run by the government, while private schools are owned and run by individuals for profit making (Amjad & MacLeod, 2011). Public secondary schools are owned, funded and administered by the government or public agency rather than private individual(s) or corporation. Private secondary schools are secondary schools that are owned by private individual(s) or a corporation rather than a government or public agency. Private secondary schools are funded by students' tuition and administered by a private body. It is also known as independent schools (Alderman *et al.*, 2001). However, the educational structures of both private and public secondary schools are the same. There is no distinction in terms of social-cultural context (climate, religious and tradition) between private and public schools (Nguyen & Raju, 2014).Kennedy (2017) opined that public schools are funded by taxes and controlled by the government, private schools are autonomous and generate their own funding through various sources like student tuition, private grants and endowments. Also, Scheper (2013) stated that while private schools are characterized with few students, small class sizes, more facilities and advanced technology, public schools are characterized with many students, large class sizes, few facilities and technology. The aforementioned peculiarities of public and private schools may have effects on students' attitude and motivation towards the use of ICT.

For instance, Tella and Bashorun (2012) investigated the attitude of undergraduate students towards computer-based test in University of Ilorin. The results revealed that the students have positive attitude towards computer-based test. More than average of the respondent prefers computer-based test to paper-pencil test. Similarly, Balaramulu and Uma maheshwari (2015) carried out a study on secondary school student's attitudes towards using Internet as learning tool in Warangal District of Telangana State. It was found that there was a significant difference between private and public schools' students towards using Internet as a learning tool**.**

Ahmed and Lawal (2017) carried out a study on motivation of secondary school students towards Internet facilities usage for academic work. The findings confirmed significant difference in the motivation of secondary school students towards use of Internet facilities for the academic work. In another study, James (2017) investigated the effects of technology on students' motivation and engagement in classroom-based learning. The results showed that students feel motivated through the specific use of technology in the classroom. Furthermore, Olawale, *et al* (2016) investigated the perception on ICT usage by the rural and urban teachers in Ogun state. It was revealed that there was no significant difference in the perception of ICT facility usage in secondary school by rural and urban teachers. This study therefore assesses secondary schools' computer science students' attitude and motivation towards Internet usage for education in Abuja.

Statement of the Research Problem

Over the years, the most common use of instructional delivery in secondary school has been the conventional method of teaching. Sadly, this form of teaching method has been characterized by numerous problems such as pace leaning and learning at any distance apart from been in the classroom, thereby denying students that need to receive education instruction access without physically present in the classroom. If instructional delivery is to be receive by the students with the use of internet services in secondary school in FCT Abuja, what attitude would secondary school computer science students have towards internet usage in FCT Abuja? Are they properly

motivated to use internet for education purposes? Therefore, it is necessary to look into the current trend of internet based on educational purpose, in order to get a suitable strategy that will lead to effective teaching and learning of computer science in secondary school in Abuja. It is on this note that the researcher intends to find out secondary schools' computer science students' attitude and motivation toward Internet usage for education in Abuja.

Aim and Objectives of the Study

The aim of the study is to assess secondary school computer science students' attitude and motivation toward Internet usage for education in Abuja.

Specifically, the study seeks to:

(i) Determine the attitudes of senior secondary school computer science students towards Internet usage in FCT, Abuja.

(ii) Determine the attitude of senior secondary school computer science students towards Internet usage in public and private secondary schools in FCT, Abuja

(iii) Find out the motivation of senior secondary school computer science students towards Internet usage in FCT, Abuja.

(iv) Find out the motivation of senior secondary computer science students towards Internet usage in public and private secondary schools in FCT, Abuja.

Research Questions

Based on the above objectives, the study raised the following research questions:

(i) What is the mean response of attitudes of senior secondary school computer science students towards Internet usage?

(ii) What are the mean responses of attitudes of senior secondary school computer science students towards Internet usage in public and private secondary schools?

(iii) What is the mean response of motivation of senior secondary school computer science students towards Internet usage?

(iv) What would be the mean response of motivation of senior secondary school computer science students towards Internet usage in public and private secondary schools?

Research Hypotheses

The following null hypotheses were formulated and tested at 0.05 level of significance in order to guide the study:

$Ho_{1:}$ There is no significant difference between attitudes of senior secondary school computer science students towards Internet usage in public and private secondary schools.

$Ho_{2:}$ There is no significant difference between the motivation of senior secondary school computer science students towards Internet usage in public and private secondary schools.

Methodology

The research adopted was the descriptive survey design. The population for this study consisted of 193,253 senior secondary school computer science students (private and public) in Federal Capital Territory (FCT) Abuja. There are 297 secondary schools in FCT Abuja (private = 136; public = 161) (Research and Statistics Unit, Secondary Education Board FCT Abuja, 2021). The target population was 74,483 senior secondary two (SSII) computer science students. The total population of 193,253 senior secondary school computer science students captured both private and public secondary schools (private 91,901 and public 101, 352) (Research and Statistics Unit,

Secondary Education Board FCT, Abuja, 2021).Finally, random sample technique was used to select 382 SSII computer science students from six randomly selected schools for the study. The reason for using random technique was for every respondent to be given equal opportunity of being selected. The sample is in accordance with Krejcie and Morgan (1970) sample size determination table.

The Instrument for the study was researcher-designed questionnaire named Questionnaire on Attitude and Motivation toward Internet Usage in Secondary School (QAMIUSS). The questionnaire was made-up of four major sections (A, B and C). Section A captured the respondents Bio-data, section B contains items on attitude, section C contains items on motivation. Each section of the variable had ten (10)items respectively and school type was considered as moderating variable. All items were presented using a 5-Point Likert Scale in which Strongly Agree (SA) was awarded 5 points, Agree (A) was awarded 4 points, Undecided (U) was awarded 3 points, Disagree (D) was awarded 2 points, and Strongly Disagree (SD) was awarded 1 point. The QAMIUSS questionnaire on Attitude and Motivation toward Internet Usage was validated by two experts in Educational Technology, Guidance and Counseling lecturers at College of Education, Zuba, one Education Psychology expert from Ibrahim Badamasi Babangida University Lapai, Niger State and one secondary school computer science teacher in Minna, Niger State. The instrument was validated based on the contents and face validity. The reliability of the research instrument was determined after a trial testing using a simple random sample of 20 respondents (Lecturers) from the School of Technical Education, Niger State College of Education Minna, who are part of the population but not part of the sample for this study. Pilot study was carried out at Government Secondary School, Phase 4, Kubwa, Abuja and Jewel Model Secondary School, Kubwa, Abuja. Sixty-seven (67) questionnaires were administered and retrieved back for data analysis to determine the reliability coefficient, using Cronbach alpha statistics. A reliability coefficient on students' attitude was 0.77 and 0.70 reliability coefficient was obtained on students' motivation**.** The questionnaire was administered on the groups during four weeks of the study. Mean and standard deviation were used to answer research questions and t-test was used to analyze research hypotheses.

Results

Research Question One: What is the mean attitudes response of senior secondary school computer science students towards Internet usage?

The descriptive statistics of mean and standard deviation was used to answer research question one which is presented in table 1.

Table: 1: Mean and standard deviation of attitudes response of senior secondary school computer science students towards Internet usage

SN	Items	N	$\bar{X}$	SD	Agree
1.	Participating in internet usage would expand my knowledge.	382	3.67	1.088	Agree
2.	Using internet service to learn would improve my academic performance	382	3.49	1.105	Agree
3.	Using internet often will improve my computer proficiency	382	3.87	1.490	Agree
4.	Accessing, surfing and browsing the internet create pace learning for me.	382	3.34	1.155	Agree

5.	I am different about using internet for education.	382	3.46	1.140	Agree
6.	I prefer internet to learn than to face to face classroom.	382	3.36	1.193	Agree
7.	I prefer accessing my school examination results through the use of internet.	382	3.41	1.125	Agree
8.	Participating in using internet service would improve my ICT proficiency.	382	3.48	1.117	Agree
9.	Internet usage is a reliable medium of learning in my school.	382	3.55	1.082	Agree
10.	Using internet for examination in my school would reduce examination malpractices.	382	3.46	1.100	Agree
			35.10	6.177	

Decision mean 3.0

Table 1 indicates response of senior secondary school computer science students' attitude towards Internet usage. It was agreed with the mean values ranging from 3.34 to 3.87. From the analysis, it was revealed that the response of senior secondary school computer science students' attitude towards Internet usage is positive. With the grand mean of 35.10, the implication is that, the response of senior secondary school computer science students' attitude towards internet usage is favourable since all the ten items on attitude response show agreed based on decision mean of 3.0.

Research Question Two: What are the mean responses of attitudes of senior secondary school computer science students towards internet usage in public and private secondary schools?

The descriptive statistics of mean and standard deviation was used to answer research question two as presented in Table 2.

Table 2: Mean and standard deviation of attitudes response of senior secondary school computer science students towards internet usage in public and private secondary schools

School Type	N	$\bar{X}$	SD	Mean Difference
Public	221	35.21	6.028	0.27
Private	161	34.94	6.393	

Table 2 shows the mean and standard deviation of attitudes response of senior secondary school computer science students towards internet usage in public and private secondary schools. From the result, it can be seen that mean and standard deviation of male and female are; male $\bar{X}$ = 35.21, SD = 6.02 and $\bar{X}$ = 34.94, SD = 6.39, the mean difference is 0.27 in favour of public school attitude**.** To determine whether the mean scores have any significant difference, a corresponding null hypothesis was tested.

Research Question Three: What is the mean response of motivation of senior secondary school computer science students towards Internet usage?

The descriptive statistics of mean and standard deviation was used to answer research question three as presented in Table 3.

Table 3: Mean and standard deviation on motivation response of senior secondary school Computer science students towards internet usage

SN		N	$\bar{X}$	SD	Decision
1.	Internet helps the students to do class assignment.	382	3.33	1.411	Agree
2.	Internet helps the students to update their knowledge.	382	3.29	1.278	Agree
3.	Internet helps students to get wide variety of information.	382	3.35	1.329	Agree
4.	Internet enables students to learn at their own pace.	382	3.63	1.248	Agree
5.	Internet enhances students' career prospects.	382	3.35	1.244	Agree
6.	Internet motivation me to learn more.	382	3.36	1.325	Agree
7.	Internet motivates me in conducting self-research.	382	3.38	1.308	Agree
8.	Internet motivates me to develop Information and Communication Technology skill.	382	3.25	1.347	Agree
9.	Internet motivates me to involve in collaborative learning.	382	3.14	1.417	Agree
10.	Internet motivates me to learn how to participate in Computer Base Test (CBT).	382	3.09	1.313	Agree
		382	33.19	9.59	

Decision mean 3.0

Table 3 indicates the responses of senior secondary school computer science students' motivation towards Internet usage. The mean values range from 3.09 to 3.63, with the grand mean of 33.19.All the ten items on motivation agreed based on decision mean of 3.0. This implies that Internet usage promote senior secondary school computer science students' motivation.

Research Question Four: What would be the mean response of motivation of senior secondary school computer science students towards Internet usage in public and private secondary schools? The descriptive statistics of mean and standard deviation was used to answer research question fours presented in Table 4.

Table 4: Mean and standard deviation of motivation response of senior secondary school computer science students towards internet usage in public and private secondary schools

School Type	N	$\bar{X}$	SD	Mean Difference
Public	221	31.83	10.54	3.22
Private	161	35.05	7.77	

Table 4 shows the mean and standard deviation of responses of senior secondary school computer science students' motivation towards Internet usage in public and private secondary schools. From the result, it can be deduced that mean and standard deviation of public and private are: public school has mean of $\bar{X}$ = 31.83, with SD = 10.54 and private school has $\bar{X}$ = 35.05 with SD =7.77, and the mean difference is 3.22 in favour of private school. To determine whether the mean scores have any significant difference, a corresponding null hypothesis is tested.

Hypothesis One: There is no significant difference between attitudes of senior secondary school computer science students towards Internet usage in public and private secondary schools.

Table 5: t-test analysis of attitudes response of senior secondary school computer science students towards internet usage in public and private secondary schools

Participants	N	$\overline{X}$	SD	t-cal	df	p-value
Public	221	35.21	6.02			
				0.43	380	0.89^{ns}
Private	161	34.94	6.39			

ns: Not Significant at 0.05

Table 5 shows the mean responses of public school ($\overline{X}$=35.21) with standard deviation of 6.02 and the mean for private school ($\overline{X}$=34.94) with standard deviation of 6.39. The p-value of 0.89 is higher than 0.05 level of significance. This indicates that there was no significant difference between attitudes of senior secondary school computer science students towards Internet usage in public and private secondary schools (t-cal= 0.43, df = 380, p=0.89). Therefore, hypothesis one was not rejected.

Hypothesis Two: There is no significant difference between the motivation of senior secondary school computer science students towards internet usage in public and private secondary schools.

Table: 6: t-test analysis of motivation of senior secondary school computer science students towards internet usage in public and private secondary schools

Participants	N	$\overline{X}$	SD	t-cal	df	p-value
Public	221	31.83	10.54			
				24.99	380	0.01*
Private	161	35.05	7.77			

*: significant at 0.05

Table 6 shows the mean responses of public school is ($\overline{X}$=31.83) with standard deviation of 10.54 and the mean for private school ($\overline{X}$=35.05) with standard deviation of 7.77. The p-value of 0.01 is less than 0.05 level of significance. This indicates that there was significant difference between senior secondary school computer science students 'motivation towards Internet usage in public and private secondary schools in favour of public schools (t-cal= 24.99, df = 380, p=0.01). Therefore, hypothesis two was rejected.

Discussion

There was no significant difference between attitudes of senior secondary school computer science students towards Internet usage in public and private secondary schools in Abuja. This agrees with the study of Tella and Bashorun (2012) that investigated the attitude of undergraduate students towards computer-based test in University of Ilorin and found that students have positive attitude towards computer-based test than paper-pencil test. However, the finding disagrees with that of Balaramulu and Uma maheshwari (2015) who carried out study on secondary school student's attitudes towards using Internet as learning tool in Warangal District of Telangana State and found that there was a significant difference between private and public school students towards using Internet as a learning tool**.**

The finding also revealed that senior secondary school students from private schools were highly motivated that their counterparts from public schools in Abuja. This agrees with the study of Ahmed and Lawal (2017) who carried out study on motivation of secondary school students

towards Internet facilities usage for academic work. Their findings revealed a significant difference in the motivation of secondary school students towards use of Internet facilities for the academic work. The finding also agrees with the study of James (2017) who carried out study on the effects of technology on student motivation and engagement in classroom-based learning and found that students feel motivated through the specific use of technology in the classroom. Similarly, it also agrees with the study of Olawale, *et al* (2016) who carried out investigation on the perception on ICT usage by the rural and urban teachers in Ogun state and found that no significant difference in the perception of ICT facility usage in secondary school by rural and urban teachers.

Conclusion

Computer science students at public and private schools have positive attitude towards Internet usage for educational purpose in Federal Capital Territory. Students believed that the use of Internet for educational purposes will create room for self-development. Students from private secondary schools in Abuja were highly motivated towards Internet usage than those in public secondary schools in FCT Abuja.

Recommendations

The following recommendations are proffered based on the findings of this study:

(i) Basic training should be organized on how students can make use of internet for educational purposes, in order to guide them to use it strictly for educational. This will enable them to acquire basic knowledge and skills in Internet usage for educational purpose.

(ii) Both students and computer science teachers should be motivated by providing effective and functional internet facilities in the school.

(iii) The school administrators should create an enabling environment for the integration of Internet mode of instruction delivery as a complementary instructional mode

(iv) Governments and Non-Governmental Organizations' should make enough funds available in order to provide School-Net Projects in all the schools in FCT Abuja in order to serve as a driving force to all students to use Internet for educational purposes.

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Smart Classroom as Panacea for Effective Teaching and Learning in the 21st-Century

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Abstract
This paper presents the importance of smart classroom for teaching in Nigeria schools. The smart classroom is an enhanced classroom of technology that improves teaching and learning opportunities by group action learning technologies, like computers, special software, response technology audiences, helpful listening devices, networking, and audio / visual capabilities. The smart classroom also involves the use of newer technology in the classroom which makes the classroom lively and friendly for both teachers and students. This paper gives an insight on the definition of smart classroom, smart classroom technologies which include; laptop, desktop, ipad, digital podium, printer, smart board, clickers, scanner, interactive projector, digital camera, graphic table, multimedia, wire microphone, speakers, document camera, scanner radio, television, wireless microphone. Also the importance of smart classroom was discussed which involves immediate feedback, learners' engagement, personalised learning, collaborative learning, interactive content, automated roll call, easy access to information, performance-based assessments and student centric and offers flexibility in learning. It was concluded that smart classroom will ease the duties of the teachers in this modern age of tech savvy students by helping the teacher to access recent and relevant information easily by using newer technology in the classroom. Therefore, it is recommended that government owned schools and individual school owners should provide relevant and newer technologies in the classroom in order to meet up with the modern demands of the society.

Keywords: Smart classroom, importance, teaching.

Introduction
Over the past few years, technology in classrooms has increased tremendously. Smart classroom is physical environment that is enriched with digital, context-aware and adaptive devices, to promote better and faster learning (Koper, 2014). Smart classroom is the representative of the modern teaching. With the advent of modern technology, it becomes easier for the students as well as teachers to perform their tasks more efficiently. Smart classroom is important in all fields and levels of learning. The need to key into this modern classroom is very important to Nigeria schools in other to meet up with the technology era we are in right now.

Smart Classroom
A smart classroom is a physical classroom integrated with Artificial Intelligence technologies to support the students and the teacher in the teaching and learning process (Timms, 2016). The smart classroom is a face-to-face classroom that employs active learning processes in combination with advanced forms of educational technology to deliver customized learning experiences (Yanhong, 2018). Similarly, Jaiswa *et al*. (2018) defined smart classroom as an enhanced classroom of technology that improves teaching and learning opportunities by group action learning technologies, like computers, special software, response technology audiences, helpful listening

devices, networking, and audio / visual capabilities. In addition, Phoong *et al.*, (2019) defined Smart classroom as a classroom equipped with a computer and audio-visual equipment that allows teachers to use a variety of media. The smart classroom is an enhanced classroom of technology that improves teaching and learning opportunities by group action learning technologies, like computers, special software, response technology audiences, helpful listening devices, networking, and audio/visual capabilities. A Smart Classroom must be enriched with technology to accomplish the following attributes: personalisation and customisation of the learning, feedback provision, self-regulation and autonomy, context awareness and connecting capabilities.

A basic feature of a Smart Classroom is the ability to adapt itself to student needs in terms of the curriculum, course content, strategy and support. This is possible as smart classrooms are physical spaces endowed with digital devices to ease processes, but teachers and learners are the ones that must drive learning situations and, as a consequence, they must have the digital competencies and the ability to manage advanced solutions. According to previous studies, schools often experience difficulties in implementing advanced technologies (Cebrián, 2020). The use of smart classroom enables students to source for information collaboration with others while they are creating, attaching, connecting, and taking data with them from one location to another and from one group to the next. There is no single model of a smart classroom around the world because there are a number of innovative learning spaces in various educational institutions which can be considered to be smart classrooms (Bautista & Borges, 2013).

Smart classroom incorporates advanced technology in education in order to enhance the teachers' ability to facilitate students' learning and capabilities in order to take part in formal teaching and learning experiences above the possibilities of normal classrooms. While the notion of the 'classroom' originated in traditional education settings, it is also used in the context of distributed learning environments, whether online, blended, and/or distance learning. Smart classroom technologies look for active engagement through gestures, activity, and so on, but there is educational value to silent, reflective practices and quiet contemplative spaces. Smart classrooms integrate mobile and wearable devices, tracking technologies, data collection systems, big data processing capabilities, objects interconnected with human agents, automated machine decision making to inculcate learning content. This was buttressed by (Kwet 2020) who noted that a smart classroom can detect and scrutinize every single movement, can stifle independence and induce self-censorship among students and teachers, who strive to meet the expectations of the all-seeing machines – and the humans who operate them. Smart classroom has become a preferred type of classroom because of its integration of so many types of media and Information Technologies (Bogart & Wichadee, 2016).

Smart Classroom Technologies

There are several types of technology that makes a classroom smart. This includes laptop, desktop, iPad, digital podium, printer, smart board, clickers, scanner, interactive projector, digital camera, graphic table, multimedia, wire microphone, speakers, document camera, scanner radio, television, wireless microphone among other devices in which are further discussed.

Interactive Whiteboard (IWB)

An interactive whiteboard is one of the technologies of smart classroom that provides touch control of computer applications which enable students to experience interactive lessons and is now found worldwide throughout classrooms (Cebrián *et al.*, 2020).

Interactive Whiteboard (IWB) has come to replace the chalk board and in some instances the whiteboard IWB, is a classroom tool that allows images from computer screen to be displayed. It can be interacted with by the teacher and students. Some IWB have recording mechanism, which allow users to copy or playback the instruction irrespective of format. Components of IWB include computer, projector, appropriate software and display Panel.

Clickers

Clickers are interactive and can speed up didactic lessons when teaching learners. Clickers are small transmitters that look similar to a television remote control (Bojinova and Canisius 2013). They are advanced technological devices that allow students to quickly answer questions that are presented in class. When the students answer the questions, the clickers codes appear on screen and students know that their responses have been recorded. A computer summarizes the responses and the results are automatically displayed in chart form, usually a histogram. Responses can be anonymous or linked to specific students through the clicker unit identity, allowing the teacher to know who gave correct and incorrect] oresponses. Clickers provide significant benefits to both the teacher and students (Preville 2018). The use of clickers helps the teacher to get immediate feedback about the students learning process. Clickers are also very effective at engaging students in the class, promoting interactions among students, providing immediate feedback on their understanding of the lessons, and facilitating the active participation of students in the learning process by discussing the answers given to the questions. This brings about cordial relationship between the teachers and the students which makes the activity entertaining thereby increasing their willingness to participate in the classroom.

Interactive Response Systems (IRS)

In developing education system globally, technology has made instructional delivery improved in many ways. One of these improvements is the Interactive Response Systems (IRS) that is applied in classroom activities. Interactive Response System IRS is also known as, class response system or audience response system which are interactive remote answering devices enabling the teacher to access and assess immediate and real-time feedback from the students or audience.

Smart Audio

Smart Audio is designed to ensure effective distribution of the speaker's audio to every sitting area of the room. The components include Speaker system, room module, Software infrared control unit and digital Slate. It is a teaching pad also called wireless teaching slate or graphic tablet. It is writing device which displays content on the screen or projection when synchronized with either the projector or computer system. The picture depicts connection with a laptop. In the classroom question will be written for display through the teaching pad and the teaching will be given to any student for response. As such, there is no need for the student to stand before the board.

Document Camera (docucam)

Document Camera (docucam) is also known as visual presenter, visualizers, digital overheads, or docucams. It is a real-time image capturing device for displaying objects to a large audience. It is capable of projecting documents and transparencies. In the simplest terms, a document camera or visual presenter is the next-generation, digital replacement of an overhead projector. However, a document camera goes far beyond the simple functions of an overhead by allowing users to display not only transparencies, but documents, 3-D objects, microscopic images, moving objects, x-rays, slides, and more. With the ability to connect to a multimedia projector, monitor or TV, a document camera is able to display the presenter's thoughts, ideas, lessons and examples on a large screen format, live in vivid colour and detail.

Smart Podiums

Smart Podiums are also called smart boards or smart LCDs. It is an interactive pen display which can be connected to the computer or laptop externally via the USB port or RGB ports. It can be called as an external monitor with the facility of digital inking. With a smart podium, documents can be opened and work can be saved, presentations can be carried out and multimedia files can be written on by digital pen. There are a large number of videos available on the internet but still there is a requirement of VCD or DVD player because there are some videos which have copyright and have to be purchased. These are often in the form of DVDs or CDs.

Importance of Smart Classroom

The importance of smart classroom is numerous as it is beneficial to both teachers and students in this 21st century to be engaged with and meet up with the demand of the techno age we are in. Below are some importance of smart classroom;

Immediate feedback

The use of smart classroom enables students to get answers to their questions immediately online and they do not have to ask their teachers any questions if they do not want to. Hence, the students are opportune to have immediate and synchronous feedback which can improve their learning process as they can make amends where and when necessary, as indicated in the feedback.

Learners' engagement

The smart classroom creates an interactive environment that increases students' interest and engagement in learning inside the classroom. It will simplify the concept that is difficult for students to visualize without the use of the technology, which will subsequently improve learning and academic performance (Phoong, et al. 2019). It is suitable for students with different Intelligent Quotients, as it uses different forms of media and sources, which allow students to adjust and benefit from it.

Personalised learning

Smart classroom enables students to learn at their own pace of study. It encourages them to collaborate, encourage creativity, and students are able to use the web portal to search for information on their own. Smart classroom helps teachers develop students' abilities and performance, access multimedia content, and information that can complement teaching.

Collaborative learning
A Smart Classroom can use universal computing technology to enhance collaborative learning. Collaborative learning activities of team projects, team work of problem solving, debating, sharing, exposing and presenting ideas among others are made possible in a smart classroom. In a smart classroom, students are constantly reminded of their goals and responsibilities which enable them to follow class routines and understand what they are expected to achieve each day and how they are to go about it.

Interactive content
With the use of Smart classroom, students are able to learn and understand difficult concepts and understand complex problems by watching highly effective audio visuals and animations. By using the smart classroom learning can be fun for the students which will definitely improve their overall performance (Phoong *et al.,* 2019). Smart classroom also enables instructors to rapidly evaluate the learning process in the class.

Automated roll call
The system can automatically mark attendance of students, teachers, lecturers and instructors by just swapping the smart card and many other activities. Smart classroom, is environmental friendly, so that they can provide good environmental practice for the students as well as instructors (Siddiqui & Masud, 2016).

Easy access to information
Smart Classrooms allow students to access a worldwide range of knowledge and information from different sources globally. Teachers can utilize the various online information such as knowledge databases, online audio-video and worldwide news items to strengthen their lessons and classroom teaching. Students and Learners can quickly access the wide range of powerful and resourceful tools in their respective fields and resources to conduct their academics activities (Tiwari, 2017).

Performance-based assessments and student centric
The use of smart classroom encourages regular performance-based assessments by teachers through various activities such as by conducting quizzes and polls (Tiwari & Vihar, 2017). In this vein, teachers can help students to think critically and they can discover and master new concepts and their learning styles can be changed. Since the students are encouraged to participate actively, learning responsibility is also improved.

Offers flexibility in learning
A smart classroom is integrated with interactive technology tools which are incorporated with various forms of media such as photos, illustrations, snapshots, maps, graphs and charts, games, and video, to be displayed (Tiwari & Vihar, 2017). These interactive technology tools make learning to be more dynamic as the different methods of offering information are readily available.

Conclusion

With the aid of modern technology, it has become easier for the students and teachers across the world to get a good grasp of the theoretical as well as practical knowledge. Through technology it has become easier to visualize anything in 3D and therefore the technology helps us to be conversant of the nuances of any concept. The smart classroom is rectification to various problems that teacher as well as student faces inside the classroom.

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Investigating Perceive Usefulness and Perceive Ease of use of Digital Technologies Among Secondary School Science Teachers in Niger State, Nigeria

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Abstract
The study investigated perceive usefulness and perceive ease of use of digital technologies among secondary school science teachers in Niger State, Nigeria. The population for this study comprised 4789 secondary school science teachers in Niger state. The target population was all science teachers in all Niger state secondary schools that were selected within the study area. Comprising of three senatorial zones in Niger state (Zone A, Zone B and Zone C). The sample for this study was made up of 310 science teachers (male=193 female=117) in Niger State. A random sampling technique was used for the study. The Instruments for the study wasresearcher-designed questionnaire named Perceive usefulness and Perceive ease of use toward digital technology questionnaire (PPDTQ) was used for data collection in this study. (PPDTQ) was divided into section A, B and C. Section A was used to collect demographic data such as name of the school and gender. Section B of (PPDTQ) consists of 10 on the Perceive usefulness, section D will consists of 10 items that was used to collect data on perceive ease of use. A five-point type Likert scale which decision mean of 3.0 was used to determine the decision mean to each section of the questionnaire. The reliability of the research instruments was determined after conducting a pilot study on the teachers at Day Secondary School Tunga, Minna and Day Secondary School Badegi, who were among the population, but not part of the sample for the main study were used. The researcher carefully administered the instruments once on the respondents and the data obtained were analyzed using Cronbach Alpha. The following reliability coefficient indexes were obtained perceive usefulness 0.747 and perceive ease of use 0.837 which was acceptable reliability. Mean and standard deviation were used to answer research questions and ANOVA was used to analyze research hypotheses. Conclusion it was established that teachers perceive usefulness could influence usage of digital technologies materials in teaching and learning process. Digital technology can serve as teaching and learning platform to learn sciences. Recommendations; Digital technology should be used in teaching and learning of sciences in secondary schools in Niger State Nigeria. Secondary school students should adopt usage of digital technology to serve as supplementary tool in order to improve on the difficult concepts to them.

Key Words: Digital Technologies, Perceived Usefulness and Perceived Ease of Use

Introduction
Technology is a systematic approach in an integrated process to achieve practical purposes or achieve an end product (Arkorful&Abaidoo, 2014). Technology entails solving human problem technologically, scientifically and systematically. Technology is to be functional, qualitative and socio-personal driven. Socio-personal in the sense that it must be tailored toward serving the society and the personality involved. This accounts for why every society is concerned and deeply involved in the content and quality of education given to the individuals in the society. It is because of the role attributed to education by the society that account for its being defined as "transmission and renewal of culture from one generation to another (Abdullahi, 2002). The word technology

was defined by Amesi and Yellowe (2018)as a body of knowledge which when applied, helps in solving problems.

Technology integration in education encompasses hardware and software applications deeply rooted in Information and Communication Technology (ICT). Over the past decade, education has experienced extensive implementation of ICT as an integral part of teaching and learning process as well as other educational needs. ICT cuts across wide range of computerized and electronic technologies used in the acquisition, processing, transmission, and storage of information (Adebisi, 2014). Implementation of new teaching and learning ICT tools, especially within the scope of education will demand education providers, teachers, and students to find new researches outlining and updating innovations in the area of educational technology (Kim *et al.*, 2015) and the innovation could be seen in the area of digitalization in education.

The term digital technology include all tools used to support teaching and learning regardless of whether they are in form of computer, software programs, or printed books. (Bates, 2015). The issue of digital technology by Archambault*et al*. (2010) noted that newer technologies used in the digitalization of the schools and into school teachers' is every day practices. The concepts includes various information communication and administration technologies and software, as well as devices such as computer, laptops and tablets; either connected to the internet or not and mobile phones equipped with Global Positioning System (GPS) sensors of different kinds, as well as whiteboards, projectors with or without interactivity.

Digital Technologies (DT) are new kinds of classroom learning infrastructure enabled by advances in theory, research, and one-to-one computing initiatives (Dede & Richards, 2012). To effectively use digital technologies in schools, teachers should be able to integrate and use digital technologies in the classroom to create, share, communicate, connect, and collaborate with people within and beyond their schools, and how this is changing over time **(**Baskerville & Myers, 2015**).** This system is designed to operate in a teacher-led classroom as the major carrier of the curriculum content and to function as the primary instructional environment. Implementation of digital technologies materials depends on either it'sperceive usefulnessby the teachers and the students?

Perceived Usefulness (PU) is described as the extent to which a science teacher trusts that the use of digital technologies would improve the user's work performance (Buraimoh& Yusuf, 2019). It can also be explained as the extent to which users of technologies perceive that the usage of an information system will argument their teaching and learning process. The TAM also assumes that the adoption and use of a particular technology is motivated by the behavioural intention. Nonetheless, the behavioural intention is motivated by the user's attitude towards the use of the technology, and also by his or her perception of its usage. The attitude of a user is not the only factor that drives his or her desire to use a system, however, it is also based on the outcome or effect it may have on his or her achievement.

Perceived Ease of Use (PEOU), which is the next foundational drive in the Technology Acceptance Model is explained as the level to which a science teacher considers that using an information system would not be difficult to operate (Davis, 1989). The concept of the Perceived ease of use accounts for the level where a user accepts the fact that a particular technology would not be difficult to handle. The study seeks to examine the perceived ease of use in order to establish

teachers' attitude to use digital technologies in the promoting or enhancement of teaching and learning process. It is also imperative to understand that the perception of teachers can shape their actions towards the method of delivering their teaching through the use of digital technology.

Perception refers to the extent of believe of people that the utilization of a particular digital technology material or object will enhance teaching of a given particular concept (Ertmer*et al*., 2001). The belief is that the use of digital technology will improve the teaching pedagogy of teachers and it will also help to broaden the knowledge of teachers as well as that of students about the sciences concepts. The perception of people, especially teachers towards the utilization of any material will affect their level of interaction and acceptance of the material (Folarin, 2016). This implies that having a positive perception about the utilization of digital technology among secondary school teachers can add values to their method of teaching and consequently, their adoption, which will also be of benefits to the learners in line with teachers irrespective of gender. Gender is a factor in every aspect of human endeavor and as impact to all sector of life. Gender and DT connote the gender relation (male & female) as they react to that existence or discoveries of new technologies tools in the improvement of teaching and learning process (chukwuemeka, 2015).

Ayu*et al* (2017) carried out study on teachers' perceptions towards digital-based teaching material. The results finding indicates that teachers have the desire to integrate digital-based teaching materials effectively in the classroom.Falode*et al* (2019) who carried out study on self-efficacy and behavioral intention of pre-service teachers towards electronic teaching in Niger State, Nigeria. It was revealed that there were no significant difference between male and female self-efficacy and behavioral intention towards electronic teaching.Fumei*et al* (2018) investigated a technology acceptance model-based study of the attitude towards use intention of multimedia among school teachers. The results showed that the ease of use of the multimedia material would enhance the intention to use. The attitude toward use also influences the intention to use. Also in support of the study of Ernest (2019) carried out study on sing technology acceptance model to promote students adoption and use of digital technologies**.** The study revealed that respondents had developed positive attitudes and right perceptions toward the use of digital technologies during lessons because they gained more understanding and insight through the lively course content they offer.Thus, the focus of this study is to investigate the availability and perception of digital technologies among secondary school science teachers in Niger State, Nigeria.

Statement of the Research Problem

Over the years, the most common type of instructional delivery in Nigeria particularly for the teaching of sciences subjects has been the conventional method. Sadly, this method has been characterized by numerous problems such as non-usage of science instructional facilities, also low attention span of students, inability of the method to meet learners of different learning abilities. This disturbing trend in Nigeria educational system shows that educational system is losing its quality; a serious threat to quality education standard (Kozma*et al*., 2003).

However, teachers' perception has implication for the integration of technology in the classroom. Teachers with positive perception are more likely to integrate digital technology on the contrary teachers with negative perception may not integrate technology for teaching and learning. Hence, the drive for this study. Also there seem to be limited research on the perception of digital

technology among teachers in the population of this study. Worry of this study is: are the science teachers perceive digital technological materials useful and easy to use? It is on this note that this study is geared towards investigating perceive usefulness and perceive ease of use of digital technologies among secondary school science teachers in Niger State, Nigeria.

Research Questions

The following research questions guided the study;

1) What is the mean response of perceive usefulness of digital technologies among secondary school science teachers in Niger State, Nigeria?
2) What is the mean response perceived ease of use of digital technologies among secondary school science teachers in Niger State, Nigeria?
3) What extent is the mean response of perceived usefulness of digital technologies based on gender among secondary school science teachers in Niger State, Nigeria?
4) What is the mean response of perceived ease of use of digital technologies based on gender among secondary school science teachers in Niger State, Nigeria?

Research Hypotheses

The following null hypotheses were formulated and tested in the study at 0.05 alpha level

HO_1:There is no significant difference between mean response perceive useful of digital technologies based on gender

HO_2:There is no significant difference between mean response of perceive ease of use of digital technologies based on gender

Methodology

The population for this study comprised 4789 secondary school science teachers in Niger state (Research and statistics office, Niger state Ministry of Education Minna, 2020). There are 416 secondary schools in the entire 25 local government areas of Niger state as at 2018/2019 academic session (Niger State Ministry of Education, Minna, 2018).The target population was all science teachers in all Niger state secondary schools that were selected within the study area. Comprised of three senatorial zones in Niger state (Zone A, Zone B and Zone C). The sample for this study were made up of 310 science teachers (male=193 female=117) in Niger State. A random sampling technique was used for the study, the reason for using this technique was for every respondents to be given equal opportunity of being selected.

The instruments for the study wasresearcher-designed questionnaire named Perceive usefulness and Perceive ease of use toward digital technology questionnaire (PPDTQ) was used for data collection in this study. (PPDTQ) is divided into section A, B and C. Section A was used to collect demographic data such as name of the school and gender. Section B of (PPDTQ) consists of 10 on the Perceive usefulness, section D will consists of 10 items that was used to collect data on perceive ease of use.A five-point type Likert scale for section Strongly Agree (SA) was awarded 5 points, Agree (A) was awarded 4 points, Undecided (U) was awarded 3 points, Disagree (D) was awarded 2 points and Strongly Disagree (SD) was awarded 1 point. A grand mean score of 3.0 was used by adding 5+4+3+2+1 divided by five to determine the decision mean to each section of the questionnaire.

The questionnaire (PPDTQ) was validated by three Educational Technology experts from Federal University of Technology Minna and a psychology expert from Niger State College of Education

Minna. The experts examined research instruments appropriateness, suitability for target population in terms of clarity, depth of coverage and language; that is whether its statements were simple and unambiguous. Vital inputs that was made by all the experts, their suggestions and corrections were diligently effected by the researcher and the research instruments was finally found fit for the research.

The reliability of the research instruments was determined after conducting a pilot study on the teachers at Day Secondary School Tunga, Minna and Day Secondary School Badegi, who were among the population, but not part of the sample for the main study were used. The researcher carefully administered the instruments once on the respondents and the data obtained were analyzed using Cronbach Alpha. The following reliability coefficient indexes were obtained perceive usefulness 0.747 and perceive ease of use 0.837. Based on these reliability coefficient indexes obtained, the instrument was considered to have high and acceptable reliability. Alpha coefficients above 0.70 are considered acceptable.

The questionnaire was administered on the sampled science teachers within four weeks of the main study and wasanalyzed using descriptive and inferential statistics. Mean and standard deviation were used to answer research questions and t-test was used to analyze research hypotheses. Conclusion it was established that **t**eachers perceive usefulness could influence usage of digital technologies materials in teaching and learning process. Digital technology can serve as teaching and learning platform to learn sciences. Recommendations; Digital technology should be used in teaching and learning of sciences in secondary schools in Niger State Nigeria. Secondary school teachers should encourage students to adopt usage of digital technology as supplementary tool in order to improve on the difficult concepts to them.

Results

Research Question One: What is the mean response of perceive usefulness of digital technologies among secondary school science teachers in Niger State, Nigeria?

Table 1: Mean and standard deviation of perceive usefulnessof digital technologies among secondary school science teachers in Niger State, Nigeria

SN	Items	N	Mean	Sd	Decision
1	I find it easy to apply the digital technology material in my class	310	3.77	1.236	Useful
2	Digital technology material enables me to accomplish tasks more quickly	310	3.55	1.278	Useful
3	Using digital technology material is easy and understandable.	310	3.60	1.290	Useful
4	Using digital technology material is more flexible to teach than traditional method of teaching.	310	3.59	1.345	Useful
5	Digital technology material can open educational opportunities for students to meet up the miss classes.	310	3.56	1.267	Useful
6	Using digital technology material reduces the time I spend on unproductive instructional planning.	310	3.72	1.170	Useful

7	Teaching and learning process would be difficult without digital technology	310	3.56	1.202	Useful
8	Digital technology material provide teachers to assess other countries academic curriculum to extract best out of it.	310	3.37	1.305	Useful
9	Digital technology material will give science teachers opportunity to research on new development in my area of specialization.	310	3.41	1.359	Useful
10	Digital technology make me as a teacher to attend conference virtually	310	3.84	1.049	Useful

Table 1 Indicate perceive usefulness of digital technologies among secondary school science teachers. It was agreed with the mean values ranging from 3.37 to 3.84. From the analysis, it was revealed that perceive usefulness of digital technologies among secondary school science teachers in Niger State is positive. The implication is that, the perceive usefulness of digital technologies among secondary school science teachers is favourable, since all ten items on perceive usefulness show agreed based on decision mean of 3.0. Meaning?

Research Question Two: What is the mean response of perceived ease of use of digital technologies among secondary school science teachers in Niger State, Nigeria?

Table: 2: Mean and standard deviation of perceived ease of use of digital technologies among secondary school science teachers in Niger State, Nigeria

SN	N	N	Mean	Sd	Decision
Q1	Digital technology material supports critical aspects of my teaching and learning process	310	3.17	1.358	Easy
Q2	It is easy to become skillful at using digital technology material	310	3.33	1.296	Easy
Q3	Interacting with the digital technology material during learning improve my knowledge	310	3.20	1.290	Easy
Q4	I find it easy to recover from errors encountered while using digital technology material during learning process	310	3.31	1.270	Easy
Q5	I find it easy to apply the digital technology material in my class.	310	3.29	1.310	Easy

Q6	Using digital technology material is easy and understandable.	310	3.34	1.385	Easy
Q7	Using digital technology material gives me greater control over my learners	310	3.17	1.306	Easy
Q8	My interaction with the digital technology material is easy for me to understand	310	3.18	1.348	Easy
Q9	Overall, I find digital technology materials easy to use during teaching and learning process	310	3.31	1.300	Easy
Q10	Digital technology material is flexible mean of instructional delivery.	310	3.16	1.256	Easy

Table 2 Indicate perceived ease of use of digital technologies among secondary school science teachers. It was agreed with the mean values ranging from 3.16 to 3.34. From the analysis, it was revealed that perceived ease of use of digital technologies among secondary school science teachers in Niger State is positive. The implication is that, the perceived ease of use of digital technologies among secondary school science teachers is favourable since all the ten items on perceived ease of use show agreed based on decision mean of 3.0.

Research Question Three: What is the mean response of perceived usefulness of digital technologies based on gender among secondary school science teachers in Niger State, Nigeria?

Table 3: Mean and standard deviation of male and female science teachers' response on perceived usefulness of digital technologies in secondary school

Gender	N	Mean	Sd
Male	193	36.92	7.14
Female	117	37.07	7.96

Table 3 shows the mean and standard deviation of the male and female lecturers' perceived usefulness of digital technologiesamong secondary school science teachers in Niger State. From the result, it can be seen that mean and standard deviation of male and female are; male $\bar{X}$ = 36.92, SD = 7.14 and $\bar{X}$ = 37.07, SD = 7.96, the mean difference is 0.05 in favour of female science teachersperceived usefulness**.** To determine whether the mean scores have any significant difference, a corresponding null hypothesis was tested.

Research Question Four: What is the mean response of perceived ease of use of digital technologies based on gender?

Table 4: Mean and standard deviation of male and female science teachers' response on perceived ease of use of digital technologies in secondary school

Gender	N	Mean	Sd
Male	193	34.22	8.60
Female	117	32.34	9.32

Table 4 shows the mean and standard deviation of the male and female perceived ease of use of digital technologies among secondary school science teachers in Niger State. From the result, it can be seen that mean and standard deviation of male and female are; male $\bar{X}$ = 34.22, SD = 8.60 and $\bar{X}$ = 32.34, SD = 9.32, the mean difference is 1.88 in favour of male science teachers perceived ease of use**.** To determine whether the mean scores have any significant difference, a corresponding null hypothesis was tested

Hypothesis One: There is no significant difference between perceive useful of digital technologies of secondary school science teachers based on gender

Table 5: ANOVA analysis of male and female science teachers' response on perceive useful of digital technologies in secondary schools

Source	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1.667	1	1.667	.030	.863
Within Groups	17154.127	308	55.695		
Total	17155.794	309			

Table 5: shows the hypothesis that stated that no significant difference between perceive useful of digital technologies of secondary school science teachers based on gender was tested. The finding in (table 5) showed f = 0.030 with p = 0.863 since p> 0.05, H01, was accepted. Therefore there was no significant difference between perceive useful of male and female secondary schools science teachers' on digital technologies**.**

Hypothesis Two: There is no significant difference between perceive ease of use of digital technologies of secondary school science teachers based on gender

Table 6: ANOVA analysis of male and female science teachers' response on perceive ease of use of digital technologies in secondary schools

Source	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	256.286	1	256.286	3.249	.072
Within Groups	24299.185	308	78.893		
Total	24555.471	309			

Table 6: shows the hypothesis that stated that no significant difference between perceive ease of use of digital technologies of secondary schools science teachers based on gender was tested. The finding in (table 6) showed f = 3.249 with p = 0.072 since p> 0.05, H02, was accepted. Therefore there was no significant difference between perceive ease of use of male and female secondary schools science teachers' on digital technologies**.**

Discussion of Findings

There is no significant difference between perceive useful of digital technologies of secondary school science teachers based on gender. This is in agreement with the findings of Viraiyan*et al* (2017) examining the antecedents of ICT adoption in education using an Extended Technology Acceptance Model (TAM). The results suggest that demographic variables such as level of qualification do matter to some extent but are rendered insignificant when the two TAM factors, perceived usefulness (PU) and perceived ease of use (PEOU) are added to the model. Moreover, PU and PEOU substantially improved the model and were both found to have a significant positive direct effect on ICT adoption.Ayu*et al* (2017) carried out study on teachers' perceptions towards digital-based teaching material. The results finding indicates that teachers have the desire to integrate digital-based teaching materials effectively in the classroom.

There is no significant difference between perceive ease of use of digital technologies of secondary school science teachers based on gender. This is in support of Falode*et al* (2019) who carried out study on self-efficacy and behavioural intention of pre-service teachers towards electronic teaching in Niger State, Nigeria. It was revealed that there were no significant difference between male and female self-efficacy and behavioural intention towards electronic teaching. The findings also in agreement with the study ofFumei*et al* (2018) investigate a Technology acceptance modell-based study of the attitude towards use intention of multimedia among school teachers. The results showed that the ease of use of the multimedia material would enhance the intention to use. The attitude toward use also influences the intention to use. Also in support of the study of Ernest (2019) carried out study on sing technology acceptance model to promote students adoption and use of digital technologies**.** The study revealed that respondents had developed positive attitudes and right perceptions toward the use of digital technologies during lessons because they gained more understanding and insight through the lively course content they offer.

Conclusion

1 Teachers perceive usefulness could influence usage of digital technologies materials in teaching and learning process.

2 Digital technology can serve as teaching and learning platform to learn sciences.

Recommendations

1 Digital technology should be used in teaching and learning of sciences in secondary schools in Niger State Nigeria.

2 Secondary school students should adopt usage of digital technology to serve as supplementary tool in order to improve on the difficult concepts to them.

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Effect of Augmented Reality-Based Mathematics Application on Mathematics Education Students' Achievement; a Case Study of IBB University, Lapai, Niger State

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Abstract
This study investigated the effect of augmented reality-based mathematics application on Ibrahim BadamasiBabangida University (IBBU) Mathematics education studentsLapai, Niger State. The study adopted pre-test and post-test randomized experimental design. The target population for the study was all the 200 level mathematics education students atIbrahim BadamasiBabangidaUniversity. A random sample of 123 students (75 male and 48 female) were randomly selected from science education department (Mathematics option), in IBBU Lapai. Twogroups were assigned to experimental group one (63 students) and control group(60 students) respectively. Two research questionsguided the study and two null hypotheses were tested at 0.05 level of significance. The researchers developed augmented reality-based Mathematics application (ARBMA) on mathematical concepts, which was used as treatment for experimental groups. A pilot study was carried out to test the research instrument. A reliability coefficient of 0.72 was obtained using the test retest method. Thirty (30) multiple choice questions of Mathematics Achievement Test (MAT) were administered to both groups before and after the treatment as pre-test and post-test. The data collected from the administration of the research instrument (ARBMA) were analyzed using SPSS version 20.0. The mean and standard deviations were used to answer the research questions while analysis of covariance (ANOVA) was used to test the research hypotheses. The findings of the studyrevealed that there was significant difference in the achievement of IBBU Lapai Mathematics education student taught using augmented reality-based Mathematics application and those taught using conventional method F (1, 121) =100.11 P= 0.00, with P < 0.05. There was no significant difference in the achievement of gender of mathematics student taught using augmented reality-based Mathematics application F (1, 61) = 0.00 P = 0.97, with P > 0.05. Based on the findings, the study recommends that augmented reality-based Mathematics application (ARBMA) should be encouraged in schools for teaching and learning of Mathematics.

Keywords: Augmented Reality, Achievement and Application

Introduction
Mathematics education is referred to as the practice of teaching and learning of Mathematics in a way of solving problems involving learning the Algorithms and formulas necessary for

computations (Okeke, 2011). It is a platform to learn and teach Mathematics with better way for students to learn in different ways. The way in which a person learns has an impact on how learning is experienced over time and this can be achieved with the use of augmented reality Mathematics application.

Augmented reality (AR) employs multimedia as digital content augmented with 2D and 3D animations or videos. It is indicated that augmented reality takes into account individual differences among learners and is a safe way for students while the impact of learning with the learner's sense of fun (Chiang *etal.*, 2014).Augmented reality is a three-dimensional technology that supports individuals to understand and perceive the real world surrounded by objects created in a virtual environment (Leung &Blauw, 2020). In other words, augmented reality is a three-dimensional computer-generated graphics that create a bridge between virtual and real environments (Diegmann*et al.*, 2015).

Augmented reality-based applications differ from virtual reality applications that are created in artificial environments that have no connection with the real world, since augmented reality-based applications allow real-time interaction, where virtual and real exist together (Carmigniani&Furht, 2011).AR-based applications have become applications that can be used in educational environments as they have the potential of educational use and become more accessible to technological tools (Danaei*et al.*, 2020). Augmented reality-based applications are used in many fields of teaching from mathematics, which is a subject that requires students to think in three dimensions (Chao & Chang, 2018. &Estapa&Nadolny, 2015).

Animation used in augmented reality contributes to achieving educational objectives and furnished children with fun and happiness and that the appearance of 3-dimensional models while learning increases their motivation towards learning (Rabia&Sevdakucuk, 2015). Augmented reality provides an interactive environment that the real world does not offer. Augmented reality in the classroom contributes to making students busier with the curriculum, learning more deeply, and interacting and cooperating better. It is indicated that augmented reality furnishes the learners with multiple options in representing information dynamically and quickly, helping to increase learners' motivation, and developing their academic achievement (Catenazz&Sommaruga, 2013). Augmented reality is a form of technology that enhances the real world by merging the textbook with technology, especially a mobile phone.

Augmented reality is characterized by the complementarity between the media-based on education, which aims to enhance and enrich the real world (Cuendet*etal.*, 2013). The media-based augmented reality such as icons, printed images, and interactive videos contributes to raising the efficacy of academic achievement, allows students to control the presentation, and repeats the scenes that embody the information, ensuring the realization of the principle of visual analysis by controlling the speed of presentation (Wang & Hartley, 2003). The augmented reality contributes to achieving the highest degree of interaction between the mathematics content and the learner, which is difficult to achieve in traditional learning, especially in learning abstract concepts in Mathematics, which are difficult for the learner to understand and perceive, as augmented reality contributes to the survival of the Mathematics students and the achievement of self-learning (Derry, 2007).

Statement of the Research Problem

The most common use of instructional delivery in University has been the conventional method of teaching. Sadly, this teaching method has been attributed by numerous problems such as pace learning and inadequate coverage of syllabus, which affect their academic achievement. It was discovered from the previous Mathematics examination results of 2017 to 2021 from science education department of IBBU Lapai. Students are not performing well in MAT 211 in MathematicsEducation as a course offered in first semester at undergraduatelevel. It is in the light of this that the researchers intended to carry out this research on effect of augmented reality-based Mathematics application on Ibrahim BadamasiBabangida University Mathematics education student Lapai, Niger State.

Research Questions

The following research questions were raised to guide the study:

1. What is the difference in the mean achievement scores of the students taught Mathematics using augmented reality compared to those taught using conventional method?
2. Will there be any difference in the mean achievement scores of male and female students taught Mathematics using augmented reality?

Research Hypotheses

The following null hypotheses were formulated and tested at 0.05 level of significance:

1. There is no significant difference in the in the mean achievement scores of the students taught Mathematics using augmented reality compared to those taught using conventional method.
2. There is no significant difference in the mean achievement scores of male and female students taught Mathematics using augmented reality.

Methodology

The study adopted pre-test and post-test randomized experimental design.The population of the study comprised of all science education students of Ibrahim BadamasiBabangida University Lapai. The target population for the study was all the 200 level Mathematics education students. A random sample of 123 students (75 male and 48 female) were randomly selected from science education department (Mathematics option) at IBBU Lapai. Two groups were assigned to experimental group one (63 students) and control group (60 students) respectively. Both groups were pre-tested and experimental group were exposed to mathematics lesson using augmented reality-based mathematics application while control group were exposed to Mathematics lesson using conventional method of teaching for the period of five weeks. Post test was administered to both groups.

The research was guided by two research questions and two null hypotheses and tested at 0.05 level of significant. The researchers developed Augmented Reality-Based Mathematics Application (ARBMA) on mathematical concepts, which was used as treatment for experimental group. A pilot study was carried out to test the research instrument. A reliability coefficient of 0.72 was obtained using the test retest method. Thirty (30) multiple choice objective questions named Mathematics Achievement Test (MAT) were administered to both groups before and after the treatment as pre-test and post-test. The data collected from the administration of the research instrument (ARBMA) were analyzed using SPSS version 20.0. The mean and standard deviation

were used to answer the research questions while analysis of covariance (ANOVA) was used to test the research hypotheses. The findings of the study revealed that there was significant difference in the achievement of IBBU Lapai Mathematics education students taught using augmented reality-based Mathematics application and those taught using conventional method. There was no significant difference in the achievement of gender of Mathematics students taught using augmented reality-based Mathematics application. Based on the finding, the study recommends that augmented reality-based Mathematics application (ARBMA) should be encouraged in schools for teaching and learning of Mathematics.

Results

Research Question one: What is the difference in the mean achievement scores of the students taught Mathematics using augmented reality-based Mathematics application compared to those taught using conventional method?

Table 1: Mean and Standard Deviation of Pretest and Posttest Scores of Experimental and Control Group

GROUP	N	Pretest		Posttest		Mean Gain
		X	SD	X	SD	
Augmented Reality	63	25.65	8.97	69.08	11.34	43.43
Conventional Method	60	25.77	8.38	50.22	9.41	24.45

Table 1 shows the mean and standard deviation of the mean achievement scores of experimental group and control group in pretest and posttest. The result revealed that mean and standard deviation scores of the pretest and posttest experimental group are $\bar{X}$ =25.65, SD = 8.97 and $\bar{X}$ = 69.08, SD = 11.34 respectively. This gives a mean gain of 43.43 in favour of the posttest. On the other hand, the mean and standard deviation of the pretest and posttest of the control group are $\bar{X}$ = 25.77, SD = 8.38 and $\bar{X}$ =50.22, SD = 9.41 respectively and gives a mean score of 24.45 in favour of the posttest. The result also revealed that experimental group and control group had mean gain of 43.43 and 24.45 respectively, and with the experimental group having the highest mean gain of 43.43.

Research Question Two: Will there be any difference in the mean achievement scores of male and female students taught Mathematics using augmented reality-based Mathematics application?

Table 2: The Mean and Standard Deviation of Pretest and Posttest Scores of Male and Female Augmented Reality-Based Mathematics Application)

Group	N	Pretest		Posttest		Mean Gain
		$\bar{X}$	SD	$\bar{X}$	SD	
Male	35	21.52	6.92	69.13	12.14	47.61
Female	28	30.83	8.63	69.03	10.47	38.2

Table 2 shows the mean and standard deviation of the pretest and posttest scores of male and female experimental group. From the result, it can be seen that mean score of the pretest and posttest score of the male are $\bar{X}$ =21.52, SD = 6.92and $\bar{X}$ = 69.13, SD =12.14. The mean gain is 47.61 in favour of the male posttest achievement score. Similarly, the mean and standard deviation of pretest and posttest score of female are $\bar{X}$ = 30.83, SD = 8.63 and $\bar{X}$ = 69.03, SD = 10.47, the mean gain is 38.2 in favour of the female posttest score. Also the result reveals the difference of 9.41 between the posttest mean gains score of male and female in favour of the male.

Hypothesis One: There is no significant difference in the mean achievement scores of students taught Mathematics using augmented reality-based Mathematics application compared to those taught using conventional teaching method.

Table 3: Summary of Analysis of Variance (ANCOVA) comparison on the posttest mean achievement scores of the experimental and control group taught Mathematics using (augmented reality-based Mathematics application and conventional method)

Groups	Sum of Squares	df	Mean Square	F	Sig
Between groups	10934.320	1	10934.32	100.11	0.00
Within groups	13215.815	121	109.22		
Total	24150.135	122			

Table 3shows that F (1, 121) =100.11 P= 0.00, with P <0.05 the null hypothesis was rejected. This revealed that there was significant difference in the mean achievement scores of students taught Mathematics using augmented reality-based Mathematics application compared to those taught using conventional teaching method. The null hypothesis was rejected; therefore there was significant difference in the mean achievement scores of students taught Mathematics using augmented reality-based Mathematics application compared to those taught using conventional teaching method**.**

Hypothesis Two: There is no significant difference in the mean achievement scores of male and female students taught Mathematics using augmented reality-based Mathematics application.

Table 4: ANOVA Analysis of achievement of male and female students taught Mathematics using augmented reality-based Mathematics application

Groups	Sum of Squares	Df	Mean Square	F	Sig
Between groups	0.145	1	0.145	0.00	0.97
Within groups	7981.229	61	130.840		
Total	7981.374	62			

Table 4 shows the results of the analysis of variance on achievement of male and female students taught Mathematics using augmented reality-based Mathematics application as shown above. Table 4 revealed F (1, 61) = 0.00 P= 0.97, with P >0.05 the null hypothesis was accepted. Therefore, there was no significant difference in the mean achievement scores of male and female students taught Mathematics using augmented reality-based Mathematics application.

Discussion of the Findings

There was significant difference in the mean achievement scores of students taught Mathematics using augmented reality-based Mathematics application compared to those taught using conventional teaching method**.**This result was confirmed on null hypotheses one presented in table three that there was a significant difference in the mean scores of Experimental and Control Groups with F (1, 121) =100.11 P= 0.00, with P < 0.05.Hence the null hypothesis stated was rejected.

This could be ascribed to the active involvement and participation of the students in the augmented reality-based Mathematics application. This is in agreement with the study Fadi (2021) who investigated the effect of augmented reality in improving visual thinking in mathematics of 10th-grade students. The results of the study show that there are statistically significant differences in the development of visual thinking in favor of the experimental group students taught by the augmented reality technology. Also in support of the study of Chao and Chang (2018) who carried out study using augmented reality to enhance and engage students in learning mathematics. The result before and after studying using augmented reality indicates that the learning effects have significantly promoted with use of augmented reality mathematics application. It isalso in agreement with the study of Adalikwu*et al* (2021) who investigated the effects of voice thread modes on achievement of students in Computer Science in Colleges of Education in North-Central Nigeria. The findings of the study revealed that there was significant difference in the achievement scores of students taught computer Science using voice thread in favour of those exposed to video and animation modes.

There was no significant difference in the mean achievement scores of male and female students taught mathematics using augmented reality-based mathematics application.This result implies that both male and female students performed better in the achievement test.

Similarly, Table four result reveals that there was no significant difference in the mean achievement scores of male and female students taught Mathematics using augmented reality-based Mathematics application, F (1, 61) = 0.00 P = 0.97, with P > 0.05. The null hypothesis was accepted. This is in line with the study of Jimoh*et al*(2018) who investigatedeffect of three modes of mobile instructional package on achievement and gender of mathematics students in colleges of education, in North-Central Nigeria**.** It was revealed that there was no significant difference in the achievement of male and female students taught Mathematics using video-only mathematics mobile instructional package.

Conclusion

The fact that Mathematics as a subject consists of abstract concepts shows that students may have problems in understanding the lesson and greater achievement towards this lesson. However, augmented reality-based applications were used to overcome these problems. In this process, augmented learning Mathematics application was used in order to improvestudents' achievement in Mathematics course at university level, due to screen-sharing features and objects in three dimensions from their own computers and phones.

Recommendations

1. The current study recommends using augmented reality technology in education in general, and in mathematics education in particular, organizing the content of Mathematics curricula in line with augmented reality technology.
2. Training courses should be organized for Mathematics education students in order to learn how to integrate augmented reality Mathematics application in learning of Mathematics.

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Influence of Information and Communication Technology (ICT) on Job Performance of Librarians in Federal Universities in South-West, Nigeria

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Abstract
This study investigated the influence of Information andCommunication technology (ICT) on job performance of librarians in federal university libraries in South-West, Nigeria. Three research questions guided the study in line with the objectives. Descriptive survey research design was used and the target population of one hundred and sixty-four (164) librarians in the three selected federal university libraries in South-West, Nigeria were adopted for this study. A close ended structured questionnaire was used as data collection instrument. Total frequencies and median were statistical tools used for data analysis. Results showed that level of job performance of librarians is moderate,influence of ICT skills possession on job performance of librarians is high and ICT skills possession has a positive and strong relationship with job performance of librarians in federal university libraries in South-West, Nigeria. The study concluded that provision of good working environment, sufficient possession of ICT skills, high quality of ICT facilities and training and re-training of librarians in the aspect of ICT to acquire more ICT skills especially the advanced ICT skills would no doubt enhance their job performance.The study recommended that federal university libraries in South-West, Nigeria should make their libraries more conducive for staff and users,organise training and re-training for librarians to acquire more ICT skills especially the advanced ICT skillsand more opportunities should be given to librarians to attend conferences, workshops and seminars in the area of ICT.

Keywords: Federal Universities, Influence, Information Communication Technology, Job Performance, Librarians.

Introduction

University libraries are those libraries that are established in universities as higher institution of learning to collect, organise, preserve and store information for the use of users such as students, teachers and others for educational purposes to enhance education, assist both students and teachers achieve their educational objectives(Ode and Ode, 2018). Considering the vital roles that libraries and their respective librarians play in achieving, the visions and missions of universities form the foundation on which the roles of university library are based. University library caters for the information needs of the university by providing reading materials for the various programmes of the university. There are different bodies that establish universities such as Federal, State and Private organisation. The focus of this study is on federal universities being established and funded by Federal Government of Nigeria. They receive allocations and support from the Federal Government and some percentage of the total grant to universities are meant to procure library resources and render library services. This is to enable them support the academic objectives of the host institution.These services are mostly provided by librarians.

A librarian is one who undergo Library and Information Science (LIS) training in any approved institution of learning and has obtained first or higher degree in librarianship and perform professional duties such as selection and acquisition, cataloguing and classification, conducting reference services, bibliographic services (Saidu*et al.,* 2020). It is pertinent to note that no university library can be effective or successful in its activities without the presence of qualified librarians who have been trained on how to provide relevant information resources and services to the user community. Thus, librarians have the responsibility of acquiring, organizing, preserving and disseminating information. Librarians perform a wide range of services such as technical, readers', administrative and ICT related services in the university libraries. Librarians are believed to be the backbone of the services offered by the university libraries on their different job descriptions. Librarians working in Federal University Libraries in Nigeria are expected to possess adequate ICT skills in order to carry out effective library operations. Adequate ICT skills needed to possess by librarians could be the overall competencies, skills, knowledge, attitude and technical know-how to create, save, analyze, organize, retrieve, disseminate and manipulate digital information such as images, text, sounds and graphics in digital libraries or any type of information.

Job performance could be viewed as a core concept within work organizational system. This has to do with orientation of an individual on the approach to whatever task the person is carrying out. Job performance can also be described as what an employee does in work situation and how effectively and efficiently it was done for accomplishment of organizational goals and objectives. Agba*et al.* (2013) defined job performance as the task accomplished by individual employee; it is how well a staff accomplishes a given task in an organization. Job performance is a result of activities of either an individual or organization for a specific period. Job performance involves taking series of actions to produce results and this is done through proper integration of knowledge and skills. Individual performance is generally determined by factors such as: motivation, the desire to do the job, the capability to do the job, the work environment, the available tools, facilities and information needed to do the job. If the problem is with the environment, the library management can adjust to promote higher performance. If a librarian lacks ability to perform, the person can be trained to perform.

Job performance of a worker can be determined by many factors such as work environment, knowledge, abilities, training skills, experience, technology or equipment available and willingness to improve on the job. This is so that, a work environment that is too hot or cold, dark and poorly ventilated will certainly not promote and encourage good job performance, thus culminating in poor productivity. However, a conducive work environment that is not hazardous and promotes collaboration, team work and trust is likely to encourage good job performance. For an organization to excel among its peers in this competitive world, job performance of its workforce goes a long way in determining its success. Performance could be high or low, and keeping high performing employee has become a top priority for modern-day organizations, university libraries inclusive. Losing good and high performing workers is enormous in terms of time and finance required to recruit, interview, hire, assess, train and integrate new employees to replace the high performing ones who might have left. Thus, retention of high job performers should be the main concern of the management of academic libraries (Adeeko*et. al.,* 2017). Any

noticeable shortfall in ICT skills, abilities, knowledge and in-service training of librarians working in university libraries would no doubt have negative effect on their job performance. Therefore, job performance of librarians can be determined by use of Information Communication Technologies (ICTs) in library operations to enhance their job performance.

Information and Communication Technology (ICT) is a term that connotes various meanings. Information Communication Technology refers to technology that provides access to information via telecommunications devices and infrastructure. Information and Communication Technology (ICT) is the coming together of computing, telecommunication and broadcasting technologies to produce information. Example of computing technologies are the computers and its accessories while telecommunication technologies include telephone, facsimile, fax, e-mail. The broadcasting technologies include: radio, television, video. ICT can also be defined as the science of information processing which deals with the use of computer and other electronic devices to collect, process, store, retrieve and transmit or disseminate information to any part of the world. ICT skills could be viewed as the overall competencies (skills, knowledge, attitude and technical know-how) needed to create, save, analyse, organise, retrieve and disseminate digital information such as images, text, sounds and graphics in digital libraries or any type of information. In recent times, work for the information profession has become characterised by fast-paced change and new skills requirements (Seena and Pillai, 2014).

Information and Communication Technology (ICT) has brought tremendous transformation to academic libraries and information services. Such areas of transformation and development occasioned by ICTs in academic libraries include; computing technology, communication technology and mass storage technology. This has reshaped the way that libraries access, retrieve, store, manipulate and disseminate information to the users. In other words, students and staff (library users) now use ICT facilities available in the universities to source for reference material, online journal as well as send and receive e-mail from within and outside the country (Odionye, 2016).

Applications of Information and Communication Technology (ICT) are numerous but mainly it is used in converting the existing paper-print records in the entire process of storage, retrieval and dissemination. ICT presents an opportunity to provide value-added information services and access to a wide variety of digital based information resources to their clients. Furthermore, university libraries are also using modern ICTs to automate their core functions, implement efficient and effective library cooperation and resource sharing networks, implement management information systems, develop institutional repositories of digital local contents, and digital libraries and initiate ICT based capacity building programmes for library users (Krubu and Osawaru, 2010).The use of ICTs in library operations is significant, as it would help to accelerate the operations.

The availability of ICT facilities in university libraries such as CD ROM, computers, digital cameras, facsimile, Internet facilities, microfilm, photocopying machine, plotters, printers, projectors, scanners, white smart board is significant as it helps to increase accessibility and adequate use of information resources. Hence, ICT usage will facilitate development and job performance since there will be free flow of information between library personnel and users (i.e. lecturers, students and the academic community). However, effective service delivery can only be

achieved where ICT facilities such as: computers, printers, digital telephone, photocopying machines, CD-ROMs, projector, Internet facilities, plotters, facsimile, scanners, multimedia resources are available especially in the federal university libraries. The pervasive influence of ICT is obvious in all areas of human endeavour via the following ICT devices: computers, printers, digital telephone, photocopying machines, CD-ROMs, projector, Internet facilities, plotters, facsimile, scanners, multimedia resources. It is vital to note that ICT use in research has become a norm in university libraries where librarians have been identified as stakeholders in its development and implementation. The availability of ICT facilities in the university libraries would play a very vital role by providing easy, speedy and accelerated access to required information needed by the library users.

Availability of ICT facilities would also enhance the job performance of the librarians by effectively and efficiently discharging their responsibilities towards satisfying the users basic information needs. Yisadoko*et. al.* (2017) stated that ICT facilities have become the spine of many academic institutions. They serve as motivating factors to both library personnel and users by providing them with opportunity to transmit, acquire, download process and disseminate information on any subject of interest. It is enough for university libraries to make the ICT facilities available but also accessible for use. The accessibility of ICT is the ability of a person to perceive, use, navigate, communicate and interact with the ICT facilities. Similarly, increasing the availability of accessible ICT is considered a positive step in removing barriers that limit library personnel to effective use of ICT facilities in the university libraries in Nigeria. Therefore, university libraries should play active role in using ICT facilities as a means of effective information delivery, so as to equip librarians with right skills to access information independently which could also help in job performance. Afolabi (2014) observed that the prospects of ICT and the ideal situation of educational research in our ICT driven campus is still a mirage. This is why university libraries should endeavour to make ICT facilities available and accessible to their users.

The use of ICT facilities in the university libraries play a very crucial role by enabling library to easily provide the required information to the clienteles. Oriogu*et.al*. (2014) stated that the use of Information and Communication Technology (ICT) is gaining momentum in university libraries especially now that most universities in Nigeria are adopting ICT in the development and improvement of their services. ICT has provided libraries with new opportunities to improve their resources and services.

Statement of the Problem

The workforce of any organisation including libraries are responsible for its success and failure. The working environment of the library personnel is fast changing which demands new knowledge and skills for them to perform their job effectively and efficiently. For university libraries to achieve maximum productivity in terms of supporting learning, teaching, research and service to host community where the universities are located. University library personnel (Librarians) are expected to perform the statutory functions so as to achieve the set objectives of their university library. Thus, the job performance of librarians in federal university libraries in South-West, Nigeria was below expectation as Aboyade (2014) found that the job performance of professional librarians in Nigerian federal universities was on low level. Extant literature and researchers' observation have shown that, some librarians in federal university libraries in South-West, Nigeria found it difficult to cope with the tools of the ICTs in library operations which may invariably

affects their job performance. Could the challenges be due to inadequate ICT facilities, insufficient ICT skills, knowledge, abilities and technical known-how by librarians?It is against this backdrop that, the researcher investigated the influence of Information Communication Technology on job performance of librarians in federal university libraries in South-West, Nigeria.

Research Objectives

The objectives of the study are to:

1. determine the level of job performance of librarians in federal university libraries in South-West, Nigeria;
2. ascertain the influence of ICT skills possession on job performance of librarians in federal university libraries in South-West, Nigeria;
3. find out if there isa significant relationship between ICT skills possessionand job performance of librarians in federal university libraries in South-West, Nigeria.

Research Questions

The following research questions guided the study:

1. What is the level of job performance of librarians in federal university libraries in South-West, Nigeria?
2. What is the influence of ICT skills possession on job performance of librarians in federal university libraries in South-West, Nigeria?
3. Is there a significant relationship between ICT skills possession and job performance of librarians in federal university libraries in South-West, Nigeria?

Inuwa (2020) conducted a similar study with two specific objectives. The study was an experimental in nature. The population of the study covered the of all JSS II in Dutsinma zone. The researcher divided the students into two (2) groups: controlled and experimental and were taught some topics in social studies and thereafter forty objectives questions were administered to all the groups. ANOVA was used to analysed the results. The result showed that ICT has a positive impact in enhancing students' academic performance. The study concluded that there is significant difference in the mean academic performance of students taught social studies with ICT and those taught without it. The study recommended among other things that the use of ICT in the classroom instruction in the study area should be encourage in upper basic level in Dutsinma zonal quality assurance, Katsina State, Nigeria. The present study is similar with this study because the studies are on how ICT enhanced performance of a particular group of people.

Oziko*et. al.* (2018) conducted a similar study that was guided by three specific objectives. The study adopted a descriptive survey design. The population of the study comprised 94 library staff and 711 library users. The instruments of the study were questionnaire and observation checklist. Descriptive statistical tools such as frequency and mean were used to analysed the collected data. The findings of the showed that various ICT facilities such as network facilities, photocopiers, printers, scanners, local area network among others were available in the libraries; that ICT application are used for different purposes in the libraries; that the extent of ICT application to library services in those libraries is extensively low except few services that are of great extent. The study concluded that provision of adequate technical support and provision of qualitative bandwidth were suggested to enhance maximum application of ICT in the libraries. The study

recommended that more ICT facilities should be made available, power supply should be improved and that adequate fund should be provided by the government to the libraries. The present study is similar with this study because the studies are on ICT application in academic libraries.

Okpokwasili (2018) carried out a similar study that was guided by two specific objectives. The study adopted survey research design. The population of the study comprised 542 library staff. The instrument used for the study was a structured questionnaire. Descriptive statistical tools such as: frequency, mean and standard deviation were used to analysed the collected data. From the findings of the study, the study concluded that there is high level of type of library crimes committed in academic libraries and high level of curbing library crimes with ICT in academic libraries in Nigeria. It was recommended that government and concerned authorities should adopt and make available information and communication technologies as means of curbing library crimes in academic libraries in Nigeria and since the traditional methods seems not meeting the security expectations. The present study is similar with this study because the studies are on impact of ICT and both used university libraries in Nigeria as areas of coverage.

Idakwo*et. al.* (2018) conducted a similar study that was guided by five research questions in line with the objectives of the study. The study adopted survey research design. The population of the study comprised 30 circulation staff of University of Ilorin, Federal University Lokoja and University of Abuja Libraries. The instrument used for the study was a structure questionnaire. Data collected were analysed using simple percentage. Findings of the study revealed that ICTs are utilised in circulation operations in the Federal University Libraries; ICT devices are available for circulation operations in the libraries among others. The study recommended that government should endeavour to provide adequate funds for procurement of ICT facilities for university libraries to enhance automation of circulation operations and university management should engage the circulation staff on continuous ICT training through organised seminars and workshops and among others. The present study is similar with this study because the studies are on application of ICT in library operations and both used university libraries as areas of coverage.

Yisadoko*et. al.* (2017) carried out a similar study that was guided by six specific objectives. The researchers adopted descriptive survey design. The population of the study was the 200 postgraduate students of Federal University of Technology, Minna. The instrument used for the study was a structured questionnaire. Descriptive statistical tools such as: frequency table and simple percentage were used to analysed the collected data. Findings revealed that ICT facilities were available at a low level. It was recommended that efforts should be made to place a high premium of priority on application of ICTs in the services on university libraries and adequate training and orientation on ICT should be emphasised. The present study is similar with this study because the studies are on influence of ICT on library professionals and both used university libraries as areas of coverage.

Seena and Pillai (2014) conducted a similar study that was guided by three research questions. The study was based on a questionnaire survey of library professionals in the library of the University of Kerala, India. The population of the study consisted of 102 professionals, para-professionals and university administrators. The instrument used for the study was a structured questionnaire. Data collected were analysed using version 23 of MS-Excel for appropriate statistical analysis and description. Findings revealed that lack of training (40.20%) is one of the main constraint in

acquiring ICT skills, ICT facilitates quick access to current data (52.94%) and ICT application improves quality of library services (53.92%). The study concluded that the university library needs proper ICT infrastructure and training for the professionals in using the digital resources effectively. It was recommended that libraries should promote ICT awareness to the professionals as well as users by providing short-term courses, in-house training programmes, organising workshops, seminars, conferences and public lectures etc. The present study is similar with this study because the studies are on ICT and both used university libraries as areas of coverage.

Ojiegbe (2010) conducted a similar study that was guided by three research questions. The study adopted descriptive survey design. The population of the study consisted of 136 professional and para-professional staff working in the university libraries. The instrument used for data collection was questionnaire. Mean score and percentages were used in analysing the data collected. Findings from the study revealed that the level of ICT competence among the library staff working in the university libraries were very low. Many of the library staff acquired the competencies they possess through private computer training, personal practice and on the job training. The study concluded that Nigerian Library Association (NLA) and Librarians' Registration Council of Nigeria (LRCN) should take up the mantle of leadership role to educate library heads and set standards of operations for libraries. The National Library's Centre for Advanced and Information Management (CALIM) in Enugu should be properly developed and put to use for competency training of librarians in Nigeria. It was concluded that the two Federal University libraries should dedicate a reasonable percentage of their annual library budget to training, the two Federal Universities libraries should create an internal committee on training that would be responsible for planning training programmes for the library staff and the two Federal Universities must make sure that every library staff have access to the use of the ICT facilities available in the library for practices. The present study is similar with this study because the studies are on ICT competencies of library staff and both used Federal University libraries as areas of coverage.

Methodology

This study adopteda descriptive survey research design. The survey research design is used because survey type of research is characterized by population and sample as well as the use of data collection instrument. Mole (2019) defined descriptive survey research design as one which is aimed at collecting data from members of a given (usually large) population on their views, opinions, attitudes, beliefs and perceptions, in order to determine the characteristics, features or facts about the population. The population of the study comprised ofone hundred and sixty-four(164) librariansworking in Hezekiah Oluwasanmi Library; Obafemi Awolowo University, Ile-Ife, Albert Ilemobade Library; Federal University of Technology, Akure and Kenneth Dike Library; University of Ibadan, Ibadan. The study usedsimple random sampling technique to select the three universities based on status: two conventional and one specialised for the purpose of generalisation. The entire population was adopted for the study.A close ended structured questionnaire was designed titled "influence of Information and Communication Technology (ICT) on job performance of librarians' questionnaire (IICTJPLQ) to capture the level of job performance of librarians and influence of ICT skills possession on job performance of librarians in federal university libraries in South-West, Nigeria.Research questions one and twoweredescriptivelyanalysed using total frequencies and median as a measure of central tendency or average. According to Kostoulas (2021), the median is the number found precisely in the middle of the distribution that shows what the likeliest response might be or what the average respondent

might think. The draft copies of questionnaire were validated by three lecturers in the Department of Library Information Technology, one professional library staff all from Federal University of Technology, Minna and 40 copies of the modified version were pre-tested on 40 librarians of Kebbi State University of Science and Technology Library, Aliero, and AbubakarGimba Library; Ibrahim BadamasiBabangida University Lapai respectively using test re-test method. The selection of these universities is due to the fact that they are State based conventional and specialised universities that are neither part of population, study area nor part of sample. The reliability coefficient of 0.92 was obtained. The figure is above half (1/2), which is an indication that the instrument is excellent and reliable. A total of 164 copies of questionnaire were administered to librarians in the selected federal university libraries in South-West, Nigeria. A response rate showed the retuned of 164 copies of the questionnaire representing 100 percent.The analysis of the research questions one and two was done through median with a decision criterion of fx ≥ median = (high or agreed), and *fx*< median = (low or disagreed). Research question three was inferentially analysed using Spearman's rho correlation analysis tested at 0.05 level of significance. Spearman's rho correlation analysis was used because it is the non-parametric version of the Pearson Product Moment Correlation (PPMC). Spearman's rho correlation determines the strength and direction of the monotonic relationship that exists between two variables rather than the strength and direction of the linear relationship between two variables.

Results of Analysis of the Major Variables of the Study

Research Question One: What is the level of job performance of librarians in federal university libraries in South-West, Nigeria?

The response on the level of job performance of librarians in federal university libraries in South-West, Nigeria is presented in Table 1.

Table 1: Response on the level of job performance of librarians in federal university libraries in South-West, Nigeria

S/N	STATEMENTS	Total *F*x	Median M=2078	DECISION
	Motivation (Personal Desires)			
1	The prompt payment of staff salary encourages industrial harmony and good job performance in the library.	2189	*f*x ≥ M	High
2	Regular promotion of staff motivates me to come up with new ideas and better ways of doing things.	2145	*f*x≥M	High
3	The reward system for dedicated staff motivate me to make meaningful contributions during meetings in the library.	2114	*f*x≥M	High
4	Career prospects motivate me to work harder and meets work deadlines in the library.	2205	*f*x≥M	High
	(Work Environment)			
5	The working environment in the library is quite conducive for high performance.	934	*f*x≥M	Low
6	The requirements needed for promotions in my university encourages me to publish more locally and internationally.	2171	*f*x≥M	High
7	There is constant provision for acquisition of required skills for library personnel on the job performance.	1438	*f*x<M	Low
	Skills (Mental Ability)			

8	Ability to comprehend complex ideas enables me acquire ICT skills to perform my job efficiently.	1835	*f*x<M	Low
9	Librarians ability to reason quickly facilitates speedy completion of routine duties.	1882	*f*x<M	Low
10	My ability to learn fast enables me to acquire ICT skills to perform my job better.	2004	*f*x<M	Low
	(Physical Ability)			
11	My ability to move around enables me to acquire ICT skills and enhances job performance.	2247	*f*x≥M	High
12	My ability to see properly enables me to acquire ICT skills and work effectively.	2173	*f*x≥M	High
13	My ability to hear properly enables me to acquire ICT skills and work better.	2135	*f*x≥M	High
	(Experience)			
14	My years of experience on the job improves my skills perform my work very well.	1955	*f*x<M	Low
15	My experience on daily tasks improves my skills which enhance my job performance.	1951	*f*x<M	Low
	Facilities			
16	Use of ICT facilities helps me reduce redundant work.	1749	*f*x<M	Low
17	Use of ICT facilities improves my job competency to work better.	2119	*f*x≥M	High
18	Use of ICT facilities enables me to provide quality library services.	2042	*f*x<M	Low

Key 1: *f*x= ∑ (SA value*statement value + A value*statement value + N value* statement value + D value*statement value + SD value*statement value).

Key 2: *f*x≥M = High Performance, *f*x<M = Low Performance.

The data presented in Table 1 were analysed for level of job performance of librarians. The median (M) of the total score (*f*x) for each item of the university libraries assessed was used. The criterion for each statement was High if *f*x ≥M of 2078 (greater than or equal to 2078) and Low if *f*x< M of 2078 (less than 2078). The results on Table 1 showed that the respondents indicated high performance to nine statements out of the eighteen items listed on the level of job performance of librarians as the *f*x ≥M of 2078 (greater than or equal to 2078). On the other hand, respondents indicated low performance to the other nine statements as the *f*x< M of 2078 (less than 2078).

Research Question Two: What is the influence of ICT skills possession on job performance of librarians in federal university libraries in South-West, Nigeria?

The response on the influence of ICT skills possession on job performance of librarians in federal university libraries in South-West, Nigeria is presented in Table 2.

Table 2:Response on the influence of ICT skills possession on job performance of librarians in federal university libraries in South-West, Nigeria

S/N	STATEMENTS	Total *F*x	Median M=2194	DECISION
	Basic Operation of ICT Hardware Skills			
1	Ability to retrieve documents from storage devices enhance my job performance.	2238	*f*x≥M	High

2	My ability to save, edit and copy data into secondary storage devices such as: diskettes, flash drive and USB effectively enhances work output.	2287	*f*x≥M	High
3	My knowledge of ICT enables me to save, edit and copy data into primary storage device such as: hard disk effectively and this enhance job performance.	2213	*f*x≥M	High
4	Ability to scan and upload documents enhance librarians work output.	2236	*f*x≥M	High
5	My knowledge of ICT enables me to type and print documents which enhances job performance.	2195	*f*x≥M	High
	Email Management and Setup Skills			
6	My knowledge of ICT enables me to create an online email account for my colleagues thus enhancing job output.	2152	*f*x<M	Low
7	Ability to use e-mail in sending and receiving messages and this enhance job performance.	2282	*f*x≥M	High
	Safe Internet Usage Skills			
8	My ability to open web pages, navigates web links and save favourite web pages enhance job performance.	1925	*f*x<M	Low
9	My knowledge of ICT enables me to perform online cataloguing and classification and this enhance job performance.	2238	*f*x≥M	High
10	My knowledge of ICT enables me to use OPAC/Web OPAC to retrieve bibliographic information and this enhance job performance.	2235	*f*x≥M	High
	Online Research Skills			
11	Ability to use search Engines such as: Mamma, AOL, Yahoo, Google in searching for information online enhances my job performance.	2229	*f*x≥M	High
12	My knowledge of ICT enables me check for reference sources online which enhance job performance.	2246	*f*x≥M	High
13	My knowledge of ICT enables me collect research data using Google forms or Survey monkey and this enhance job performance.	2160	*f*x<M	Low
	Online Communication and Collaboration Skills			
14	My knowledge of ICT enables me to use Electronic Bulletin Boards which enhances job output.	2109	*f*x<M	Low
15	My ability to communicate and hold meetings with others on ZOOM enhances job performance.	1889	*f*x<M	Low
16	Ability to share work related files on Dropbox or Google drive enhance librarians job performance.	2037	*f*x<M	Low
17	My knowledge of ICT enables me to perform Electronic Documentary Delivery Services and this enhance job output.	2194	*f*x≥M	High
	Social/Academic Networking Sites Management Skills			
18	My knowledge of ICT enables me to perform Networking activities and this enhance work output.	2142	*f*x<M	Low
19	Ability to search and retrieve research papers on ResearchGate and Academia.edu. enhance librarians work performance.	2203	*f*x≥M	High
20	My knowledge of ICT enables me share my work findings on Twitter and this enhance work output.	2162	*f*x<M	Low
21	Ability to reach out and collaborate with other colleagues on LinkedIn, ResearchGate enhance my job performance.	2229	*F*x> M	High
	Document Creation and Retrieval Skills			
22	My knowledge of ICT enables me to perform Statistical skills such as SPSS to analyse data and this enhance job performance.	1974	*f*x<M	Low

23	My knowledge of ICT enables me to use Graphics such as: CorelDraw which enhance job output.	2048	*f*x<M	Low
24	Ability to use spreadsheets to enter numerical value and text into cells as well as performing calculations using formula enhance my job performance.	2181	*f*x<M	Low
25	My knowledge of ICT enables me to perform Presentation skills such as: power point presentation which enhance job output.	2191	*f*x<M	Low
26	My knowledge of ICT enables me install Software and this enhance job output.	2192	*f*x<M	Low
27	My knowledge of ICT enables me to select relevant and appropriate materials for download and this enhance work performance.	2200	*f*x≥M	High

Key 1:*f*x= ∑ (VHI value*statement value + HI value*statement value + MI value* statement value + LI value*statement value + VLI value*statement value).

Key 2: *f*x≥M = High Influence; *f*x<M = Low Influence.

The data presented in Table 2were analysed for the influence of ICT skills possession on job performance of librarians. The median (M) of the total score (*f*x) for each item of the university libraries assessed was used. The criterion for each statement was high if *f*x≥M of 2194 (greater than or equal to 2194) and low if *f*x<M of 2194 (less than 2194). The results on Table 2 showed that the respondents indicated high influence to fourteen statements out of the twenty-seven items listed on the influence of ICT skills possession on job performance of librarians as the*f*x≥M of 2194 (greater than or equal to 2194). On the other hand, respondents indicated low influence to the other thirteen statements as the *f*x<M of 2194 (less than 2194).

Research Question Three: Is there a significant relationship between ICT skills possession and job performance of librarians in federal university libraries in South-West, Nigeria?

This hypothesis is to ascertain whether there is significant relationship between ICT skills possession and job performance of librarians in federal university libraries in South-West, Nigeria.

Table 3: ICT skills possession correlation coefficient test result on job performance of librarians.

Correlations

			Job Performance	**ICT Skills Possession**
Spearman's rho	Job Performance	Correlation Coefficient	1.000	.717**
		Sig. (2-tailed)		.000
		N	164	164
	ICT Skills Possession	Correlation Coefficient	.717**	1.000
		Sig. (2-tailed)	.000	
		N	164	164

**. Correlation is significant at the 0.01 level (2-tailed).

Table 4.12 showed that Spearman's correlation coefficient $r_s = 0.717^{**}$, and that this is statistically significant at (p=.000 which is less than 0.05 level of significance). **Therefore, the null**

hypothesis is rejected. This means that ICT skills possession has a positive and strong relationship with job performance of librarians in federal university libraries in South-West, Nigeria. The Spearman's correlation coefficient of ICT skills possession of 0.717, this number is positive, meaning that every time there is an increase in the ICT skills possession of 0.717, job performance will also increase by 0.717 points.

Summary of Major Findings

1. The level of job performance of librarians in federal university libraries in South-West, Nigeria is moderate.
2. The influence of ICT skills possession on job performance of librarians in federal university libraries in South-West, Nigeria is high.
3. The hypothesis testing result showed that ICT skills possession has a positive and strong relationship with job performance of librarians in federal university libraries in South-West, Nigeria.

Discussion of Findings

Response to research question one sought to find out the level of job performance of librarians in federal university libraries in Nigeria. The result showed that respondents indicated high performance to nine statements out of the eighteen items listed on the level of job performance of librarians as the*f*x ≥M of 2078 (greater than or equal to 2078). This is corroborated by the respondents' affirmative responses to the questionnaire items. The finding is supported by a similar study by Agada*et. al.* (2021) that, job performance is a measure of how effectively library staff carry out their duties or responsibilities in order to accomplish specific and desirable results. Furthermore, in line with the opinion of Curral (2013), individual job performance is the unique contribution of an employee to the achievement of organisational goals and can be enhanced by helping employees to acquire competencies through capacity building strategies such as training and re-training, workshops, conferences and seminars. This finding does not corroborate the finding of Adeeko et. al. (2017) who reported that the level of job performance of library personnel in universities of Southwest Nigerian is high. On the other hand, the respondents indicated low performance to other nine statements as the *f*x< M of 2078 (less than 2078). This is in line with the findings of Aboyade (2014) and Akor (2009) who both reported that job performance of professional librarians in Nigerian federal universities and government-owned universities in North-Central, Nigeria was on a low level. However, Library as a unit within an institution of higher learning such as universities requires high performing personnel so as to realise its vision and mission of meeting the information needs of the parent institution. Thus, a moderate level performance among librarians cannot be a source of joy, satisfaction and achievement with a feeling of mastery and pride. It is therefore, necessary for the management of various federal university libraries in Nigeria to put in placemeasures that will improve job performance of librarians. These measures include: adequate training in both the conventional and ICT aspects of library operations, good condition of services, possession of sufficient ICT skills, abilities and knowledge, goodwages, provision for advancement in terms of promotion (for those who meet the requirement) as at when due and good working environment devoid of dangers and hazards, robust and adequate health and medical services.

Response to research question two sought to find out the influence of ICT skills possession on job performance of librarians in federal university libraries in Nigeria. The result showed that

respondents indicated high influence to fourteen statements out of the twenty-seven items listed on the influence of ICT skills possession on job performance of librarians as the *f*x ≥M of 2194 (greater than or equal to 2194). This is corroborated by the respondents' affirmative responses to the questionnaire items. The finding is supported by a similar study by Seena and Pillai (2014) that, ICT skills are the overall competencies (skills, knowledge, attitude and technical know-how) needed to create, save, analyse, organise, retrieve and disseminate digital information such as images, text, sounds and graphics in digital libraries or any type of information. Consequently, in line with the opinion ofAbba (2017), to increase the ICT skills of the information professionals, there is need for continuous training and orientation program. Although computer is becoming popular, still we lack computer literate professionals, many senior and old information professionals do not know how to operate computer effectively. On the other hand, respondents indicated low influence to other thirteen statements as the *f*x< M of 2194 (less than 2194). This is in line with the finding of Yisadoko*et. al.* (2017) who reported that possession of some listed ICT skills by postgraduate students in Nigerian universities is at low extent. Similarly, Ugwuoke (2012) opined that any worker, who is not adequately equipped with ICT skills for operating in the new environment, automatically becomes a misfit.Ugwuoke (2012) further asserted that the introduction of ICT to the workforce using the Digital Nervous System (DNS) approach has necessitated re-training of workers.

Conclusions

Based on the major findings, the study concluded that Research question one showed that level of job performance of librarians is moderate as this could be attributed to poor working environment, insufficientICTskills possession orlow quality of ICT facilities to functional well.Research question two revealed that influence of ICT skills possession is high. Thus, the provision of good working environment, sufficient possession of ICT skills, high quality of ICT facilities and training and re-training of librarians in the aspect of ICT to acquire more ICT skills especially the advanced ICT skills would no doubt enhance their job performance.

Recommendations

1. Federal university libraries in South-West, Nigeria should make their libraries more conducive for staff and users.
2. Federal university libraries in South-West, Nigeria should organise training and re-training for librarians to acquire more ICT skills especially theadvanced ICT skills.More opportunities should be given to librarians to attend conferences, workshops and seminars in the area of ICT.

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Assessment of the Emergence of Digital Technology in English Language Teaching Pedagogy for Basic Education Schools in Gombe State, Nigeria

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Abstract
The purpose of this study was to assess the emergence of digital technology in teaching of English Language in Basic Education schools (Junior Secondary Schools) in Gombe State in pandemic situations. The study used sample size of 52 English Language teachers out of the total population of 264 English Language teachers across public and private Basic Education schools in Gombe state. Questionnaire and checklist were used as instruments to collect data for this study. Statistical tools used to analyze results for this study were Mean and Chi-Square. Findings for this study revealed a significant absence of digital technology facilities for language teaching among most basic education schools in Gombe state and less usage of these facilities where available by the teachers. It was also observed that the few available digital technology facilities ended up broken down, resulting from lack of power supply and consequent non-usage. In line with the findings of the study, it was recommended that the Basic Education schools be provided with the latest digital technology facilities for English Language teachers by the government and proprietors respectively to ease language teaching delivery in the class. In addition, schools that receive supply of these facilities should be connected to a sustainable source of power to make them functional. Language teachers should be engaged in training on how to operate the facilities for optimum productivity.

Introduction
There is an increasing volume of research and theoretical literature on digital communication, 'new' digital literacies and the use of digital technology as teaching and learning English language tools in classrooms. The literature that was used to inform the current study came from several areas: digital literacy, digital pedagogies, the Information and Communication Technology skills of Indigenous tertiary students, and using digital pedagogies to teach literacy. The foci of the literature on digital literacy seem to fall into two broad categories, developing critical and discerning abilities in the students and providing up-skilling for the teachers. Most of the current generation of students has grown up with digital technologies, and it has been claimed that not only are current students' techno-savvy but also that they think and process information differently from their predecessors (Prensky, 2001. p1). The use of Prensky's term 'digital natives' as applied to all of the current generation of students has been questioned as it 'obscures inequalities in access to technology' (Hague & Williamson, 2010). The latter authors also note, for example, that the types of technology and media that are said to generate informal learning are 'products of the commercial landscape, usually designed for purposes other than education' and that students may not be learning anything that is transferable to their education. They also note that students may not be able to discern the commercial side or impact of that on them.

A number of studies stated that teachers need to teach students how to use digital media alongside of teaching them critical skills (Hague & Williamson, 2010; Luckin, Clark, Graber, Logan, Mee& Oliver, 2009; MCEETYA, 2010). When developing students' skills with digital technologies for education purposes, it is also necessary to consider how the technology has changed what is now regarded as Literacy. Literacy itself now entails a wider range of interconnecting elements including decoding and writing text in multimodal forms and scripts, visual interpretation, site navigation, media manipulation, and comprehension. This includes comprehension of the words and how the media may impact or alter the meaning of the words (Asselin&Moayeri, 2011; Poore, 2011). In a recent text based on classroom research Walsh (2011, p12) indicated that multimodal literacy 'may also include listening, talking, enacting and investigating as well as writing, designing and producing such texts'.

As the notion of what constitutes literacy changes, approaches to teaching literacy in schools also changes (Carroll, 2011). These changes are more than teachers adopting new tools to teach literacy in the same way as before. As an awareness of the way in which literacy has changed, fundamental changes in literacy pedagogy are being developed. In the current study the pre-service teachers researched their practice in teaching literacy in elementary/primary classrooms through the medium of ICTs. The lecturer investigated the best ways he could support the students' development of digital literacies and the development of their own digital pedagogies to teach literacy.

What is Literacy?

The Australian MCEECDYA report (2010) into ICT in Education in the middle school years identified three strands of digital proficiency: working with information, creating and sharing information and using ICT responsibly. The report further identified six processes involved in digital literacy. These are: accessing, managing and evaluating information, creating new understandings, communicating with others, and using ICT appropriately. It was reported that some of the students assessed on these categories showed that only 57% of Year 6 met their expectations (p.6).

Students may use ICTs competently for social networking but need teacher guidance for learning based digital literacy (Luckin et al, 2009). It was also noted that students are not expert at evaluating the relevance of material found online, its accuracy or the authority of the person who uploaded it.

What is Digital Pedagogy?

Digital pedagogy includes several axiomatic changes to traditional pedagogy and has more in common with a constructivist approach, in which students construct their own knowledge in a social context. However, digital pedagogy goes beyond that to include teaching about and for digital technology for learning. Central to digital pedagogy is the co-construction of knowledge. A digital pedagogy includes planning for learning which is less content than problem-solving based. It can present knowledge as problematic rather than as fixed. As such it promotes higher order thinking skills and students move from remembering content to gaining a deep understanding of concepts (Kent &Holdway, 2009). It develops critical analysis, meta-cognition and reflection, often through creation, editing and publishing online (Luckin et al, 2009). Further, digital pedagogies can include Web 2.0 technology for social networking, with the use of blogs, wikis, i-

phones and i-pads for learning. In this way digital pedagogies help to promote connectedness to the wider world, (Kent &Holdway, 2009).

In order to embrace digital pedagogies teachers may find they are no longer the experts and that they need to change from being users of technology, such as when they find and print off activities for students, or information for themselves to use in teaching, to becoming co-creators (Poore, 2011).

As not all students have navigation skills or use the whole range of ICT competently (MCEEDYA, 2010), teachers need to demonstrate how to identify, select, analyze and use ICT information such that students develop critical digital literacy (Asselin&Moayeri, 2011). Teachers also need to accept that there will be fundamental changes to activities, rather than using old activities on new media, as world is fast changing. Hence, the need for English Language teachers to go with the pace of the technological changes in the classroom cannot be over emphasized.

Using Digital Pedagogies to Teach English Language

Some recent studies have investigated current classroom practices around digital pedagogies for literacy. For example, Oakley (2008) investigated using a language experience approach with digital storytelling using power point with voice recordings and Ciampa (2012) studied the use of electronic storybooks to increase reading motivation. Both found the methods successful in motivating students and teaching an aspect of literacy. A series of linked studies were undertaken to investigate a professional development model of up-skilling classroom teachers in pedagogical practices with ICT to teach literacy. An initial survey demonstrated that many primary students were not choosing to read print based texts for leisure outside of the classroom.

Statement of the Problem

In recent years, technology has tried to fulfill its role inhelping humanity leading to the substantial mediumof interaction in the social world as well as inteaching and learning. Over the years those in highereducation have explore the exciting opportunities newtechnologies bring to institutions, educators andstudents. Technology has changed the way peopleinteract and has brought about the emergence of anopen social platform such as social media that allowsthe inhabitants of this planet earth to connect with each other making the world a global village. Alarmingly, these opportunities are sporadically present or not at all at the basic Education level especially in Gombe State. The few available can be observed in private schools only. This cannot be unconnected with the attitude of the government and the proprietors towards budgetary allocation for the supplying of these digital technology facilities for the teaching of language. Hence, informed the researcher to embark on the study to assess the Emergence of Digital Technology in English Language Teaching Pedagogy in Basic Education Schools in Gombe State, Nigeria

Objectives of the Study

The general purpose of the study was to identify the emergence and presence of digital technology in the way English language teachers deliver the curriculum at the basic level and specifically to:

i. Determine the presence of digital technology facilities for teaching English language in Junior Secondary Schools in Gombe State.
ii. Determine conditions and usage of the available digital technology facilities for teaching English language in Junior Secondary Schools in Gombe State.

Research Questions:

i. Is there presence of digital technology facilities for teaching English language in Junior Secondary Schools in Gombe State?
ii. What is frequency of utilization of the available digital technology facilities for teaching English language in Junior Secondary Schools in Gombe State?

Methodology

In this study, survey technique was used to get the information that is quantitative in nature from representative population through questionnaire. Multiphase sampling was used and the 52 respondents were measured.The population of the study was derived from English language teachers at the Junior Secondary School (JSS) level being part of the basic education in Gombe state. A checklist of expected digital technological instructional materials for teaching English language was also used to determine availability and of course appropriate usage where available in the classroom situations.

Findings

Research Question1: Is there presence of digital technology facilities for teaching English language in Junior Secondary Schools in Gombe State?

Table 1: Presence of Digital Technology Facilities for Teaching English Language

S/N	Item	FE	FO
1	Head phones	204	24
2	Monitor	24	12
3	Digital computers	26	2
4	Loud Speakers	27	12
5	Microphones	27	14
6	Central Control	34	3
7	Inverters	45	1
8	Projectors	56	0
9	Interactive Boards	43	0
10	Video Clips	65	23
11	Power Point Slides	34	12
12	Auto Cards	54	12
13	Audio Recorders	23	13
14	Video Recorders	67	21
15	CCTV Cameras	65	23
		794	**172**

From the Table 1 above the difference between the Frequency Expected (FE) and Frequency Observed (FO), the value of total frequency observed 172 is by far less than the expected frequency of 794 digital facilities in teaching English language

Research Question 2: What is Frequency of Utilization of the Available Digital Technology Facilities for Teaching English Language in Junior Secondary Schools in Gombe State?

Table 2: Utilization of the Available Digital Technology Facilities for Teaching English

S/N	Item	Mean	Decision
1	Head phones	1.3	Not Frequent
2	Monitor	2.1	Not Frequent
3	Digital computers	1.3	Not Frequent
4	Loud Speakers	1.4	Not Frequent
5	Microphones	2.4	Not Frequent
6	Central Control	1.4	Not Frequent
7	Inverters	1.5	Not Frequent
8	Projectors	1.8	Not Frequent
9	Interactive Boards	1.4	Not Frequent
10	Video Clips	1.4	Not Frequent
11	Power Point Slides	1.6	Not Frequent
12	Auto Cards	1.4	Not Frequent
13	Audio Recorders	1.6	Not Frequent
14	Video Recorders	1.5	Not Frequent
15	CCTV Cameras	1.6	Not Frequent
		Grand Mean 1.58	

From the data in Table 2 above the grand mean of 1.58 indicated that all the items are not been put into used by the teachers in the schools, from item 1-15 the frequency ranges between 1.3-2.4 which is less than the average.

Conclusion

In a drastically brief overview of technology in language teaching, the very brevity that forced the myriad details of CALL applications to be glossed over highlights what stands out as being essential: the human being involved in acquiring skills that will contribute to safety.

Upon the advent of the motor car at the beginning of the twentieth century, proud owners used their cars mainly for joy rides and social display. It took some time and democratization with the Model T Ford for cars to become usefully integrated into society. The profusion of media and technology may well have a similar effect. It requires a conscious effort to focus on selecting media to fit pedagogy rather than devising courses to suit the technology at one's disposal.

The introduction of new technologies into the workplace and schools is very often superimposed on existing organizational methods and pedagogy and does not in itself generate the kind of mental and social transformations that would be necessary to take full advantage of them (Kling &Zmuidzinas). New technology is first and foremost an opportunity to rethink teaching methods in order to make the most of the human potential of learners and teachers alike.

Ultimately, courseware in an aviation context needs to be assessed in the light of operational requirements. In other words, we should always ask ourselves what communicational situations a syllabus is, in some way or another, preparing a professional to deal with more effectively.

Mark Warschauer's work has been inspirational in the writing of the present paper. Therefore it is fitting to conclude with a remark of his that closely reflects the spirit in which the paper was written. 'I heard a very good expression the other day. It was something like "A good toy is 90% child and 10% toy." I think a good pedagogical device is 90 percent learner and 10 percent device', (Anker 2002).

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Gap Analysis on Effective Communication Skills of Technical Educators for Teaching and Learning Technical and Vocational Education and Training (TVET)

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Abstracts

The study analyzed the gap in effective communication skill of technical educators for teaching and learning of Technical and Vocational Education and Training *(TVET).Three research questions and a hypothesis were formulated to guide the study. The study adopted a survey research design. The population of the study was made up of 205 subjects. 25 lecturers in school of technical education and 180 of educators in state technical colleges Niger State.The sample for the study consisted of 70. 25 lecturers in the school of technical education in Niger State College of Education, Minna and 45 technical college educators in three technical colleges and three departments in Niger State drawn through Multistage Sampling Techniques. The instrument used for data collection is a structured questionnaire. Mean and standard deviation (SD) were used to analyzed research questions. Independent sample t-test was used to analyzed hypothesis which determined the no relationship at (P .05) level of significance on the gap between the effective communication skills needed and possessed by technical educators in technical colleges in Niger State. The study found out among others that the effective communication skills listed are all needed by technical educators for effective TVET in technical colleges. The technical educators possessed some of the skills and some are not possessed. The gap shows that the following skills are needed to be improve on for effective communication in teaching and learning of TVET: ability to use electronic communication devices, emotional management, speed and sequence of speech and so on. There were significance differences between the effective communication in some of the skill needed and possessed by the technical educators. Based on the findings of this study, it was recommended among others that, the government should provide electronic communication devices in technical colleges. The ministry of education should organize training for technical educators on the uses of electronic communication devices, ability to use body language, ability to involve students in teaching and learning and so on to improve effective communication in technical colleges.*

Key Words: Effective communication, skills, technical educator, Technical colleges and Technical and vocational education and training (TVET)

Introduction

The fact that you can stand before the student and spend 40 minutes to 1 hour does not mean you have imparted knowledge in them, in as much that learning has not taken place. Learning is the outcome of teaching processes in the classroom or other settings where the teacher imparted knowledge to the students through communication. All human interactions are form of communication. In the business world the most successful business men/women have something in common that makes them to be a successful people in their business, they have mastered the art of communication which is the means of interaction between them and their employees, clients, suppliers and customers (Shonubi&Akintaro, 2016). Teaching and learning process are form of business where there must be an interaction between seller and buyer so as it is in the educational system, the interaction between the teacher and students is significant for learning achievement to takes place. Learning can only take place when there is an interaction through communication between teacher and students in the classroom.

Communication is the sending and receiving information from sender to receiver through different means. Communication according to Lalit (n.d), is a process of sharing of knowledge, information, ideas, feelings or attitudes to others using symbols or signs. According to the Oxford Advanced Learner's Dictionary the word communication is the activity or process of expressing ideas and feelings or giving people information, which is in line with teaching and learning processes in the classroom. Communication is the basic social process in which information is provided and received, but it is also a process that allows interaction between individuals and groups, students-to-teachers, students-to-students, teachers-to-students(Nath, 2018).Shonubi and Akintaro (2016) stress that nothing can be achieve in any organization without communication. Communication represent the blood stream in human body without it human body cannot function effectively. Therefore, communication is important in all human activities, including teaching and learning. Nevertheless, the ideas or knowledge or information can be misinterpreted or not properly received by the receiver if the message is not effectively communicated. It therefore means nothing can be achieving in the education settings without effective communication.

Communication is effective only when the message sent by sender is received by the receiver in the way it was expected by the sender (Lalit, n.d).Different authors and researchers have defined communication in different ways but, the basic of it all is that it comprises of: sender, message, channel or medium, receiver and feedback. Effective communication is not about just transferring of ideals, knowledge or information, it is the giving of understandable ideals, knowledge or information which can be received by the students so that it can be understood and acted upon. The main objectives of the effective communication are to inspire, motivate, disseminate information, advise, warn, direct, establish better relation with others, to make learning meaningful and understood (Nair & Joglekar, 2012).

In order word, for effective communication to take place the teaching process in the classroom has to be cleared, specific, meaningful, simple and feedback confirming that the message is well received, because it has meet up the targeted objective (learning). Loy, (2006) argued that no matter the level of the students, if the teacher is effective, clear and complete in communication the students will develop interest and retained what he/she has learnt because they are going to be involved in the teaching-learning processes in the classroom, understand, and learning will take place which is the achievement. It is of no used or it is a waste of time, energy and resource after

spending 45 minutes in a classroom and at the end students achieve little or nothing at all. If students must achieve in academic wise teachers have to do allot in the classroom most especial in the areas of effective communication. Yes, there are many variables that determine the learning achievement of the students in the classroom, among them effective communication skills are paramount (Nath, 2012; McCarthy & Carter, 2006; Bee, 2012; Nair & Joglekar, 2012). However, the effective communication is not only beneficiary to students alone it enables the goal and objective of the educational system of the country to be achieved most especially the technical and vocational education and training (TVET). For effective communication to take place there are some skills the technical educator must possessed and applied in the classroom. Which is referred to as communication skills.

Skill can be referred to as the activities or task a person possessed in order to effectively achieve his goal. Therefore, effective communication skills are those things that technical educators must possessed and master in the classroom for effective communication to take place. These effective communication skills are important in the life of the technical college students.

Technical colleges are institutions established for producing skilled manpower for actualizing national development goals. It is one of the institutions established by Federal Government of Nigeria and state governments where students acquire saleable skills, basic scientific knowledge, attitude and practical skills in Technical and Vocational Education and Training (TVET) that enable them to become self-reliant and reduce the rate of unemployment in the country (Federal Republic of Nigeria [FRN] 2014). Technical colleges offer programmes in Automobile trades,Building & Wood Work Trades, electrical and electronics trades and others (NBTE, 2012).

These trades are broad fields of study designed for the purpose of training students in order to meet up with the day-to-day needs of individual in the modules in an ever-changing society (Ogbu, 2012). The main goal of technical colleges in Nigeria as stipulated by FRN (2014) stated that the trainees completing Technical College programmes shall have three options: secure employment either at the end of whole course or after completing one or more modules of employable skills, set up their own businesses and become self-employed and be able to employ others and pursue further education in advance craft/technical programmes and in post-secondary (Tertiary) technical institutions such as Polytechnics or Colleges of education (Technical) and University. From the above aims and objective of technical colleges it is obvious that effective communication is needed between teacher-teacher, teacher-students and students-students. The effective communication in technical colleges does not limited to student's achievement alone but to help them build their future career. As it is practiced in the world of work or business world, today whether you are self-employed, employer or employee, planner, organizer, director, leader and controller you need an effective communication to succeed in your endeavours. It is the duty of the teacher to assist the student in learning by effectively communicate the concept in order for students understand, develop, contribute so that learning will take place using the appropriate teaching method.

In the classroom there are different methods of teaching that teacher could adopt, they are majorly grouped in to two which are: teacher centred methods and students centred methods. Teacher centred methods is an approach where activities in the classroom are centred on the teacher and involves rote memorization and coverage of the context on the part of the students (Khalid

&Azeem, 2012). It is a method where teacher like to talk and expect the students to write down what they are saying and to learn it. While, students centred methods according to Alemu (2010) is a teaching method that is extremely effective in maintaining students' information processing, developing skills, attitude and interest. The responsibility for learning is focused on the students. Most importantly, both the teachers and students are actively involved, they must engage in such higher-order thinking tasks as analysis, synthesis and evaluation all these could not be achieve if there is no effective communication between the teacher and the students. Either way, effective communication will go a long way to improve the students' performance and achievement.

Moreover, no matter how effective the teaching method adopted by the teacher could be, without the effective communication students may achieve little or nothing. The facts that teaching and learning methods have been changing from teacher centred methods to students centred methods does not relegates the importance of teacher. In fact, it is now that the role of teacher is prominent as a guidance, supervisor, coordinator and many more, it means that there is need for effective communication between the teacher, students and teaching methods.One of the characteristic of students centred methods of teaching and learning is the possibility of free choice of information by both the teachers and students. students centred methods which some people referred to as active learning give room for free communication, because students selected and construct their learning activities by themselves and this gives the teacher the opportunity to interact with the students, by guiding, direct, coordinate and supervised the student's activities. It could be through group work, discussion class, exercise or examples. If the relationship between students and teachers is disrupted due to lack of effective communication, it will negatively affect the acquisition of knowledge by the students (Neslin, 2019**;** Fashiku, 2017). The effective communication in the classroom can leads to student's achievement and retention.

Effective communication is useful not only in the school system but is part of the employability skill needed by the individual to make them employable. Gowsalya and Kumar., (2015), listed some of these employability skills which include: team working, problem solving, self-management, knowledge of the business, literacy and numeracy relevant to the post, ICT knowledge, effective interpersonal and communication skills, ability to use own initiative but also to follow instructions and leadership skills where necessary. In fact, some organization ranked effective communication as first skill required for employment in this 21st century. It is therefore, clear that technical educators need this effective communication skill in order to impart the required knowledge to their students so that they can perform excellently while in school and outside the school system. It will help them to fit in to this 21st century challenges and the business world. In addition, for technical students to understand and apply the effective communication and other employability skill they have to be taught by technical educators (Gowsalya *et al.,* 2015).

Technical educators should take effective communication seriously if the students' achievement and performance is their major priority.Bacsa-Bán, (2020) referred to technical educator as technical teacher, vocational instructor, technician teacher or engineer teacher. Technical educator is a teacher who embrace the importance of technology in the classroom, have the skills and intention to use technology, and have the knowledge to teach students how to use technology and digital resources (Diamond, 2019). Technical Educators must understand industry, business and the workplace need and ensure that they trained students towards that, that is when they will become useful to the students.

Succinctly, there is no education without having process, therefore, since there is need for effective teaching-learning process, the need to consider effective communication in the classroom is highly imperative since lack of consideration to this variable could lead to poor student's achievement and performance. With greater consideration, the goal of TVET in particular and education system in general may not be achieve without effective communication. Different researches reveals show that student motivation is one of the key predictors of course completion and student's achievement and student's motivation is linked with the ability of the teacher to communicate effectively in the classroom (Williams & Williams, 2011; Armstrong & Hope, 2016). But the extent to which technical educator communication effectively in the classroom is unknown. In line with this, the researchers south to analyze the gap between effective communication skill needed and possessed by technical educator for effective TVET.

Problem Statement

As we move from teacher centred methods to students centred methods of teaching and learning in our educational system coupled with the aims and objectives of the TVET has made it clear with the expectation of better or greater improvement in education sector.

It is obvious that the education system of Nigeria needs reformation in many areas, because the society is expecting so much from the graduates. In line with this, the Nigeria Education Policy makers approved the National Policy on Education and made it cleared the goals of TVET which are: Provide trained manpower in the applied sciences, technology and business particularly at craft, advance craft and technical levels; Provide the technical knowledge and vocational skills necessary for agricultural, commercial and economic development; and give training and impart the necessary skills to individual for self-reliance economically (Federal Republic of Nigeria, [FRN] 2014).

It is revealed that most of TVET graduates are not employable due to lack of employability skill (Sarimah&Dahiru, 2014, Abodunrin, Adekanmi, &Adepoju, 2018). It is also an indication that the goal of TVET is failing. In order to solve above mentioned problem, researchers have look in to different possible element that could lead to solving the problem, such has teaching method, curriculum, environment, personnel, and many more, but, resent studies indicated that the problem still persist. In line with this, the researchers sought to look at one possible way that could provide solution to poor performance and unemployable rate of TVET graduates. Which is the effective communication of the educators in the technical colleges in Niger State. Since these educators has major roles of imparting the necessary employability skills to the students.

Students achievement and performance are linked to different factors such as qualified teachers, adequate and up-to-date equipment, government policy, relevant curriculum, adequate infrastructure, effective communication and many more (Siqing, Cangyan, Jihong, Li &Huali, 2014). Effective communication plays a significant role in fulfilling the goal of TVET in technical colleges (Neslin, 2019,). Other researcher in other fields of studies has conducted studies indicating the greater role of effective communication in the life of students even beyond the school level (Neslin, 2019; Fashiku, 2017; Gowsalya *et al.*,2015) which little or none studies has been done in respect to the gap analysis of the effective communication skill of technical educators in technical colleges.

Research Questions

The following research questions were formulated to guide the study:

1. What are the effective communication skill needed by technical educators for teaching and learning of TVET?
2. What are the effective communication skill possessed by technical educators for teaching and learning of TVET?
3. What are the gap between the effective communication skills needed and possessed by technical educators for teaching and learning of TVET?

Hypothesis

A null hypothesis was formulated and tested at 0.05 level of significance:

$H_{o1:}$ There is no significant difference between the effective communication skills needed and possess by technical educators for teaching and learning of TVET in technical colleges in Niger State, Nigeria (P□ .05).

Research Methodology

This study adopted a survey research design. This design enables the researchers to describe the attitudes, opinions, behaviours or characteristic of the population based on data collected from a sample of the technical department of College of education, Minna, Niger State and technical colleges in Niger State on the effective communication needed and possessed by Technical educators. The study was carried out in Niger State, Nigeria, The state lies on longitude of 03□ 30 to 07□ 40 East and latitude of 80□ to 11□ : 30 North. The state is bordered to the West by Kebbi State, North by Zamfara State, South-West by Kwara State, South-South by Kogi State, South-East by FCT, North East by Kaduna State and the state has international boundary with the Republic of Benin to the North West.

The population of the study was made up of 205. 25 lecturers in school of technical education in college of education, Minna Niger State and 180 of teachers in state technical colleges in Niger state.The sample for the study consisted of 70. 25 lecturers in the school of technical education in Niger State college of education, Minna and 45 technical college teachers in three technical colleges in three departments: Electrical Installations and Maintenance Works (EIMW), Motor Vehicle Mechanics and Block laying,in Niger State drawn through Multistage Sampling Techniques. The instrument used for data collection is a structured questionnaire. The questionnaire was designed to generate data for answering the research questions of the study. All the questionnaires administered were returned representing 100% return rate. The data collected for the study was organized and analyzed on the basis of the research question and hypothesis. SPSS version 23 was used for the analysis. Decisions on the research questions were based on the resulting means score interpreted relative to the concept of real lower and upper limits of numbers as shown in Table 1. The standard deviation was used to decide on the closeness or otherwise of the respondents to the mean in their responses. Any item with standard deviation of less than 1.96 indicated that the respondents were not too far from the mean or from one another in their responses and any item having standard deviation equal or above stated value signified that respondents were too far from the mean. Independent sample t-test was used to analyzed hypothesis to determine the no significant at (P □ .05) level of significance on the gap between

the effective communication needed and possessed by technical educators in technical colleges in Niger State.

Table 1 Interpretation of Four Point Scale

S/N	Scale of R.Q 1	Scale of R.Q 2	Point
1	Highly Needed	Highly Possessed	3.50 – 4.00
2	Moderately needed	Moderately Possessed Adopted	2.50 – 3.49
3	Needed	Possessed	1.50 – 2.49
4	Not Needed	Not possessed	0.50 – 1.49

Key: R.Q = Research Question

Research Question One: What are the effective communication skill needed by the technical educators for teaching and learning of TVET?

Table 2. the mean response of NCE lecturers on the effective communication needed by technical educators for teaching and learning of TVET.

S/N	ITEMS	Mean	SD	Decision
1	Ability to get the message across	3.27	.86	MN
2	Emotional management in the communication process	3.20	.55	MN
3	Abilities to Listen to all students (active listening)	3.20	1.04	MN
4	Assertive (self-confidence) communication	3.16	.93	MN
5	Ability to understand individual differences	3.13	.87	MN
6	Ability to involve students during the teaching-learning process	3.24	.91	MN
7	Use of appropriate language in the classroom	3.40	1.01	MN
8	Ability to communicate using body language	2.89	1.01	MN
9	Ability to use appropriate instructional materials	3.56	.76	HN
10	Ability to use electronic communication medium	3.29	.92	MN
11	Speed and sequence of speech	2.71	1.06	MN
12	Mutual relationship between the teacher and students	2.89	.75	MN

KEY: HN=Highly Needed; MN=Moderately Needed; N=Needed; NN=Not Needed SD=Standard Deviation

Table 2. shows that the 12 items are moderately needed by technical educators for effective communication in the classroom with the mean ranging between 2.71 to 3.40. Since the standard deviation of the respondent on the effective communication skill needed by the technical educators in technical colleges are less than 1.96 it is an indication that the respondents were not too far from the mean or from one another in their responses.

Research Question Two: What are the effective communication skill possessed by technical educators for teaching and learning of TVET?

Table 3: the mean response of technical educators on the effective communication possessed by technical educators for teaching and learning of TVET.

S/N	ITEMS	Mean	SD	Decision
1	Ability to get the message across	3.47	.76	MP
2	Emotional management in the communication process	2.87	.92	MP
3	Abilities to Listen to all students (active listening)	3.33	.95	MP
4	Assertive (self-confidence) communication	2.87	1.04	MP
5	Ability to understand individual differences	2.75	1.15	MP
6	Ability to involve students during the teaching-learning process	2.44	1.18	P
7	Use of appropriate language in the classroom	3.02	.82	MP
8	Ability to communicate using body language	3.33	.83	MP
9	Ability to use appropriate instructional materials	3.33	.83	MP
10	Ability to use electronic communication devices	1.29	.69	NP
11	Speed and sequence of speech	1.65	1.03	P
12	Mutual relationship between the teacher and students	2.13	1.18	P

KEY: HP=Highly Possessed; MP=Moderately Possessed; P= Possessed; NP=Not Possessed SD=Standard Deviation.

Table 3 revealed that items 1, 2, 3, 4, 5, 7, 9 and 10 are moderately possessed by technical educators with the mean ranging between 2.87 to 3.47. Items 6, 11 and 12were possessed by the technical educators with the mean ranging between 1.65 and 2.44 while the respondents revealed that item 10 isnot possessed by technical educators with the mean of 1.29. It is revealed that the respondents were not too far from the mean or from one another in their responses since the standard deviation of the respondent on the effective communication skill possessed by the technical educators in technical colleges are less than 1.96.

Research Question Three: What are the gap between the effective communication skills needed and possessed by technical educators for teaching and learning of TVET?

Table 4: the t-test analysis of the null hypothesis difference between the effective communication skills needed and possessed by technical educators for effective teaching and learning of TVET in technical colleges in Niger State, Nigeria (P□ .05).

S/N	ITEMS	Group	Mean	SD	Sig.(2-ailed)	Decision
1	Ability to get the message across	L	3.27	.86	.246	NS
		T	3.47	.76		
2	Emotional management in the communication process	L	3.20	.55	.040	S
		T	2.87	.92		
3	Abilities to Listen to all students (active listening)	L	3.20	1.04	.527	NS
		T	3.33	.95		
4	Assertive (self-confidence) communication	L	3.16	.93	.167	NS
		T	2.87	1.04		
5	Ability to understand individual differences	L	3.13	.87	.078	NS
		T	2.75	1.14		
6	Ability to involve students during the teaching-learning process	L	3.24	.91	.001	S
		T	2.44	1.18		
7	Use of appropriate language in the classroom	L	3.40	1.01	.054	NS
		T	3.02	.82		
8	Ability to communicate using body language	L	2.89	1.05	.024	S
		T	3.33	.83		
9	Ability to use appropriate instructional materials	L	3.56	.76	.186	NS
		T	3.33	.83		
10	Ability to use electronic communication medium	L	3.29	.93	.000	S
		T	1.29	.69		
11	Speed and sequence of speech	L	2.71	1.06	.000	S
		T	1.64	1.03		
12	Mutual relationship between the teacher and students	L	2.89	.75	.001	S
		T	2.13	1.18		

KEY: L=Lectures; E=Educators; SD=Standard Deviation; S=Significant and NS=NotSignificant

Table 4 shows that there is significance difference between the effective communication needed and possessed by technical educators in the items 2,6,8,10,11and 12 this is because the p-value of those items are less than 0.05 sig. level. While items 1, 3, 4, 5, 7 and 9 accept the non-hypothesis state at 0.05 sig. level, because there is not enough evidence to reject the null hypothesis.

Discussion of Findings

Based on the first objective of the study, which seek to find out the effective communications skill needed by the technical educator for teaching and learning of TVET in technical colleges. It was revealed that all the effective communication skills listed are needed by technical educator for teaching of TVET in technical colleges. For effective teaching and learning of TVET in technical college level there are effective communication skill needed which has been agreed with by the

respondents in table 2. To be an effective technical educator and to ensure that TVET is taught effectively in technical colleges, technical educators have to be an effective communicator. Since the effective communication is the process of sharing information, ideas, feelings, knowledge, skills, experience and thoughts with other people and having those sharing information, ideas, feelings, knowledge, skills, experience and thoughts understood and the feedback indicated that the aim of the messages sent is achieved. Khan, Khan, Zia-Ul-Islam and Khan (2017) affirm that effective communication skills of teacher are the basic need of academic's success of students and professional success of life. Therefore, some skills are needed by technical educators for the effective communication in the classroom such as: active listening, ability to use body language, assertive communication skill, speed and sequence of speech, ability to use electronic communication devices and others. Several studies are in the agreement with this study on the effective communication skills needed by the educators (Neslin, 2019;The Scientific World, 2019; Kubat, 2018;Flavia and Enachi-Vasluianu, 2016;Care, 2013 and Sean, 2010).

The research question two sought to know whether the technical educators possesses the effective communication needed by them for teaching and learning of TVET. It was revealed 1 out of 12 effective communication skills needed was not possessed by technical educators, which is ability to use electronic communication devices. From the result it is cleared that technical educators have more to do in term of using electronic communication devices. As revealed by different researcher shows that some of the educators do not possessed the require skill needed to utilized electronics devices, some are not ready to integrate it into the education system due to one reason or the other. Such devices are, mobile phones, PowerPoint presentation, Computer Assisted Instruction and many more. The studies of Ferry, (2009), Dias & Victor (2017),Murray and David (2014)concord with this study by revealing that educators do not possessed the skill to use electronic communication devices for different reasons. Some of the reasons are inadequate preparation and training of the educators in using technology, some educators believe that such technology does not enhance what they already do and only adds an extra layer of complexity. Some do not belong to the generation of young people who are call the 'digital natives' generation. The effective communication of a teacher motivates students to learn at school, it can be transfer across all aspects of life. Therefore, it is imperative if technical student must perform effectively in terms of academic achievement and fit into the world-of-work there is need for an effective communication through the uses of electronic communication device in the classroom.

Based on the research question three, it is revealed that there is need for technical educators to be trained in some of the effective communication skills needed for teaching and learning of TVET in technical colleges for the students to meet up with the 21st century opportunity. It is revealed that there is significant difference in the emotional management in the communication processes, ability to involve students during the teaching-learning process, ability to communication using body language, ability to use electronic communication devices, speed and sequence of speech, mutual relationship between the teacher and students, between the effective communication needed and possessed by technical educators because the sig. value which ranges from 0.000 to 0,040 is less than the pα=0.05.

The emotional management of the technical educators is important in the classroom for effective teaching and learning processes. Emotional of the teacher contribute to effective communication of a teacher and influence the learning process of the students. The ability to controls one's emotion help to better communication skills and meeting academic requirements because it will help in

focusing on the stated objectives. Teachers emotional in the classroom can positively or negatively affect the learning ability of the students. In support of this study, Mustafina, Ilina and Shcherbakova (2020) revealed that, one's emotions can affect mental state which in turn can cause some behavioural changes often expressed in communication. From the above explanation it shows that there is a strong connection between emotional state of a teacher and learning abilities of the students. also, the study of Hendrix and Morrison, (2020) revealed that helping communicators understand the link between their emotions and their communication is a valuable step in improving communication ability and developing valuable emotional intelligence skills. It is therefore cleared that technical educators need to do more work on their emotional management in the classroom because, effective communication and emotion are closely linked.

It is also revealed that there is significant difference when it comes to the involvement of students in teaching and learning by technical educators. Ability to involve students in the teaching and learning processes in the classroom can enhance effective communication and enable student to learn more by team work and creating their own knowledge. It can encourage communication, cooperation and collaboration and help students talk more and effectively express themselves with their peers. It is supported by the study of Alsubaie, (2017)who revealed that when students are involved in the communication process in the classroom activities does not only improve student's abilities to speak with others but also to measure their strengths and weaknesses in communication. In addition, when students are not allowed to speak in the classroom there will be fear in them to speak in the public and communicate to his customers while in the business world.

There is need for technical educators to improve on the uses of electronics communication devices. Electronics communication devices is one of the way for technical educators to communicate effectively in technical education if the aims and objective of TVET must be achieve in this 21st century. The world is moving digital we most as well move with them. People all over the world utilize different kinds of electronics communication technologies such as: Mobile phone (smart phones), Computer Assisted Instruction (CAI) and PowerPoint Presentation,computers, and Personal Digital Assistance. In agreement with the study Usman and Madudili (2020) recommended that there should be an awareness campaign and computer literacy training program particularly for teachers and school administrators through in-service training, seminarsand conferences to improve their technical know-how on computer application.

Aljaber (2016) state that countries are looking to find the easiest way to deliver education to inspire students to make education and training a high priority in their life. And one of the easiest way to do that is to embrace the uses of electronic communication devices in the classroom for effective communication. Aljaber (2016) stress that using communication technology devices may be the key to help education via mobile learning. In harmony to this study TheScientific World (2019) stressed that since many of today's teachers did not grow up in schools that use computers and the Internet, unlike the students of the digital generation of our time, teachers had to respond to this change and bridge the digital culture gap between generations. McKeachie (2009) also agreed with this study by saying that every communicator must obtain any necessary training on the uses of multimedia.Therefore, there is need for technical educators to have the knowledge to choose the one that is best for the student and know how to use it for effective communication.

Conclusion

To be an effective technical educator and to ensure that the goal of TVET is been achieve the technical educator must be an affective communicator. And to be an effective communicator, there is need for them to possess some effective communication skills. It is revealed that technical educators possessed some of the effective communication skills needed, however, it is also revealed that they do not possessed the effective communication skills related to electronic communication devices skill. The electronic communication skills are important skill since the world is going digital there is need for technical educators to improve on these skills for effective TVET.

Recommendations

Based on the findings of this study, the following recommendations were made:

1. The Government should provide electronic communication devices in technical colleges.
2. The ministry of education should organize training for technical educators on the following communication skills: ability to involve students during teaching and learning, Speed and sequence of speech,uses of electronic communication devices and others to improve effective communication in technical colleges.

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Biology Pre-Service Teachers' Awareness and Readiness Towards the use Virtual Learning Platforms in Tertiary Institutions an Implication for Instructional Approaches in Stem

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Abstract
This study investigated the Biology Pre-Service Teachers' Awareness and Readiness Towards the Use Virtual Learning Platforms in Tertiary Institutions an Implication for Instructional Approaches in Stem.The research adopted was a descriptive survey research design. The population of this study comprised of all One Hundred and Fifty (150) pre-serviced biology teachers from two tertiary Institutions (Ibrahim Badamasi Babangida University, Lapai and Federal University of Technology Minna, Niger state).Questionnaire titled 'Assessment of pre-service biology teachers awareness and readiness towards the use virtual learning platforms in Tertiary Institutions of Niger State.' was used for data collection on a four modified rating scale. Reliability of the instrument was determined Using Cronbach-alpha, the result computed generated a reliability index 0.76.The data collected were analyzed using Mean and Standard deviation to analyze the stated Research QuestionsThe study on assessment of pre-service biology teachers' awareness and readiness towards the use virtual learning platforms in Tertiary Institutions of Niger State concluded that most of the pre-service teachers have low awareness on virtual learning platforms. The pre-service teachers should increase their participation in trainings of virtual learning platforms and the pre-service teachers should always be ready to use virtual platforms to teach in the classroom.

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Introduction
The role of Information and Communication Technology (ICT) to the development of any nation in recent times cannot be over emphasized. ICT has brought significant changes to all aspects of human social-economic activity in which the educational sector is not left out. Notable changes often occur as technology advances, with the inception of the electronic learning paradigm, there have been improvements in the qualities of teaching, of learning, accessibility, and efficiency in higher education through access to resources, services, remote exchanges and collaborations. Electronic learning whose acronym is e-learning can simply be explained as learning online or offline through CD/DVD type coursework instead of the conventional classroom teaching and learning. It comprises of a wide range of technologies, majorly the Internet and computer. Virtual technology is a subset of Information and Communications Technology (ICT) encompassing the application of information technologies, and communicating same through electronic devices. Virtual technology is a good tool for enlightening biology teaching and learning and an access path to research materials (Naidoo, 2014).

Stressing more on the benefits of virtual technology, Adekunle (2015) stated that it makes delivery of biology instructions very flexible, interactive, learning and lasting. Eya (2016) basically perceives virtual technology as the use of computer-aided-gadgets to aid biology learning. Rees (2014) perceive virtual technology as the use of advanced learning technology that is computer

based, and that makes delivery of biology knowledge flexible, interactive and long lasting. Eya (2016) recaps that virtual technology is the largest and the most challenging application of ICT in the delivery of education. The author sees virtual technology as the process of e-literate teachers interconnecting with e-literate learners with up-to-date books and information using electronic skills.

Virtual technology is a platform among the many e-learning platforms. Virtual technology aimed at large-scale interactive participation and open access via the web. Virtual technology differs from Open Courseware and Open Education Resource in that it opens up opportunities for learners to participate in learning activities, rather than making resources or courseware openly available. Virtual technology provides participants with course materials that are normally used in a conventional education setting such as, lectures, videos, study materials, examples and problem sets. Virtual technology also offers interactive user forums, which are very useful in building a community for students, teaching assistants and professors. Virtual technology development has seen in recent times in education. It is an idea of offering quality education to massive number of students across globe through internet. The first virtual technology emerged from the open educational resources (OER) movement (Wikipedia. 2013).

Statement of the Problem

Despite all the efforts by the Government and many Non-governmental organisations to encourage and facilitate ICT integration in teaching and learning, research shows that in most of the educational institutions, there is very little integration, especially in STEM (Hardman *et a*l., 2013; Shehu 2012).If there is to be effective ICT integration in teaching and learning, the teacher must be prepared both intrinsically (sufficient ICT integration skills and positive attitude towards ICT integration) and extrinsically (be provided with sufficient ICT resources and be accorded the necessary support by the administration). It is against this background that the researcher found it useful to investigate teachers' readiness to integrate ICT into the process of teaching and learning, considering that the teacher is a key player in the success of any educational program.

Purpose of the Study

The purpose of this study is to assess pre-service biology teachers' awareness and readiness towards the use virtual learning platforms in Tertiary Institutions of Niger State. The objective of the study is to assess;

1. Pre–service teachers' awareness on the use of virtual learning for teaching and learning biology
2. Pre-service teacher readiness to use of virtual learning for teaching and learning biology.

Research Questions

The following research questions were raised and answered in this study are as follows;

1. Are Pre-service teachers aware of virtual learning for teaching and learning of Biology?
2. Are the Pre-service teachers ready to use virtual learning for teaching and learning biology?

Scope and Delimitation of the Study

The study was restricted to tertiary institutions in Niger State i.e. Federal University of Technology Minna and Ibrahim Badamasi Babangida University, Lapai. The study also focused towards the use virtual learning platforms in Tertiary Institutions of Niger State.

Methodology

This research adopted was a descriptive survey research design.The population of this study comprised of all One Hundred and Fifty (150) pre-serviced biology teachers from two tertiary Institutions (Ibrahim Badamasi Babangida University, Lapai and Federal University of Technology Minna, Niger state). All One Hundred and Fifty (150) pre-serviced biology teacherswere usedas sample the population of the study. Questionnaire titled 'Assessment of pre-service biology teachers awareness and readiness towards the use virtual learning platforms in Tertiary Institutions of Niger State.'was used for data collection on a four modified rating scale. The instrument was validated by experts in the Department of Science Education and Department of Educational Technology, Federal University of Technology Minna, Niger state, to ensure the face and content validity of the instrument. Reliability of the instrument was determinedUsing Cronbach-alpha, the result computed generated a reliability index 0.76. The questionnaires were directly administered to the respondents with the help of research assistant and all copies were retrieved.The data collected were analyzed using Mean and Standard deviation to analyze the stated Research questions.

Results

Research Question One: Are Pre-service teachers aware of virtual learning for teaching and learning of Biology?

Table 1: Mean Responses of respondents on Pre –service teachers awareness and readiness on the use of virtual learning for teaching and learning biology?

S/N	ITEMS	$\bar{X}$	SD	REMARKS
1.	3P learning	2.14	1.11	Not Aware
2.	Bloomz	2.52	1.05	Aware
3	Buncee	2.26	1.08	Not Aware
4.	Class Dogo	2.27	1.09	Not Aware
5.	Decks Toys	2.23	1.08	Not Aware
6.	Dial pad	2.17	1.1	Not Aware
7.	Edmodo	2.53	1.05	Aware
8.	Od puzzles	2.32	1.1	Not Aware
9.	Edu Lastic	2.38	1.06	Not Aware
10	Edu Planet	2.16	1.11	Not Aware
11	Flip Grid	2.22	1.05	Not Aware
12	Genially	2.25	1.08	Not Aware
13	Google Classroom	2.27	1.09	Not Aware
14	Haybts	2.23	1.08	Not Aware
15	Hapara	2.17	1.1	Not Aware
16	Kahoof	2.33	1.05	Not Aware
17	Kapwing	2.32	1.1	Not Aware
18	Managed Methods	2.38	1.06	Not Aware
19	Microsoft teams	2.51	1.08	Aware
20	Parlay	2.27	1.09	Not Aware
21	Pronto	2.23	1.08	Not Aware
22	See saw	2.17	1.1	Not Aware
23	Slack	2.36	1.05	Not Aware

24	Shidy bee	2.32	1.1	Not Aware
25	Sutori	2.38	1.06	Not Aware
26	Webex	2.16	1.11	Not Aware
27	Wooclap	2.22	1.05	Not Aware
28	Ziplet	2.25	1.08	Not Aware
29	Zoom	2.62	1.18	Aware
	Grand Average	**2.29**	**1.08**	**Not Aware**
	N=150		**Decision=2.5**	

Table 1: Revealed the results on grand mean average (2.29) which indicated that there is low awareness on pre–service teachers' awareness of virtual learning for teaching and learning biology

Research Question Two: Are the Pre-service teachers ready to use virtual learning for teaching and learning biology**?**

Table 2: Mean Responses of respondents on the Pre-service teachers ready in use of virtual learning for teaching and learning biology

S/N	ITEMS	$\bar{X}$	SD	REMARKS
1.	Use of M.S Word to process professional or personal Document	2.55	1.06	Ready
2.	Use of Internet to compose relevant mails	2.57	1.09	Ready
3	Use of e-mail for sending professional or personal Messages	2.57	1.09	Ready
4.	Use of e-mail for receiving messages	2.72	1.11	Ready
5.	Use of electronic address book (subscription to mailing list)	2.65	1.05	Ready
6.	Sending attachment to e- mail	2.59	1.11	Ready
7.	Forwarding of e-mails	2.53	1.05	Ready
8.	Use of GSM to book appointment or discuss personal problem with teachers	2.52	1.1	Ready
9.	Use of Computer to search for information for assignment	2.51	1.05	Ready
10	Use of Computerized diagnostic assessment to assess learners performance	2.53	0.99	Ready
11	Use of Computer to provide feedback to learners	2.57	1.09	Ready
12	Use of computer for simulation	2.72	1.11	Ready
13	Use of multimedia to present lesson in the classroom	2.65	1.05	Ready
14	Use of computer to practice principles and procedures to learn	2.59	1.11	Ready
15	Use of computer for statistical analysis	2.53	1.05	Ready
16	Use of multimedia to present reports of research	2.52	1.1	Ready
17	Use of computer for self- education	2.51	1.05	Ready

18	Use of Computer to diagnose learning problems	2.53	0.99	Ready
19	Use of computer to chart or discuss assignments with colleagues online	2.57	1.09	Ready
20	Use of computer to discuss assignments with teachers online.	2.72	1.11	Ready
21	Use of recorded video for teaching and learning process	2.65	1.05	Ready
	Grand Average	2.59	1.07	
	N=150		**Decision=2.5**	

Table 2: Revealed the results on grand mean average (2.59) which indicated that there is high responseof pre-service teachers' readiness in use of virtual learning for teaching and learning biology.

Summary of Findings

1. Low awareness on pre–service teachers' awareness on the use of virtual learning for teaching and learning biology
2. High awareness on pre-service teachers' readiness in the use of virtual learning for teaching and learning biology

Discussion of Results

The results revealed that there is low awareness on pre–service teachers' awareness on the use of virtual learning for teaching and learning biology. The findings of the study with Schreurs, Ehler& Moreau, (2018) virtual learning readiness is one of the important construct investigated in this study and the term is defined by the Oxford Advanced Learner's Dictionary as "The state or quality of being ready; preparation; promptness; aptitude; willingness. Prepared for what one is about to do or experience; equipped or supplied with what is needed for some act or event; prepared for immediate movement or action". Readiness can be considered as students' capacity of adapting themselves to technological innovations, collaborative learning, and self-paced training.

The results revealed that there is high awareness on pre-service teachers' readiness in the use of virtual learning for teaching and learning biology. The findings of the study agreed with Wang and Higgins (2006) argued that technology acceptance takes some time and users can learn how to use new technology at different rates. There may be some reasons for different readiness periods for each learner. According to the Dias (2002), some prejudices against virtual learning such as perceiving virtual learning as intrusion may limit the degree of acceptance of virtual learning. Dias (2002) stated that learners might see virtual learning as an intrusion to their own personal space, which may limit their readiness and acceptance of using virtual devices. Stockwell (2008) conducted another research about pace of readiness. According to the Stockwell (2008), how eager to use the virtual technology is not depending people to have own virtual phones and actually use it. Stockwell (2008) also claimed that patience of instructor with learners is the most important for the early stage of development into virtual learning. Thus, instructors can empathize with the learner, and let the learner investigate and get used to virtual technologies. Moreover, Stockwell (2008) added that learners who did not want to use new technologies at the beginning could see their advantages after observing other learners over time.

Conclusion

The study on assessment of pre-service biology teachers' awareness and readiness towards the use virtual learning platforms in Tertiary Institutions of Niger State concluded that most of the pre-service teachers have low awareness on virtual learning platforms.

Recommendations

Based on the findings of the study, the study recommends that: The pre-service teachers should increase their participation in trainings of virtual learning platforms and the pre-service teachers should always be ready to use virtual platforms to teach in the classroom.

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Relationship Between Information and Communication Technology (ICT) Competency, Accessibility and Performance Among Biology Students of Colleges of Education in Niger State

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Abstract
This study examined relationship between information and communication technology competency, accessibility and performance among biology students of colleges of education in Niger State.The study adopted a correlational and Ex-post facto research design. Multi-stage sampling techniques was used to select a total of 300 students. The instrument was validated by two experts, Cronbach Alpha formula was used to calculate the reliability coefficient of the instrument and the reliability index of 0.84 was obtained. Data collected were analysed using Mean, Standard Deviation and Pearson Product Moment Correlation formula. Findings from the study revealed that a considerable number of students have access to ICTs and the internet and have cultivated positive habit towards searching for information to widen their academic base and must of the students were not formally trained on the use of ICT device and the internet for learning. Also there was significant positive relationship between student study habit and their semester performance in Biology. It was recommended that ICT and internet facilities should be adequately procured for lecturers and students' use in the colleges. Courses related to ICT should be made compulsory and as core courses for every student to facilitate skills and competency development on the use of internet before graduation from college.

Keywords: ICT, Internet, Biology, College of Education Students, Competence

Introduction
Information and Communication Technology (ICT) refers to technologies that provide information through communications. It is similar to information technology (IT), but primarily focuses on communication. This includes the internet, wireless network, cell phones and other communications media. In the past few decades, information and communication technologies have provided society with a vast array of new communication capabilities. People can communicate in real-time with others in different countries using technologies such as instant messaging, voice over IP and video conferencing Social networking websites like Facebook allow users from all over the world to remain in contact and communicate regularly. Modern information communication technologies have created a global village where people communicate with others worldwide as if they were living next door (Mathur, 2017).

ICT is an umbrella term that includes any communication device, encompassing radio, television, cell phones, computer and network hardware, satellite systems, and the various services and applications such as video conferencing and distance learning. ICT is often spoken of at particular contexts, such as, ICTs in education, health care, or libraries. ICT also consists of computer hardware, application software (that is a spreadsheet, word processing, excel), disc and storage media (that is memory cards, flash drives, CD-ROMs, audio and video cassettes, films, picture, e-books, e-magazines), networks and media for the collection, storage, processing, transmission and

presentation of information (Muhammad *et al*2015). list the authors first before et al, unless more than five.

ICT is one of the most efficient tools for advancing knowledge and skills, and highly needed for quality education to take place, Attention is being given to the integration of ICT driven learning activities (Falode*et al* 2016). As a result of improvements in technology, ICT has become affordable and sophisticated; hence, parents can equip their households with such technologies for the benefit of their children. Parents believe that using computers and having access to computer-related technologies have the likelihood of increasing children's academic performance. Hence, they buy computers with internet connections to help their children in their academic endeavors. Early exposure to ICT is essential, so also, regular access to it for academic activities at school is crucial to students' improved academic performance. Despite the increase in the number of computers and related technologies, everyone does not have the same access to these technologies. Students are dependent on both the ICT possibilities offered by the school and that which they have outside the school (Wajszczyk, 2014).

ICT facilitates both the instructional and learning process and has a great influence on teaching and learning in higher education. It provides the opportunity for personalized, flexible and asynchronous learning and shifts the learning from teacher-centered to student-centered and hence is a catalyst for reforms about the classroom, educational institute, community and system. It enhances the learning of the students, helps the students to learn new skills set, promotes social mobility, helps the citizens to compete in a worldwide economy, and thus has a multiplier effect across the education system (UNESCO, 2014).

The ICT tools or ICTs used by students in schools include computers, internet facilities, audiovisual devices, multimedia projectors and so on. Computers and internet facilities are now in place in many institutions of learning. It is envisaged that educators will see ICTs as a major teaching and learning device across all educational institutions. Good background knowledge and exposure to ICT facilities within and outside the school premises improve the quality of personal learning. Computer literacy and access to adequate and satisfactory ICT infrastructure are among the most significant factors that contribute to the successful and effective utilization of ICTs in all subjects and for all learners, and the presence of ICT in schools is an essential condition for the successful introduction of creative educating methods and techniques (Wajszczyk, 2014). Access to ICT facilities provides valuable learning experiences, thereby giving the students' educational benefits in line with the school's educational programme. Access to ICT facilities has a positive impact on students' academic success.

The internet is an essential tool for facilitating academic activities in tertiary institutions in Nigeria, For a number of years now, the managers of these tertiary institutions of learning have invested heavily in establishing internet services in their schools. The services provided by the internet have had a major impact in the university context, in organizations and in teaching and learning methods. The Internet has made computers across the globe interconnected. According to Emeka *et al* (2016), the internet today is a worldwide entity whose nature cannot be easily or simply defined. To many, the internet is a large computer network linking together millions of smaller computers at numerous sites in various countries belonging to thousands of businesses, governments, researchers, educational and other organizations. Thus, the advent of the Internet has

heralded the emergence of a new form of knowledge production and distribution in the soft form particularly when it comes to Biology teaching and learning.

Biology, as a natural science subject, deals with contents from microscopic organisms to the biosphere in general, encompassing the earth's surface and all living things. Looking at the fundamental characteristics and importance of Biology, it is today viewed as a standard subject of instruction at all levels of our educational systems, from pre-primary to tertiary Education. Biology deals with the study of living things and how they relate to each other and with their environment. Consequently, knowledge of Biology, if well applied, can improve the welfare of humans. It is because of the uses of Biology that several or all the countries in the world include it in their curricula. This is because a curriculum is supposed to enable learners to acquire and develop the desired knowledge and skills. The relative popularity of Biology reflects a changing emphasis on curriculum. The traditional content has been replaced by modern discoveries in the fields of cell biology, basic genetics, bioengineering and biotechnology.

ICT has had a major impact on the university context, in an organization, and in teaching and learning biology. One puzzling question is the effective impact of these technologies on students 'academic performance and on the returns of education. Many academic researchers have tried to answer this question at the theoretical and empirical levels. They have faced two main difficulties. On the one hand, ICT is evolving technologies which effects are difficult to isolate from their environments (Ahmed, 2015).

Students' academic performance refers to the student's current state of knowledge and skills reflected in their cumulative grade point average (CGPA). The rationale of studying academic performance in the context of ICT adoption is to present a significant relationship that exists between the two variables. Socioeconomic status check can be a significant variable in determining the academic performance of the student Wael, *et al.*, (2018). The impact of ICT on learning is currently in relation to the use of digital media, primarily computers and the internet, to facilitate teaching and learning. ICTs are the technologies used in conveying, manipulating and storing data by electronic means, and they provide an array of powerful tools that may help in transforming the present teacher-centered and text-bound classrooms into rich, student-focused, interactive knowledge environments. It is based on this that this study wants to determine the relationship between information and communication technology competency, accessibility and performance among Biology Students of Colleges of Education in Niger State.

Statement of the Problem

Today, ICT is an integral part of the teaching and learning process, and students who do not have background usage and who do not have access to it are likely not to do well academically compared to their counterparts with early exposure and regular access. The ICT efficacy of students in tertiary institutions differs. Some of the reasons for the differences are based on the previous level of (omission) at secondary school, availability and presence of relevant devices at home, and previous ICT training enrolled for before securing admission to institutions of higher learning. Students with early ICT efficacy will be able to make use of computer systems to process word documents, analyze data, develop small computer programs, browse the internet and install the software. The relationship between the use of ICT and students' performance in higher education is not clear, and there are contradictory results in the literature. Earlier economic research has failed to provide a clear consensus concerning the effect on students' performance. Reframe

Therefore, this study will investigate the relationship between students' ICT competency, accessibility and academic performance in Biology in Colleges of Education in Niger State.

Purpose of the study

The aim of this study is to find the relationship between ICT competency, accessibility and performance among Biology students of Colleges of Education in Niger State. Specifically, the study sought:

14. To find the relationship between ICT competency of students of Colleges of Education and their performance in Biology.
15. To determine the relationship between ICT accessibility of students of Colleges of Education and their performance in Biology

Research Questions

The following research questions will be formulated to guide the study are;

18. Is there any relationship between ICT competency of students of Colleges of Education and their performance in Biology?
19. Would there be any relationship between ICT accessibility of students of Colleges of Education and their performance in Biology?

Meaning and Scope of ICT

ICT is an augmented term for information technology (IT) which accentuates on the role of integrated communications and the integration of telecommunications (telephone lines and wireless signals), computers and other necessary enterprise software. Singh (2013) defines ICT as a collection of technical devices and resources which are used to transmit, store and manage information; however, the utilization of ICT in the instructive process has been partitioned into two general classifications: ICT for education and ICT in education. ICT for education suggests the development of ICT particularly for teaching and learning purposes and ICT in education includes the adoption of general parts of ICT in the instructional process (Okoro *et al* 2016).

ICT in Education

The emergence of ICT has transformed the existence and activities of contemporary man particularly in the setting of globalization. In recent times, there has been an extraordinary advocacy both nationally and internationally for the use of ICT in instructional and learning process (Okoro *et al.,* 2016). The educational field has been influenced by ICT, which has explicitly influenced instructional process and research. ICT has the strength to speed up, improve and extend aptitude reforms as it has the capacity to boost teaching by inspiring and engaging learners, and help schools reform by assisting schools in understanding financial and functional practices. Ashley (2016) reiterates that technology helps educators in preparing students for the real world setting and stresses that as our countries turn out to be progressively more technology dependent, it becomes significantly more essential that to be good citizens, students must figure out how to be well informed about ICT. The utilization of ICT in teaching is a pertinent and practical method for providing education to learners that will enrich them with the required abilities with regards to the world of work.

ICTs can enhance the quality of education in several ways, by increasing learner motivation and engagement, by facilitating the acquisition of basic skills, and by enhancing teacher

training. ICTs are also transformational tools which, when used appropriately, can promote the shift to a learner-centered environment. ICTs, especially computers and Internet technologies, enable new ways of teaching and learning rather than simply allow teachers and students to do what they have done before in a better way. ICT has an impact not only on what students should learn, but it also plays a major role on how the students should learn. Along with a shift of curricula from "content-centered "to "competence-based", the mode of curricula delivery has now shifted from "teacher-centered" forms of delivery to "student-centered" forms of delivery.

ICT in Schools

ICT in schools gives a chance to instructors to change their practices by furnishing them with enhanced educational content and more powerful educating and learning techniques. ICT enhances the instructional process through the arrangement of interactive instructive materials that increase learner inspiration and encourage easy attainment of fundamental aptitudes. Utilization of different multimedia tools such as TV, recordings, videos and computers applications provides more challenging and attractive learning atmosphere for learners of any age (Cener *et al.,* 2015).

Learning through ICT

The use of ICT in educational settings, by itself acts as a catalyst for change in this domain. ICTs by their very nature are tools that encourage and support independent learning. Students using ICTs for learning purposes become immersed in the process of learning and as more and more students use computers as information sources and cognitive tools, the influence of the technology on supporting how students learn will continue to increase. In the past, the conventional process of teaching has revolved around teachers planning and leading students through a series of instructional sequences to achieve a desired learning outcome (Cener *et al.,* 2015).

Use of the Internet as Academic Materials

Shakir *et al.,* (2014) in their quantitative studies, found that teachers and research scholars have been using the internet to support their research and teaching, by the use of the internet, it had a positive impact on their academic performance, namely by writing research papers further help in doing better research and also provide a better learning experience. Besides, the more time spent with the Internet, the higher a student's addicted to the internet. The study showed that the time spent on the internet is becoming a measure of academic achievement the use of the Internet beyond the time will not be a hint of academic success. The second factor of the influence of the internet usage, is related to the impact of Internet on academic performance. The study identified the effects of the use of the internet and video games in students' academic achievement. The results showed that the route between IT use and academic performance is complex. The socio-demographic characteristics such as age, gender, race and household income associated with both the use of IT and academic performance affect the relationship between IT use and academic performance (Sushma *et al.,* 2014).

Positive and Negative Impact of Online Media on Student's Academic

Online media used in teaching are efforts to make improvements or to enhance the quality of teaching and learning process. In addition, the online media has the advantage of being able to combine a variety of different media such as text, images, animations, video and sound. The online media used for education include watching news online and viewing videos related to subjects and online media for non-education such as entertainment like video game online. Online media is interactive where the user does not obtain or communicate in one way only, but users can

communicate bilaterally in obtaining information, and also carry out activities. To find out more about online media that are used for educational and non-educational purposes, there are several reviews of previous studies.

Based on the study of Asemah *et al.* (2013), online media have a negative effect on students. This is based on studies that have been done by the researcher about the online video game which is a type of non-education online media, this online media negatively affects academic achievement. The study further stated that the decline of college students' academic achievement is due to the application of synchronous communication such as chat rooms, which can lead students to stay up late at night and decline in their academic achievement. Therefore, it can be said that online media uses affects academic performance.

Use of the Internet as Academic Materials

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The social media has a negative effect on students' academic performance. While Shakir *et al*. (2014) shows that the facts about the electronic media the authorized agent of socialization can educate the public and students in their lessons better than any other.

ICT in Biology Education

ICT has changed the traditional classroom structure and contributes to the development of the learning and teaching process. The advantages of using ICTs, in the case of biology education, include facilitating visualization, streamlining the transfer of information between teachers and students, eliminating time constraints, contributing to repeatable practices, promoting teamwork and helping to overcome geographic distances, proved in their study that better understanding of the abstract Molecular biology concepts and processes can be achieved by the students using computer animations. Students favored this ICT because it helped them to visualize the processes, the activity booklets made the lessons more enjoyable to them. They also emphasized the tasks' repeatability as a positive contributor of their studies (Rotbain *et al* 2018).

There are countless possibilities for synchronizing ICT and Biology classes, not just computers, websites, blogs, microphones, interactive boards, digital videos, online media and digital games are popular, but smartphones, iPods, iPads and other equipment can be successfully used to promote students' academic improvement (Kagohara *et al* 2013) and these tools contribute to

improving Biology studies. The role of ICT in Biology education is difficult to precisely appraise, however, it is certain that it works as a catalyst and leads to a change in teaching style, learning methods and he availability of information. According to the above examples, it can be seen that ICT supported Biology teaching worked effectively in case of different biology classes. By improving ICT supported teaching techniques, creating more and more specific programs for biology teaching, teaching the subject could be much more effective and more enjoyable for the 21st century generation (Sentilkumar *et al* 2014).

Relationship between ICT Competency and Students' Performance

Competency refers to the ability resulting from an individual's knowledge, skills, characteristics and attitudes to carry out work to achieve success (Kopaiboon et al 2014). Competency is made up of knowledge, skills, and attitudes. Knowledge connotes what a student has learned in class or in a workshop as an apprentice. This learning is subject to experience and understanding of a particular subject. Skill means to derive from knowledge the ability to perform work, in an appropriate and accurate manner, meeting a pre-determined standard. Attitude, on the other hand, refers to stance, feeling, or internal characteristics of individuals that express a sense of realizing the benefit and value of a particular thing. According to UNESCO (2014) ICT Competency refers to knowledge, skills, and ability to take advantage of ICT for the purpose of gathering, processing and presenting information in support of activities among different groups of peoples for working purposes. Please summarize the whole of this and take to the background or introduction, this is an article for publication not a project.

Method

This study adopted a correlational research design. Ex-post facto design was employed in the collection of the existing academic results of respondents. Students' ICT competency, ICT accessibility and socioeconomic status serve as independent variables while students' performance in Biology serve as the dependent variable of the study. The independent variables were separately correlated against the dependent variable to determine the relationships that exist. The population of the study was two thousand eight hundred and fifty-six (2856), which consists of the Biology students from all the combinations; Biology/chemistry, Biology/mathematics, Biology/computer, Biology/Integrated-Science and Biology/Geography at both the College of Education, Minna and Federal College of Education Kontagora in Niger State during the 2019/2020 academic session. The total number 300 Biology students in College of Education, Minna and Federal College of Education, Kontagora was used for the study. The respondents were made up of both male and female from Department of Biology, Colleges of Education in Niger State. A multi-stage sampling procedure was used to select a total of 300 students which serve as research sample. At the first stage stratified sampling technique was also used to classify students to their academic levels, after which purposive sampling procedure was employed to select the only two Colleges of Education, in Niger state which are College of Education Minna and Federal College of Education, Kontagora and year two Biology options classes. Finally, simple random sampling technique was used to select 300 students from year two; each of the schools will have a number of 150 students selected as respondents.

In order to gather data for the study, two research instruments were used for data collection. This comprised of "Students' ICT competency, ICT accessibility and socioeconomic status not part of

the study Questionnaire" (SICASSQ) and "Biology Students' Academic Scores" (BSAS). The questionnaire comprised of three sections (Sections A, B, C, & D). Section A was used to collect students' demography while Section B and C comprised of 15 items each on students' ICT competency and current level of accessibility and 10 items on socioeconomic status. The items were structured using 5-point Likert scale response mode of Strongly Disagree (1 point), Disagree (2 points), Undecided (3 points), Agree (4 points) and Strongly Agree (5 points). 4 Likert scale is preferable The questionnaire was validated by a lecturer in Science Education Department FUT, Minna and one lecturer from Educational Technology Department and Science Education Department each. And two Biological science lecturers in the Colleges of Education in Niger state. To determine the reliability of the SICASSQ instrument, a pilot study was conducted in order to establish the internal consistency of the questionnaire items. Cronbach Alpha formula was used to calculate the reliability coefficient of the instrument and the reliability index of 0.84 was obtained. The researcher collected a letter of introduction from the Department of Science Education FUT, Minna. Thereafter, the researcher was introduced to the students and the questionnaire was administered to the students at different levels (year 1- year 3). BSAS was used to collect students' academic scores from the department. Their Cumulative Grade Point Average (CGPA) as undergraduates in the department of Biology was collected from the department and awarded scores. A CGPA below 1.50 was awarded 40 points, 1.50 – 2.49 was awarded 45 points, 2.50- 2.99 was awarded 50 points, 3.00-3.49 was awarded 55 points, 3.50-3.99 was awarded 60 points, 4.00 to 4.49 will be awarded 65 points and a CGPA between 4.50 and 5.00 was awarded 70 points. The data gathered from this study were analyzed using Mean, Standard Deviation and Pearson Product Moment Correlation formula using Statistical Package for Social Sciences (SPSS Version 20.0). The results of the analyses obtained was used to provide answers to the research questions.

Results

Research Question 1.

Is there any relationship between ICT competency of students of Colleges of Education and their performance in Biology?

In order to answer research question 1, mean and standard deviation of respondents was carried out and presented

Biology Students shows their competencies in usage of ICT tools in different location. The Mean and Standard Deviation values of questionnaire items 1-15 indicates the Biology students' responses on how the ICT tools being used by students of Niger State College of Education Minna. Items 1, 4, 5, 6, 7, 8, 9, 10, 12, 13, 14 and 15 with their respective means values as 3.18, 3.18, 3.18, 3.18, 3.18, 3.18, 3.18, 3.18,3.50, 3.06, 3.33 and 3.30. These figures indicated among others in the competence of Biology students in ICT tools. They include I can use Word processing, I have good skills of the internet and E-mail, I can use Projectors, I can use ICT to access information relevant to my course of study, I can use the wireless mouse on a computer, I use the computer to complete my projects, reports. I learn on my own using computers and the internet, I use the computer to type my course works and assignments, ICT helped me through the social media to apply what I have learnt.

From the grand mean of 3.26 was greater than the decision means 3.00 it shows that Biology students show the competencies of the usage of ICT tools to improve their knowledge and skills as it relate Biology.

Biology students access ICT resources in different location. The mean and standard deviation values of questionnaire items 16-30on how Biology students access ICT resources in Niger State College of Education Minna. Items 19, 22, 23, 24, 25with their respective means values as 3.56, 3.63, 3.63, 3.59. These figures indicated among others access ICT resources premises, availability of Projector for teaching and learning, easy access to application software such as Microsoft excel for school work and assignments, easy access to application software such as Microsoft excel for school work and assignments. From the grand mean of 3.08 was greater than the decision means 3.00 it shows that Biology students access ICT resources to improve their knowledge and skills as it relates Biology.

Discussion of findings

Findings show that most of the biology students have access to computer at school which is far better than the fact that few Banglashi household owns a computer (Pew Research Centre, 2015). where did you get this? It also shows that they have poor access to Internet facilities in doing their assignment and studying through the use of internet. This is not the same findings as (Pew Research Centre, 2015) revealed that better internet access at school (50% always and 31% sometimes) as sued by the students of Bangledeshi. where are we? In Bangladesh or Niger state? Even though most of the biology students opined that they have less number of computer in their school, they were unable to manage time to prepare to learn how to use internet out of the school. It is sometimes difficult for them to buy data for their usage. The students enjoyed the use of some of the ICT tools like projector while learning as due to the less number of computers for them to get access with in teaching.

While evaluating the knowledge level it was evident that students have little knowledge on Microsoft office word, Excel, Power point and different web browsers. This is not part of this study expunge

Access to the few computers has played an important role to impact training to the students. However, it is also to be noted that a good portion of students (12 to 20%) do not possess knowledge on any of these software applications, at home for accessing educational materials. Although around 4000 contents on biology class, lectures are developed by the teachers in biology taking different courses in the same college the respondent students of the study did not find enough opportunity to harness the benefit of computer in the department and poor access to internet facilities.

Conclusion

ICT in education system through setting up multimedia classrooms in number of schools, arraying ICT training for school lecturers, developing digital contents by the teacher exchanging sentence. However, almost one fourth of the students are yet to use ICT (this work did not study use of ICT rather competency and accessibility) for learning purpose. To overcome the situation, regular internet services should be provided by the school down to the department where student of various departments could get access to.

Recommendations

6. ICT and internet facilities should be adequately procured for lecturers and students' used in the college.
7. Courses related to ICT should be made compulsory and as core courses for every students to facilitate skills and competence development on the use of internet before graduation from the college. Add more recommendations.

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Teachers' Perception and Utilization of E-Resources for Instruction towards Physics Curriculum Implementation in Niger State

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Abstract
This study focused on teachers' perception and utilization of e-resources for instruction towards physics curriculum implementation in Niger State. Descriptive survey research design was adopted. The population of the study was made of 92 Physics teachers teaching physics in public senior secondary schools in the State. A questionnaire titled "Physics Teachers Perception and Utilization of Instructional e-Resources for Implementation of Physics Curriculum Questionnaire (PTPUIeIPCQ)" made of four-point scale with a coefficient of reliability of 0.73 was administered on the population. Two research questions were raised to guide the study. Data collected was analised using mean and standard deviation, some of the findings revealed that: Teachers perceived that they cannot use e-resource as an E-teaching platforms to cover scheme of work; Teachers perceived that information on E-resource may be misleading; Teacher made use of e-curriculum to prepare lesson notes. Some of the recommendations made were: thatPhysics teachers should be motivated and encouraged to attend more training, workshop and seminars on the use of e-resources and e-content creation

Introduction
The twentieth century was shaped by sweeping changes in communication technologies. The application and use of information technology has affected every aspect of human endevour with education inclusive. The academic community has undergone tremendous changes during these years, assuming new dimensions influenced by technology-driven applications. Instructional resources have witnessed a great metamorphosis in recent years both in their collection development and in their service structures (Thanuskodi, 2012).

According to Madhusudhan (2010) Electronic resources deliver the collection of information as full text databases, e-journals, image collections, multimedia in the form of CDs, Tape, Internet, Web technology etc. E-resources may include e-journals, e-discussions, e-news, data archives, e-mail on line chatting, etc. can be called as an e-resources. Electronic information sources are a wide range of products going from electronic periodicals to CD-ROMs, from mailing list to databases, all of them having a common feature of being used and sometime modified by a computer.

Mobegi*et al*, 2010 stated that the importance of E-resources in the teaching and learning process is influenced by factors such as quality, availability, efficiency, conditions of resources, accessibility, participation, pupil ratio, perception and utilization of the e-resources. Similarly, Ene (2015) noted that educational resources if properly harnessed in the school system can ensure achievement of educational goals. Josiah and Gana (2019) have documented that performance of

Nigeria students in external physics examinations over the years have been dwindling. This, they mentioned may related to non-availability or poor utilization of resources by teachers in the implementation of physics curriculum. Abubakar (2020) explained that inadequate instructional resources and utilization of available instructional resources by few Physics teachers in the implementation of physics curriculum in secondary schools in Nigeria remain a major challenge that has negative impact on students' performance. Omebe and Akani (2015) reported that students achieved higher in physics when physics curriculum is implemented using instructional resources and the result also show no bias in gender. Therefore, this study intended to look at teachers perception and utilization of e-resource for instruction in the implementation of physics in Niger State.

Purpose of the Study

The main purpose of this study is to investigate teachers' perception and utilization of e-resources for instruction towards implementation of physics curriculum in Niger State. Specifically, this study sought to:

(i) Determine perception of physics teachers on e-Resources for instruction towards implementation of physics curriculum in Niger State.

(ii) Determine utilization of e-Resources for instruction towards implementation of physics curriculum in Niger State.

Research Questions

(i) What is the perception of Physics teachers on e-Resources for Instruction towards implementation of Physics curriculum in senior secondary schools?

(ii) What is the extent of utilization of available e-Resources for instruction towards effective implementation of Physics Curriculum in senior secondary schools of Niger State?

Methodology

The study employed descriptive method and using questionnaire to elicit responses from teachers on their perceptions and utilization of e-resources for instruction towards physics curriculum implementation in Niger State.

The population of physics teachers in senior secondary schools in Niger State are 92 and researcher used the entire population as it is not much. Therefore, purposive sampling technique was employed.

The instrument used for data collection was questionnaire designed for eliciting information from teachers on their perception and utilization of e-resources for instruction towards physics curriculum implementation which consists of ten questions for teacher perception and another ten questions for utilization of e-resources for instruction using modified four-point-scale with VHP= Very High Perception (4), HE= High Perception (3), LE= Low Perception (2), and VLE = Very Low Perception (1) and for Utilization: VHU= Very High Utilization (4), HU= High Utilization (3), LU= Low Utilization (2), and VLU = Very Low Utilization (1)

The questionnaire was face-validated by two experts from the department of Science Education department, Federal University of Technology, Minna, and all observations they made were noted and effected accordingly. The reliability of the instrument was tested using 20 Physics teachers

from private schools. The data collected were analysed using chronbachapha. And the reliability coefficient of 0.73 was obtained.

Results

The data collected from the teachers response was analysed using mean and standard deviation.

Research Question One

What is the perception of Physics teachers on e-Resources for Instruction towards implementation of Physics curriculum in senior secondary schools?

Table 1: Mean Responses of Physics teachers perception on e-Resources for Instruction towards implementation of Physics curriculum in senior secondary schools.

S/N	Items Description	Mean	Standard Deviation	Decision
1	The rate of learning is faster when teachers make use of e-resource instruction means	2.73	1.080	HP
2	E-resource for instruction can increase the productivity learning towards the implementation of physics curriculum.	2.57	1.161	HP
3	E-resource for instruction is a modern way of instructional delivery?	2.54	0.977	HP
4	The rate of curriculum implementation is faster when teachers make use of e-resource teaching means.	2.55	1.052	HP
5	E-resource for instruction can content an entire curriculum contents for easy implementation of physics curriculum.	2.70	1.503	HP
6	I can use e-resource as an E-teaching platforms to cover my scheme of work	2.45	1.113	LP
7	I like the idea of using E-resource platforms for instruction	2.54	1.063	HP
8	I regularly use E-resource because I find information on E-resource to be useful	2.54	1.181	HP
9	I get useful information through E-resource and use it for instructional delivery	2.55	1.123	HP
10	Information on E-resource are never misleading	2.49	1.074	LP
	Average Mean Score	**2.57**	**1.133**	**HP**

Results of table 1 shows Mean responses of Physics teachers perception on e-Resources for Instruction towards implementation of Physics curriculum in senior secondary schools with items 1-5 and 7- 9 have the mean rating ranging from 2.54- 2.73 respectively. This mean ratings are greater than the benchmark of 2.50 which indicate that Physics teachers perceived the use of e-Resources for Instruction towards implementation of Physics curriculum in senior secondary schools to high extent while items 6 and 10 have mean rating of 2.45 and 2.49 which are below the benchmark of 2.50 which indicate that Physics teachers perceived these two items is to a low extent.

Research Question Two

What is the extent of utilization of available e-Resources for instruction towards effective implementation of Physics Curriculum in senior secondary schools of Niger State?

Table 2: Mean Responses of teachers utilization of available e-Resources for instruction towards effective implementation of Physics Curriculum in senior secondary schools.

S/N	Items Description	Mean	Standard Deviation	Decision
1	I usually demonstrate my teaching with appropriate e-resource.	2.57	1.122	HU
2	I use e-resource to illustrate key issues during my teaching	2.51	1.143	HU
3	Graphs and charts on e-resource are used to make my teaching real in Physics	2.57	1.142	**HU**
4	Newspaper and magazines are used to help students learn currents affairs and events in my classroom.	2.58	1.131	HU
5	I usually use current physics e- curriculum to prepare my note of lesson.	2.66	1.189	HU
6	The use of e-resources can reduce use of the chalkboards when teaching since it contains more information.	2.64	1.182	HU
7	The e-resources helps a teacher gives note to copy after his teaching on the chalkboard	2.59	1.159	HU
8	The use of e-resources helps reduces stress on the part of the teacher	2.60	1.090	HU
9	The use of E-resource for instruction can bridge the gap between the traditional and modern way of instructions towards implementation of Physics curriculum.	2.70	1.126	HU
10	Using E-resource in academic studies would increase the achievement of students when curriculum content is covered.	2.58	1.141	HU
	Average Mean Score	**2.60**	**1.143**	**HU**

Results of table 2 shows Mean responses on the utilization of available e-Resources for instruction towards effective implementation of Physics Curriculum in senior secondary schools with items ranging from 1-10 have the mean rating ranging from 2.51-2.70 respectively. The mean ratings are greater than the benchmark of 2.50 which indicate that Physics teachers utilize the e-Resources for Instruction towards implementation of Physics curriculum in senior secondary schools to a high extent.

Discussion

The items that account for the physics teachers perception of e-resources for instruction towards the implementation of physics curriculum in secondary schools in Niger State showed, that the teachers agreed with almost all the items which indicated they have high perception for e-

resources instruction for the implementation of physics curriculum. The items that measured the extent of utilization of e-resources for implementation of physics curriculum in Niger State showed, that physics teachers are utilizing e-resources for instruction in their implementation of physics curriculum. This goes against the findings of Abubakar (2020) who found that very few physics teacher are utilizing instructional resources for teaching students.

Findings

The study was designed to find out physics teachers perception and utilization of e-resources for instruction towards the implementation of physics curriculum in Niger State. After the analysis of the collected data, the following findings were summarized.

(i) Teachers have high perception towards e-resources for instruction towards the implementation of physics curriculum in Niger State.

(ii) Teachers have high utilization of e-resources for instruction towards the implementation of physics curriculum in Niger State.

Conclusion

The result from this study revealed that; teachers e-resources as e-teaching platform, they perceived that information on e-resources may be misleading, learning is faster when teachers make use of e-resources, teachers make use of graph and charts on e-resources to make teaching real in physics class, teachers make use of e-curriculum to prepare lesson notes, and use of e-resources reduces stress on the part of the teacher.

Recommendation

From the findings of this research, the following recommendations are made:

(i) Physics teachers should be motivated and encouraged to attend more training, workshop and seminars on the use of e-resources and e-content creation

(ii) Physics teachers should try teaching of physics using e-teaching platforms

(iii) School administrators should encourage use of e-resources by teachers through supplying e-resources for both learning and instructions in their schools

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Languages of Instruction: A Desideratum for Instructional Approaches in Science, Technology, Engineering and Mathematics (STEM), Education in Nigeria.

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Abstract
This study was conducted on indigenous languages of instruction: A desiratum for instructional approaches in STEM education. It made use of pretest, posttest factorial design with two levels of treatment and control groups. The accessible population was the public secondary schools in one local government area of Edo state. Purposive and simple random sampling methods were used to obtain a sample of two co-educational senior secondary schools for the study. Each school provided one form of SSS 2 for the study. The instruments used for the study were instructional package, lesson plans and Physics Achievement Test (PAT). The reliability coefficient of the validated instrument was determined using Pearson Product Moment Correlation and it was 0.78. Two research questions and three null hypotheses were tested at 0.05 level of significance. The two groups were taught the same concepts in mechanics using the same method but different languages of instruction. 2 x 2 ANOVA was used to analyze the data. The results revealed that Physics students taught in Pidgin English Language (indigenous Language) performed significantly better than those taught in conventional English Language, no significant interaction between gender and language of instruction and that male physics students performed better than the female counterparts but the difference was not found to be significant. Conclusions were drawn and based on the findings, it was recommended among others that Nigeria should use her indigenous languages to teach STEM and related subjectsin our primary and secondary schools and in urban areas where we have different mother-tongue, Pidgin English Language should be adopted as our indigenous language.

Keywords: Languages of Instruction, STEM, Pidgin English

Introduction
Science, Technology, Engineering and Mathematics (STEM) education aim at exploring nature and manipulating it to serve us in a way that can positively affect our lives. STEM education is deployed to serve our present needs without compromising the needs of generation yet unborn. Therefore, STEM education should be taught and learned not for its own sake but because we are interested in the goal of making the community a better place to live (Wasagu, *et al*, 2013). Asabere-Ameyaw (2013), noted that during a ministerial conference in Lagos (1964), many African countries lamented the limitations of an absence of adequate national policies on Science and Technology education as well as bereft of any national machinery for coordinating and preparing such a policy.

In Nigeria, there has been the creation of several curriculum development centers that have helped to produce a variety of STEM curricula with textbooks and instructional materials and yet the desired goals are yet to be achieved. According to Jegede (2006), the way STEM education is taught, project only one form of world view – the western view which holds claim to superiority

over other forms of studying nature. Jegede (2006) therefore, calls for science and technology teaching in Africa to be context specific and to recognize the socio-cultural and cosmological background of the learners. The instructional approaches being used are not adequate. Science and technology subjects can better be taught to schools by exploring different approaches (Dania, 2018). Teaching in science and technology aimed at achieving some objectives which typically manifest into instructional products or students' academic achievement (Dania, 2014). He emphasized that the nature and intensity of the outcomes, the behavioral changes in the learner are function of specific instructional approach. In the same view, Nwachukwu and Nwosu (2007), pointed out that the effectiveness of any instructional approach to some extent depends on the operator and the language being used to operate the method.

Physics as a subject is the basis of STEM education through its principles. A wide range of application of physics was used in industrial development for improvement of materials useful to the well-being of human race. In his findings, Wambugu and Changeiywo (2008), pointed out that the teaching of physics provides the learner with skills and scientific knowledge needed for scientific research, fostering technological and economic growth in the society.

Physics education should therefore be taught in a language students will easily understand. The use of appropriate language of instructional approach is critical to the successful implementation of the objectives of STEM education in Nigeria. During the past years, focus has been on the medium of instruction in STEM education in Nigeria. For instance, the theme for the Thirty Second Annual conference of the Science Teachers' Association of Nigeria STAN was "Teaching Science, Technology and Mathematics in the mother tongue. The medium of instruction at all levels of education in Nigeria is English language, which is second language. It is a fact that a child learns best in his or her mother tongue.

Language generally performs a lot of functions in speech communication. Language is also a means of expressing thoughts and feelings (Nnamani, 2012). Ezieojioku (2007) observed that all the technologically developed nations achieved their breakthrough, using their indigenous languages. For instance, America, Britain, France, Russia and Germany all achieved their technological feats by using their local languages. Today, China, India, Japan, Korea and other Asian Tigers that rule the world in science and technology achieved their feats using their indigenous languages and technology (Ede, 2019). Therefore, for Nigeria to achieve her Science, Technology, Engineering and Mathematics (STEM) education objectives, the use of Nigerian languages as a means of instruction cannot be overemphasized. Research has shown that children learn better in their mother-tongue since they think first in their language and latter relate their thought to any foreign concept. Fafunwa (1995), opined that once we are able to teach concepts of mathematics and other science and technology subjects to our children in their mother-tongue, we are likely to develop faster in science and technology. Besides the three major languages, Hausa Igbo and Yoruba, efforts should also be made to develop other minority languages in the country with the view of using them as medium of instruction in our primary and secondary schools.

The fact remains that many states in the country could be regarded as Mini-Nigeria because of their individual ethnic composition. Even in many states where you have the dominant groups like the Hausa/Fulani, Igbo and Yoruba, many other ethnic groups co-exist in the same geographical

environment, especially in terms of linguistic cleavages. Below is the list of the 36 states of Nigeria and the Federal Capital Territory with the number of languages spoken in each state.

Table I: Languages by State in Nigeria

S/N	STATE	No. of Languages	S/N	STATE	No. of Languages
1	Abia	1	19	Kano	4
2	Adamawa	58	20	Katsina	2
3	Anambra	3	21	Kebbi	16
4	Akwa Ibom	26	22	Kogi	8
5	Bauchi	60	23	Kwara	7
6	Bayelsa	10	24	Lagos	2
7	Benue	14	25	Nasarawa	29
8	Borno	28	26	Niger	38
9	Cross-River	50	27	Ogun	1
10	Delta	11	28	Ondo	10
11	Ebonyi	5	29	Osun	1
12	Edo	17	30	Oyo	1
13	Ekiti	1	31	Plateau	48
14	Enugu	1	32	Sokoto	23
15	Gombe	21	33	Taraba	73
16	Imo	1	34	Yobe	9
17	Jigawa	4	35	Zamfara	1
18	Kaduna	57	36	FCT	9
Total No. of Languages			**343**		

Source: Department of Languages and Linguistics, University of Jos, Nigeria in Nigerian Tribune, Monday 7th October, 2013.

From the above analysis, there is a considerable support for the use of mother-tongue as a medium of instruction especially in the rural areas of which constitute about 70% of the entire population of the country, but a little problem exists in the urban areas as most of which are multi-ethnic. Students in urban areas have different mother-tongue and the problem is that of selecting the appropriate mother-tongue to use.

In Edo state, where the study was carried out, there are seventeen (17) languages in the state. The inhabitants use adulterated forms of English Language referred to as Pidgin English Language as a means of communication. By implication, the mother-tongue in Edo State can be said to be Pidgin English Language. The advocacy for the use of Pidgin English Language as a medium of teaching science and technology is based on mere conjecture that will improve students' achievement in science and technology education. There is no known empirical evidence to back up such. This conjecture is therefore put to test in this study.

Statement of the Problem

Students' performance in STEM education is not encouraging in Nigeria. The language being used in communicating concepts to students at primary and secondary school levels is not effective. The use of English Language as a medium of instruction in science and technology education in Nigeria

has been implicated in observed under-achievement of all the continents and people of the world, it is only in Africa and few other ex-colonial countries that formal education is offered in a language that is foreign to the child. Therefore, the problem of this study; is language of instruction responsible for students' poor performance in STEM education?

Research Questions

The study is proposed to answer two research questions;

1. Which of English language and Pidgin English language (mother tongue) will be more effective as a language of instruction in the teaching of physics concepts to senior secondary school students?
2. In which of these languages (English and Pidgin) male and female physics students perform better when each is used in the teaching of physics concepts?

Research Hypotheses

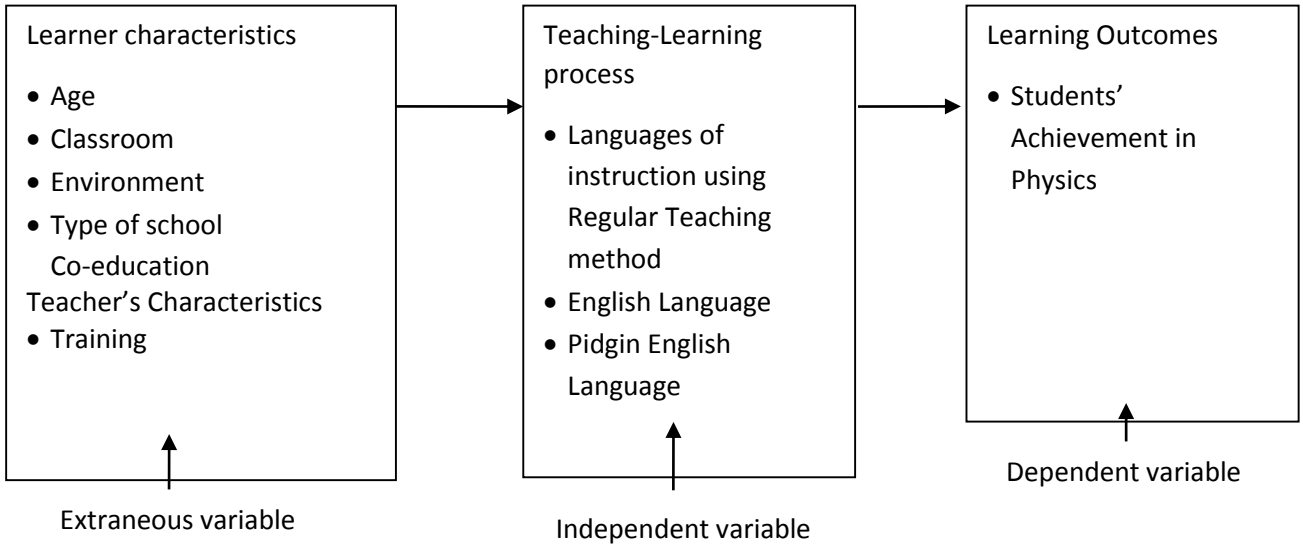
There null hypotheses were formulated for the study.

HO_1: There is no significant difference in the performance of Senior Secondary School Physics students taught using English as a language of instruction and those taught using Pidgin as a language of instruction as measured by Physics Achievement Test (PAT)

HO_2: There is no significant difference between the performance of male and female physics students as measured by Physics Achievement Test (PAT).

HO_3: There are no interaction effects between gender and the language of instructional approach on the achievement of Physics students as measured by Physics Achievement Test (PAT).

Conceptual Frame Work Used to Investigate Languages of Instruction in STEM Education



The conceptual framework to guide the study was based on the System Approach (Joyce & Weil, 1980) which holds that the teaching and learning process has inputs and outputs. To achieve good results, then the inputs must have suitable materials. The study was also based on the assumption

that the blame for a student's failure rests with the quality of instruction and not lack of students' ability to learn (Bloom 1981, Levine 1985).

Method of Study

The study is a pretest, posttest a factorial design that allows the examination of several factors at the sometime. The target population for the study is senior secondary schools two Physics students in public senior secondary school in Akoko, Edo Local Government Area, Edo state, Nigeria. The population was twenty-eight (28) public senior secondary schools with five hundred and sixty (560) physics students (Edo State Ministry of Education, Igarra, 2019/2020). Purposive sampling technique was used to select the sampled schools from the target population. The criteria used are:

- Schools with equipment and functioning Physics laboratory.
- Schools that are currently presenting candidates for external examination.
- Schools with at least one experienced professional physics teacher.
- Schools that are co-educational.

Out of the twelve (12) schools that met the criteria, two were randomly selected by balloting. The selected schools were randomly assigned to treatment and control groups. Comprehensive mixed school, Igarra was assigned experimental group, 25 physics students. While Akoko-Edo mixed grammar School Uneme-Nekhua was assigned control group 20 physics students. The study involved groups of students in their intact classes assigned to experimental and control groups. The two independent variables are sex and instructional approaches. The effects of these independent variables on the dependent variables, students' academic achievement were investigated.

The instruments for data collection were instructional package, lesson plan for the teaching session and Physics Achievement Test (PAT). The instructional package consisted of selected concepts from mechanics (Equilibrium of Forces) in Physics from S.S.S 2 syllabus with the contents: resultant and equilibrant force, centre of gravity and equilibrium, equilibrium of bodies in liquids, Archimede's principle and the law of flotation. These contents were based on SSS 2 physics syllabus. Two physics lecturers from a college of Education and two experienced physics teachers at the secondary school level, validated the instruments. Their comments and corrections were incorporated into the final form of the instrument. To ensure content validity, the instructional objectives were divided into four (4) educational hierarchy of knowledge, comprehension, application and analysis. The test blue print of the table of specification is shown in Table 1 below. Experts determined the suitability of the items for the target population in terms of class level, contents, and reading level, relevance and language level. The reliability of the test items was carried out using test-retest. The reliability coefficient of 0.78 was obtained using Pearson Product Moment Correlation.

The achievement test of 30 multiple choice items was administered as pre-test to the students just before the commencement of treatment. The exercise was to ensure confidence that the schools were experimentally equivalent enabling comparison of the performance of the control and experimental groups of the post-instructional stage. The students in the experimental group were treated with Pidgin English Language while those in control group were treated with conventional English Language. Both groups were exposed to the expository traditional method of teaching. The researcher carried out the teaching himself so as to guide against certain factors such as

qualification, teaching, experience etc. that could limit the effectiveness of the task presentation. The treatment lasted for four weeks. Immediately after the treatment, posttest was administered to the two groups. The two groups were exposed to the same physics contents. The only difference was the language of instruction.

Table 2: Intellectual Objectives

Unit	Knowledge 28.7%	Comprehension 23.3%	Application 30%	Analysis 20%	Total
Resultant equilibrant forces 10%	2	1	-	-	3
Parallel forces 13.3%	1	1	-	2	4
Moment of force(Torque) 13.3%	1	1	2	-	4
Centre of gravity 6.7%	1	1	-	-	2
Equilibrium of forces in Liquid 20%	-	1	3	2	6
Archimedes principle 16.7%	1	1	2	1	5
The law of floatation 20%	2	1	2	1	6
Total	**8**	**7**	**9**	**6**	**30**

Results and Discussion

A t-test statistics was used to verify the initial abilities of the students in Physics before they were treated with either Pidgin English Language or conventional English Language as languages of instruction as measured by PAT. A 2x2Analysis of variance was used to test the effects of the languages as a means of instructional approaches on the performances of the students in Physics as measured by PAT.

Table 3: t-test statistics of pre-test mean scores of experimental and control groups.

Variable	N	$\bar{x}$	sd	df	t-obtained	t-cal	Sig at p<0.05
Experimental group	25	5.85	2.52	43	0.85	2.021	NS
Control group	20	6.24	2.17				

A t-test analysis revealed no significant difference between the mean pretest scores of experimental and control groups. These results among other things informed the decision to use 2x2 Analysis of Variance (ANOVA) for comparing the group means of the post-test. Table 3 presents the 2x2 ANOVA summaries which were used to test the stated hypotheses instead of Analysis of Covariance (ANCOVA).

Table 4: 2 x 2 Analysis of Variance (ANOVA) of Dependent Variable post-test scores of student taught with pidgin English Language and conventional English Language

Source of variation	Df	SS	MS	F-obtained	F-crit	Sig. at p<0.05
Treatment	1	281.3	281.3	25.21	4.08	S
Sex	1	10.4	10.4	0.932	4.08	NS
Interaction (treatment x sex)	1	2.1	2.1	0.188	4.08	NS
Error (ssw)	41	401.8	11.16			

In table 4, the calculated F-statistics due to treatment (Language of instruction) is 25.21, while from the F-DST, the value of F-statistics beyond 0.05 probability level (1df and 41 degree of freedom) is 4.08. The calculated value due to treatment is therefore greater than the expected F-value. The difference is significant thus leading to the rejection of hypothesis HO_1. This implies that the performance of students in physics is related to the language of instruction and it is in favour of pidgin English Language as shown in Table 5.

Also, in table 4, the calculated F-value 0.932 due to gender is less than the expected F-value (4.08). Hence, gender has no significant effect on the performance of physics students as measured by PAT. Thus, leading to the acceptance of hypothesis HO_2. However, the mean scores of male students in both treatment and control groups were found to be higher than that of female as shown in table 4. In the same, table 4, the obtained F-value 0.188 due to interaction effect is less than the expected value 4.08, leading to the acceptance of hypothesis HO_3 at 0.05 level of significance. In other words, interaction effects between gender and the language of instruction on the achievement of physics students was not significant. This implies that the simple main effects of languages of instruction do not change as a function of variation in gender and vice versa.

The result of this study is in consonance with the assertion OF Fafunwa (1995), Ezieojioku (2017) and Ede (2019), that the use of mother-tongue has a significant effect on students' academic performance in STEM education.

Table 5: Summary of Cell and Marginal Mean

		Treatment		
		Conventional English Language	Pidgin English Language	Sample mean
Sex	Male	12.90	19.40	16.15
	Female	11.60	17.80	14.70
Sample Mean		12.25	18.6	15.43

Conclusion

In conclusion, this research has a number of interesting findings. The study has revealed that the effect of indigenous language in the teaching and learning of physics was significant. This implies that the achievement of students in physics was based on the language of instructional approach

and that sex has no significant effect on students' academic achievement irrespective of the language of instruction.

Recommendations

Based on the findings of this study, the following recommendations are made:

1. Most developed countries in the world are using their indigenous languages to develop their science and technology education. Nigeria should therefore use her indigenous language as a means of instruction and see how far she will go in the development of her STEM education.
2. There is no effective instructional approach in terms of language of instruction in our primary and secondary schools. There should therefore be adequate trained teachers in the area of the use of indigenous languages in our schools.
3. In the urban areas where we have different indigenous languages (mother-tongue), there will be problem of selecting an appropriate mother tongue. In such areas, pidgin English language should be adopted as a mother-tongue.
4. Instructional materials and textbooks with manual in our mother-tongue should be produced for pupils' use.

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Relationship Between Lecturers Perception and their Intention to use Assistive Technology for Teaching College of Education Students with Special Ability in North-West Nigeria

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Abstract
This study adopted a quantitative correlation study to investigate the factors that influence lecturer's behavioral intention to adopt assistive technology for teaching students with special needs among Colleges of Education in North-west Nigeria. The target populations will be 550 lecturers teaching students with special needs in Colleges of Education in north-west Nigeria. Using simple random sampling, 210 lecturers in Colleges of Education in North-west Nigeria were selected. Two research objectives and two corresponding hypotheses were formulated to guide the study. The instrument for this study is a structured close ended questionnaire titled "Assistive Technology Questionnaire for Students with special needs" (ATQSSN). The questionnaire was scaled using 5-point Likert type and was validated for face and content validity by experts. The reliability of the instrument was between 0.70 – 0.75. The questionnaires were administered to the respondents and the data collected was analyzed with Pearson Product Moment Correlation (PPMC) to test the formulated hypotheses. The findings show that there was a significant relationship between perceive usefulness and behavioural intention to use Assistive Technology, similarly there was a significant relationship between perceive ease of use and behavioural intention to use Assistive Technology. It was recommended among others that the government should provide adequate AT devices for teaching students with special ability.

Keywords: Assistive Technology, Behavioural intention, Perceived usefulness, and Perceived ease of use

Introduction
Technology in the 21st century is an indispensable tool for the enrichment of the quality of human life and their future prospects. Technology has become a vital component of our everyday lives; communication, work, entertainment, and Education among others. Advances in technology and Education has greatly influence human communication and learning (Sagnak, & Baran, (2021). Therefore, the effective adoption of technology has become a critical issue in today's knowledge-based economy especially in the classroom to prepare human resource that will take advantage of opportunities in the global market. Consequently, there has been an increase in the advocacy for the integration of technology for learning. Research has shown that technology enhances meaningful learning of instructional contents. These technologies, on its own, cannot make student acquire relevant skills required for success in the 21st century.

In response to 21st century teaching and learning, teachers had to act as facilitators because, Education is dynamic and is subject to changes inflicted by external forces such as globalization (Blackwell et al., 2014). Global trends in using technology in Education indicate that it is not merely used to help children learn outside the four corners of the room, but widely used as part of

the instructional program. Though it has been integrated finally in the field of Education, its use for teaching and learning remains a challenge (Wadell, 2015). In present times, literature is replete with the potential benefits of technology in enhancing meaningful learning especially among normal individuals or persons without disability. That is why many nations of the world have adopted the provision of quality Education for all citizens irrespective of their disability. This was clearly specified in the United Nations Sustainable Development goal "ensuring inclusive and equitable quality Education and promote lifelong learning opportunities for all" (Sustainabledevelopment.un.org, 2019). Thus, technologies used in special Education have significantly changed over time ranging from low electrically powered, to medium powered to highly electrically powered technologies. These technologies are now serving the roles of assistance to the specialty needs of students and complementation to their various physical challenges. And are called Assistive Technology (AT). Assistive technology and assistive technology devices have the potential to positively influence the Educational possibilities of students with special needs. Assistive technologies are devices created to enhance the learning capabilities of individuals with disability through speech communication, text to voice and mobility. Similarly, Clark, Griffiths and Price, (2016) refer to assistive technology as equipment that assist students to cope or make up for certain physical deficiencies, learning inconsistencies and mobility issues.

Mcnicholl, Casey, Desmond, and Gallagher, (2019) reported that if Assisting Technology are effectively used it will support the learning of individual with special needs. The use of assistive technologies in teaching and learning could be of importance to students with special needs; but their usage depends on lecturers' perception and utilization. The potential of technology as a learning resource that will enhance meaningful learning for all learners have been reported (Abani 2015).

Alharbi and Drew (2014) found out in their study that the perceived usefulness of technology has a significant positive-moderate correlation with the attitude of teachers towards using the learning management systems. Fathema et al. (2015) have a similar finding in their study, revealing the existence of a very strong positive correlation between the faculties perceived usefulness of technology and their attitude towards technology. Similarly, Elkaseh, Wong, and Fung (2016) carry out a quantitative study on the perceived ease of use and perceived usefulness of social media for e-learning in Libyan Higher Education, found out that the use of social media networking plays an important role in the adoption of e-learning. Their findings reveal that the attitude towards behavior or use of technology was predicted by perceived ease of use.

Statement of the Problem

The adoption of assistive technologies for teaching and learning depends on the lecturers' perception (Williams-Buffonge, 2021). Lecturers' perception is influence by several factors such as perceive usefulness, perceive ease of use, technological self-efficacy, intension to use AT and accessibility. Other factors include; demographic factors such as age, gender, and years of experience. Perception is closely linked to an individual experience and emotions, it influences the way individuals view phenomena, object and or phenomenon. Therefore, two individuals in the same condition may view the situation differently. An individual's perception can largely be governed by his background knowledge of the phenomena (Nueva, 2019). In this study the phenomena is assistive technology and how lecturer perceive it. Perception of assistive technology

is viewed from its perceive usefulness, ease of use and intention to use. Perceive usefulness of technology (AT) is the extent to which an individual lecturer sees assistive technology as a useful device that will enhance his job performance.

The zeal with which digital technologies have been accepted and become part of people lives has not been with the same enthusiasm it has been integrated into teaching and learning (Alfaraj, & Kuyini, 2014). They suggested that there is need to investigate both lecturers and students' opinions or perception as to why there is slow pace of integration of technology towards teaching and learning.

This is a gap that needs to be addressed since it is reported that lecturer's perception has influence on their teaching practices and technology integration (Cardullo, Wang, Burton, & Dong,2021). In support of this Cubukcuoglu, (2013) opined that lecturers are responsible for the implementation of assistive technology for teaching and learning. Thus, lecturers who perceived assistive technology as important for learning are most likely to integrate assistive technology for their instruction. Hence, the need for this study.

Research Objectives

- Determine the influence of lecturers' perceived usefulness on behavioral intention to use assistive technology for teaching COE students with special needs.
- Examine the influence of lecturers' perceived ease of use on behavioral intention to use assistive technology for teaching COE students with special needs.

Research Hypotheses

Ho_1: There is no significant influence of lecturers' perceived usefulness on behavioral intention to use assistive technology for teaching College (COE) of Education students with special needs.

Ho_2: There is no significant influence of lecturer's perceived ease of use on their behavioral intention to use assistive technology for teaching COE students with special needs

Research Methodology

This study adopted a quantitative correlation study to investigate the factors that influence lecturer's behavioral intention to adopt assistive technology for teaching students with special needs among Colleges of Education in North-west Nigeria. Quantitative research design of this nature helps to explain relationship between the predictor or independent variables and the criterion or dependent variable and it seek to clarify phenomena through careful data collection and analysis (Creswell, 2015). The target populations will be 550 lecturers teaching students with special needs in Colleges of Education in north-west Nigeria.

Using simple random sampling, 210 lecturers in Colleges of Education in North-west Nigeria were selected. The instrument for this study is a structured close ended questionnaire titled "Assistive Technology Questionnaire for Students with special needs" (ATQSSN). The questionnaire was developed by the researcher in line with Technology Acceptance Model (TAM) and Bandura Theory of Self-Efficacy construct. The questionnaire was scaled using 5-point Likert type. It was divided into four sections (A-E) section A: sought demographic information of the respondents' institution, gender, age and years of experience. Section B: sought participants' opinions on their

perceive usefulness of AT. Sections C: focused on lecturers perceive ease of use of AT, Section D: sought opinions on behavioral intention to use AT.

The questionnaire was given to one expert in the Department of Educational Technology, Federal University of Technology Minna, and one expert in the Department of science and Technology Education (Educational Technology section), Bayero University Kano, and one expert in the Department special education, Bayero University Kano to check for face and content validity. Their comments and suggestion was integrated to improve the questionnaire. The questionnaire was pilot tested and the sub-section of the instrument includes, perceive usefulness of AT, perceive ease of use of AT, and behavioral intention to use AT yielded a reliability of between 0.70 and 0.75. The questionnaires were administered to the respondents and the data collected was analyzed with Pearson Product Moment Correlation (PPMC) to test the formulated hypotheses.

Results

Ho_1: There is no significant influence of lecturers' perceived usefulness on behavioral intention to use assistive technology for teaching College (COE) of Education students with special needs. To test this formulated hypothesis, PPMC was used and the results presented in Table 1

Table 1: Summary of Pearson Product Moment Correlation Between Perceived Usefulness on Behavioral Intention to use Assistive Technology

Variable	N	Mean (X)	Standard Deviation (S.D)	r-cal	P-value
Perceived usefulness	210	69.75	22.783	.944	0.00
Behavioral intention	210	70.77	23.774		

Table 1 above shows the correlation between lecturers' perceived usefulness on behavioral intention to use assistive technology. The table revealed that lecturers' perceived usefulness had a mean score of (M= 88.04 and S.D =2.76), behavioural intention had Mean score of (M= 49.62 and SD=18.01), while the r-cal. = .944, indicating there is a strong positive relationship between lecturers' perceived usefulness and their behavioural intention to use assistive technology for teaching, p =(0.00) <0.05. This shows that the hypothesis is rejected. implying that the respondents' lecturers' perceived usefulness significantly influence their behavioural intention to use assistive technology. This finding is highlighted using a scattered plot

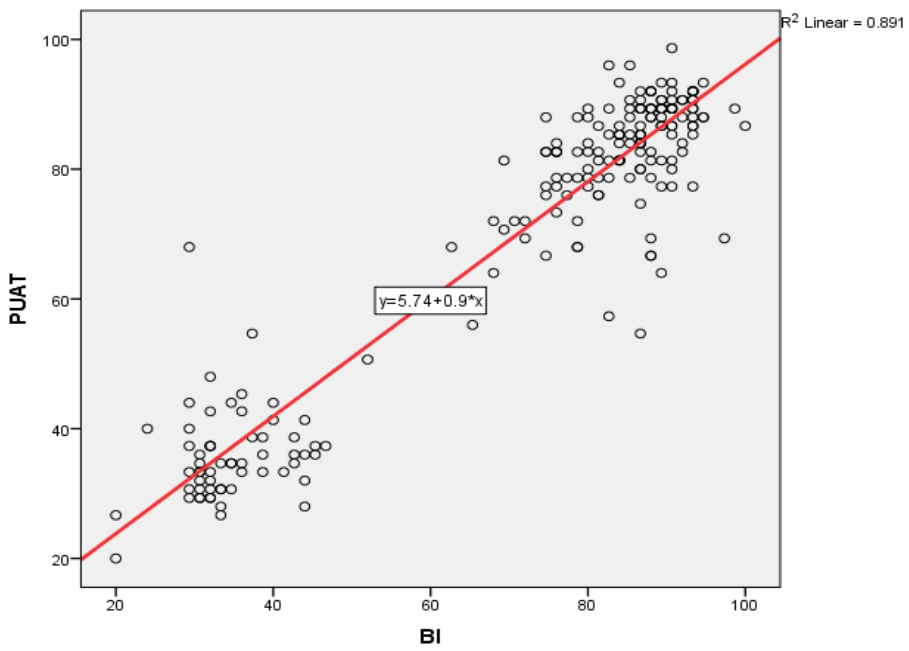

Figure 2: Scattered Plot the relationship between Perceive Usefulness of Assistive Technology (PUAT) and Behavioural Intention

Figure 1 shows relationships between perceived usefulness and behavioural intention. The scattered plot indicates that there seems to be a positive relationship between the two constructs as indicated by the regression line.

Ho2: There is no significant influence of lecturer's perceived ease of use on their behavioral intention to use assistive technology for teaching COE students with special needs.

Table: Summary of Pearson Product Moment Correlation between Perceived Ease of Use on Behavioral Intention to Use Assistive Technology

Variable	N	Mean (X)	Standard Deviation (S.D)	r-cal	P-value
Perceived Ease of use	210	70.77	23.774	.953	0.00
Behavioral intention	210	70.25	23.803		

Table 2 above shows the correlation between lecturers' perceived ease of use on behavioral intention to use assistive technology. The table 2 above revealed that lecturers' perceived ease of use had a mean score of (M= 70.77 and S.D =23.774), behavioural intention had Mean score of (M= 70.25 and SD=23.803), while the r-cal. = .953, indicating there is a strong positive relationship between lecturers' perceived ease of use and their behavioural intention to use assistive technology for teaching, p =(0.00) <0.05. This shows that the hypothesis is rejected. implying that the lecturers' perceived ease of use significantly influence their behavioural intention to use assistive technology. This finding is highlighted using a scattered plot.

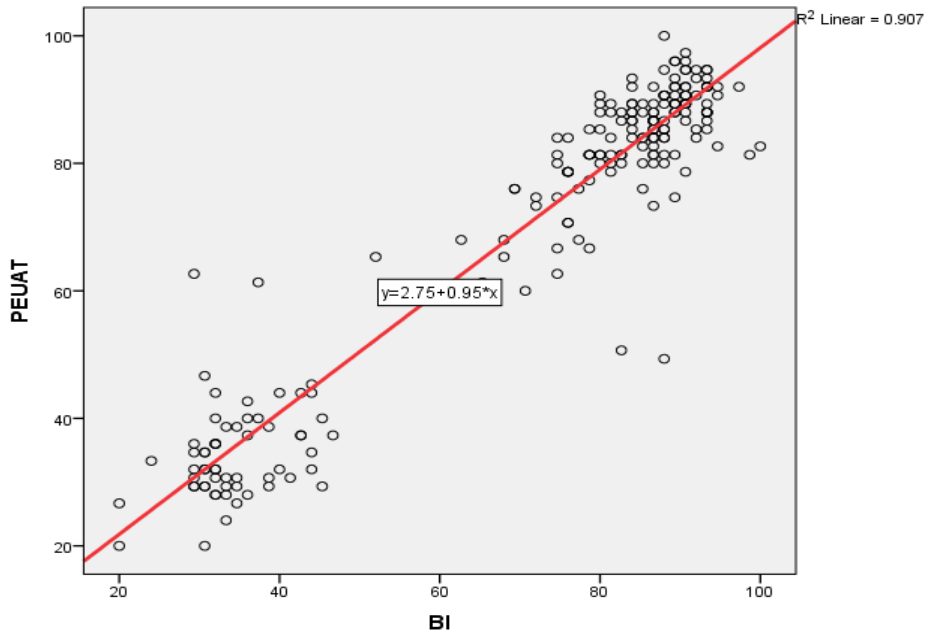

Figure 2: Scattered Plot Relationships between Perceived Ease of Use and Behavioural Intention

Scatterplot of the relationships between perceived ease of use and Behavioural intention. The scattered plot indicates that there seems to be a positive relationship between the two constructs as indicated by the regression line.

Discussion of result

The outcome of this study based on the research question one raised on what is the influence of lecturer's perceived usefulness on behavioral intention to use assistive technology for teaching COE students with special needs; The study revealed that lecturers' perceived usefulness significantly influenced their behavioural intention to use assistive technology. This outcome is in line with the work of Alharbi and Drew (2014) who found out that perceived usefulness of technology has a significant positive-moderate correlation with the attitude of teachers towards using the learning management systems. On a similar study, Fathema *et al.* (2015) found a very strong positive correlation between the faculties perceived usefulness of technology and their attitude towards technology.

On the issue of how lecturer's perceived ease of use influence their behavioral intention to use assistive technology for teaching COE students with special needs as obtained in the research question two, the result of this study unveiled that lecturers' perceived ease of use significantly influence their behavioural intention to use assistive technology with a strong positive correlation between ease of use and behavioural intention. This outcome is in line with Elkaseh, Wong, and Fung's (2016) quantitative study on the perceived ease of use and perceived usefulness of social media for e-learning in Libyan Higher Education, found out that behavioural intention to use social media for e-learning was predicted by perceived ease of use.

Conclusion

Based on the outcomes of this study, the following recommendations were made:

1. That lecturers' perceived usefulness significantly influenced their behavioural intention to use assistive technology.
2. Lecturers' perceived ease of use significantly influence their behavioural intention to use assistive technology.

Recommendations

Based on the outcome of this study, it was recommended that:

1. Government should provide adequate assistive technology devices for teaching students with special ability.
2. Lecturers should ensure consistent use of available assistive technology devices in teaching students with special needs.
3. Lecturers should develop attitude to improvise, utilize and modify assistive technology in teaching students with special needs.

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STEM and TVET for Global Health Challenges

Effects of Colchicine Induced Mutation on the Morphology and Yield of Tomato (*Lycopersicum Esculentum, Mill*)

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Abstract
The effect of colchicine induced mutation on the morphology and yield of two varieties of tomato was investigated with the aim of studying the mutagenic effect of colchicines on tomato(lycopersicum esculentum,Mill). The seeds of two varieties of tomato (Rio Grande and UC82B) were treated with four different concentrations of colchicine (1mM, 2mM, 3mM,4mM and T5 as control). The result obtained revealed there is no significant differences (P≤0.05) in the morphology of Rio Grande variety of tomato on germination percentage, numbers of days to maturity, leaf length, root length, number of leaves, percentage of seedling survival, petiole length, flowering at 50 percent, leaf width and number of fruits per plant. On the other hand the UC82B variety displayedssignificant improvement with leaf length in T2 (2mM) and T4 (4mM).There was also higher root length than in T1 (1mM),T3 (3mM) and T5 (control). Number of leafs did not differ significantly but it was highest and lowest in T2,T3 respectively. The result revealed that colchicine improved important quality traits in tomato with T4 in Rio Grande and T2 in UC82B. However, the response of variety Rio Grande to colchicine was higher in T4. More so, significant differences were observed between the leaf length,root length and number of leaf in UC82B. It was concluded that concentrations of colchicine at 4.0 mM (for Rio Grande)and 2.00Mm (UC82B), improved some traits of these two varieties of tomatoes that could be utilized in the enhancing the quality of tomato vegetable.

Keywords: *Colchicine, Tomato, Mutation, Varieties*

Introduction

Tomato *(Lycopersicon esculentum*, mill) is a popular vegetable consumed all over the world. Tomatoes are consumed either fresh or as processed products (Gary and Tchamitchian, 2001).Tomato belongs to the family Solanaceae, which includes more than 3000 species. Solanum section lycopersicon includes the cultivated tomato, S*olanum lycopersicum*, the only domesticated species, as well as many other wild relative (Kalloon, 2012). Tomato is important for healthy living and is rich in good compounds. In recent decades, the consumption of tomatoes has been associated with prevention of several diseases, such as cancer, maintains healthy blood pressure and reduced glucose in people with diabetes. (Willcox and Sharoni, 2003), mainly due to the antioxidant content.

Tomato is the principal source of lycopene in our diet. The red pigment present in tomato is lycopene. It has healthy properties and is a key carotenoid for human consumption. Regular consumption of tomato in our diet could provide protection against a broad range of epithelial cancers and cardiovascular diseases. Tomato is considered a protective food because of its particular nutritive value, as it provides important nutrients such as lycopene, beta-carotene,

flavonoids, vitamin C, and hydroxycinnamic acids derivatives. Furthermore, this crop has achieved tremendous popularity especially in recent years with the discovery of lycopene's anti-oxidant activities and anti-cancer function(Barone,2014). Consumers have become more sensitive to their health and diet thus food product processors have the opportunity to enlarge the tomato processing industry and establish a market for pharmaceutical grade thereby adding value to tomato production (Thakur *et al.*, 1996).

Improvement in the quality of tomato towards the antioxidants contents and various health factors related to this fruit/vegetable need to be seriously considered. Important characteristics for fresh market cultivar are; for example; long shelf-life, external quality of fruits (such as shape and color) and internal qualities such as flavor and juiciness(George, 2012). Tomato requires a relatively cool, dry climate for high yield and premium quality. However, it is adapted to a wide range of climatic conditions from temperate to hot and humid tropical. The optimum temperature for most varieties lies between 21 and 24 °C. The plants can survive a range of temperatures, but the plant tissues are damaged below 10 °C and above 38 °C.The world production figure of tomato in 2012 was 145.8metric tonnes with China leading with 41.9 metric tonnes.

In Africa, Egypt is the leading producer with the production of 39.5 metric tonnes and Nigeria is the fourth in Africa and leads in the West Africa sub-region with an estimated output of 1.10 metric tonnes and average yield of 10 tonnes ha^{-1}(Faostat, 2012). Increased productivity is attained only when tomato is grown adopting improved varieties and agro-techniques. Tomato is a high yielding vegetable, cultivated all over the world under normal growing conditions and under supervised farming system. The significant feature of this vegetable is its consistent consumption all over the world. Low and declining soil is a major concern in many Africa small holder farms and has been exacerbated by continuous cultivation without adequate soil fertility enhancement measure (Nandwa & Kimani, 2001).

There is no doubt that vegetables are very important in improving the quality of life and economic status of the farmers. This clearly shows that tomato research needs more concentrated research effort to develop and select varieties that are of high yields. A number of researchers have also investigated the usefulness of morphological and physiological parameters as indices of single plant yield. Singh *et al.*, (2002) observed high genetic variation in tomato for plant height, number of days to fruit set, number of fruit clusters per plant, number of fruits per plant, fruit weight per plant and fruit yield per plant. The high genetic variation observed for these traits offer an opportunity for indirect selection for yield in tomatoes.

Mutations are the tools used by the geneticist to study the nature and function of genes which are the building blocks and basis of plant growth and development, thereby producing raw materials for genetic improvement of economic crops (Adamu *et al*., 2004). Induced mutations have great potentials and served as a complimentary approach in genetic improvement of crops (Mehandjiev *et al.*, 2001). Various mutagenic agents are used to induce favourable mutations at high frequency that include ionizing radiation and chemical mutagens (Ahloowalia and Maluszynski, 2001). Induced mutations have been used to improve major crops such as wheat, rice, barley, cotton, peanut and cowpea. A number of workers (Coe and Neuffer, 1977; Mashencov, 1986; Ricardo and Ando, 1998, Oiejniczak and Patyna, 1985) have reported on the role of chemical mutagens in enhancing variability in higher plants. The mutants so produced facilitate the isolation,

identification and cloning of genes used in designing crops with improved yields, increase stress tolerance, longer shelf life and reduced agronomic input (Ahloowalia and Maluszynski, 2001).

Tomato suffers from several problems that include high disease incidence, pest infestations and adverse effect of environmental stress which greatly affects it production The aim of this paper is to study the mutagenic effect of colchicine on tomato (*Lycopersicumesculentum*, Mill) with the view of selecting improved genotype for increased tomato production. The paper intends to determine the effect of different concentration, morphology and yield on tomato plants treated with colchicines. The importance of the plant is mostly centered upon its edible fruits (Mann *et al*., 2003).The fruit contains B complex vitamins, thiamin, niacin and riboflavin which are important in a healthy diet.

Study Site
The study was conducted in agricultural farm, Federal College of Education, Zaria in April, 2020.

Source of the Seeds
Dry seeds of tomato (*Lycopersicon esculentun* Mill), varieties Rio grande and UC82B were obtained from the Institute of Agriculture Research, Ahmadu Bello University, Zaria, Nigeria and treated with colchicine at concentrations of 1.0mM, 2.0mM,3.0mM and 4.0mM.

Mutagenic Treatment
Matured air dried seeds of tomato were pre-soaked in distilled water for five hours after which the seeds were removed and properly air dried. Ten(10) number of tomato seeds, were then treated using various concentrations of colchicine. The seeds of the tomato variety was treated with five different concentrations of Colchicine (1.0mM, 2.0mM, 3.0mM, 4.0mM and 0.0mM as control) respectively for four hours. The experiments were carried out at room temperature. The treated seeds, then rinsed thoroughly with distilled water and partly air dried.

Preparation of Soil for Planting
The treated seeds were planted in polythene bags, 5kg of soil mixed with 1kg of poultry dropping, each replication having 75kg of soil and 15kg of poultry dropping the two varieties with 150kg of soil and 30kg of poultry dropping. The two varietieshave the total of 180kg of both soil and poultry dropping, each bag having 6kg and ten seeds planted in each bags. After germination then 5 plants per bag, after 4 weeks 3 plants were uprooted for chromosome analysis, shoot and root observation. After the post treatment washing, the seeds were partially air dried and then planted in bags. The research was conducted during the dry season with irrigation twice a day. The treated plants were grown in 45 polythene bags arranged in a Completely Randomized Design (CRD) with three repetitions.

Data Collection
Data was collected based on the following parameters:

A. Germinating percentage
B. Number of days to maturity
C. Seedling survival
D. Number of leaf
E. Leaf length

F. leaf width
G. Plant height
H. Petiole length
I. Root length
J. 50%. Flowering
K. Number of Fruits per plant
L. Number of fruits in Weights (g)
M. Size of the Fruits (cm)

Statistical Analysis
The data obtained would be subjected to analysis of variance (ANOVA) and where significant, ($P<0.05$) Duncan's multiple range test (DMRT) would be used to separate the means.

Results
Variety Rio Grande
The morphological parameters of Variety Rio grande for various treatments are shown in Table 4.1. There was no significant difference ($p>0.05$) in the morphological measurement of Variety Rio Grande within the treatment. However, at day 5, T2 (1.33) was the highest, while T1 and T5 with 0.33 each the lowest. Similarly, at day 8, T2 (10.00) had higher value, while T1 and T5 had 8.67 each was the least. Leaf length in T4 (7.73) had higher measurement and T1 (4.13) had the lowest. Similarly, root length in T4 (1.99) and T1 (1.44) was highest and lowest respectively. Percentage seedling survival (PSS) was 100% in T2 and 86.67% each in T1 and T5. Treatment 4 (9.00) had the highest petiole length (PL), while T1 (4.00) had the lowest. Flowering at 50% was highest at TT2, T3, T4 and T5 with 28.67, while T1 had 28.33.Leaf width (LW) in T4 (3.83) was widest, while T1 (2.40) had the least. Treatment 1 (68.33) had the highest number of days to maturity (NDM), while T4 (61.33) had the lowest NDM. Treatment 3 (20.00) had the highest number of fruit per plant (NPF), while T1 (12.67) had the least.

Table 4.1: Variety Rio Grande

	Treatment					
Parameter	T1	T2	T3	T4	T5	P-value
D5	0.33±0.33	1.33±0.33	0.67±0.67	0.67±0.67	0.33±0.33	0.481ns
D8	8.67±0.67	10.00±0.00	9.33±0.33	9.67±0.33	8.67±0.67	0.249ns
LL	4.13±0.87	5.23±1.25	5.10±1.27	7.73±2.53	4.73±1.80	0.608ns
RL	1.44±0.16	1.58±0.26	1.75±0.08	1.99±0.30	1.59±0.19	0.459ns
NL	18.00±4.16	16.67±0.67	30.00±10.58	20.00±4.16	16.33±2.96	0438ns
PSS	86.67±6.67	100.00±0.00	93.33±3.33	96.67±3.33	86.67±6.67	0.249ns
PL	4.00±0.96	5.77±2.12	5.53±0.88	9.00±2.80	5.63±1.89	0.526ns
F50	28.33±0.33	28.67±0.33	28.67±0.33	28.33±0.33	28.67±0.33	0.871ns
LW	2.40±0.45	3.03±0.83	2.53±0.59	3.83±1.25	2.43±0.84	0.717ns
NDM	68.33±2.73	67.67±2.60	62.00±1.00	61.33±1.20	66.00±4.16	0.266ns
NFP	12.67±1.76	14.33±0.88	20.00±4.16	17.33±3.53	14.67±2.33	0.424ns

Variety U.C. 82B

Table 4.2 shows the morphological variation of Variety U.C. 82B that was subjected to different treatments. At day 5 and 8, there was no significant different in germination of the seed. However, germination at day 5 was highest T1 and T5 with 1.33 each, while T2, T3 and T4 had 0.67 each. Germination at 8 was highest in T2 and T3 with 9.67 each, while T4 (8.67) had the least. Leaf length in T4 (6.40) was highest, while T5 (4.17) had the lowest. Treatment 2 (2.30) and T4 (2.40) had significantly ($p \leq 0.05$) higher root length than T1 (1.72), T3 (1.75) and T5 (1.67). Number of leaf did not differ significantly but it was highest and lowest in T2 (33.67) and T3 (17.67) respectively. Percentage seedling survival was highest in T2 and T3 with 96.67%, while T4 (86.67%) had the lowest but did not differ significantly ($p > 0.05$). The PL T2 (13.50) and T4 (14.57) did not differ significantly ($p > 0.05$) but were significantly higher ($p \leq 0.05$) than T1 (5.47), T3 (6.43) and T5 (6.07). There was significant different ($p \leq 0.05$) in 50 days to flowering with T5 (23.00) having significantly more days than T2 and T4 with 22.00 each. The LW at T2 (3.53) and T4 (3.23) were significantly higher than T5 (1.53) but were in comparison to T1 (2.40) and T3 (1.93). The NDM in all the treatments did not differ significantly, however, T5 (56.00) had higher NDM; while T2, T3 and T4 had 51.33 each had the least.The NFP in T2 (19.67) and T4 (20.00) were significantly ($p \leq 0.05$) higher than NFP in T1 (11.67), T3 (13.67) and T5 (12.00).

Table 4.2: Variety U.C. 82B

	Treatment					
Parameter	T1	T2	T3	T4	T5	P-value
D5	1.33±0.88a	0.67±0.33a	0.67±0.33a	0.67±0.67a	1.33±0.88a	0.871ns
D8	9.33±0.67a	9.67±0.33a	9.67±0.33a	8.67±0.67a	9.33±0.67a	0.713ns
LL	6.30±1.10a	6.30±1.42a	3.30±0.20a	6.40±0.81a	4.17±1.32a	0.190ns
RL	1.72±0.07b	2.30±0.17a	1.75±0.08b	2.40±0.20a	1.67±0.10b	0.006s
NL	23.00±4.04a	33.67±8.37a	17.67±0.88a	30.33±6.89a	19.67±4.26a	0.261ns
PSS	93.33±6.67a	96.67±3.33a	96.67±3.33a	86.67±6.67a	93.33±6.67a	0.713ns
PL	5.47±0.63b	13.50±3.90a	6.43±0.64b	14.57±2.03a	6.07±1.67b	0.028s
F50	22.67±0.33ab	22.00±0.00b	22.67±0.33ab	22.00±0.00b	23.00±0.00a	0.024s
LW	2.40±0.42ab	3.53±0.82a	1.93±0.09ab	3.23±0.58a	1.53±0.20b	0.078ns
NDM	53.67±2.33a	51.33±2.33a	51.33±2.33a	51.33±2.33a	56.00±0.00a	0.452ns
NFP	11.67±0.33b	19.67±2.33a	13.67±0.33b	20.00±1.00a	12.00±3.00b	0.014s

Treatment comparison of in morphological differences between Variety Grande and Variety U.C. 82B is shown in Table 4.4. For T1, all the morphological parameters did not differ significantly ($p>0.05$) except 50% number of days to flowering where Variety Grande (28.33) was significantly ($p\leq0.05$) higher than Variety U.C. 82B (22.67). Similarly, at T2, Variety Grande (28.67) had significantly higher 50% number of days to flowering than Variety U.C. 82B (22.00). There was similar trend in T3 with Variety Grande (28.67) had significantly higher 50% number of days to flowering than Variety U.C. 82B (22.67). The 50% number of days to flowering and NDM were significantly higher ($p\leq0.05$) in Variety Grande. The F50 in Variety Grande was 28.33, while Variety U.C. 82 had 22.00; NDM in Variety Grande (61.33) was also higher than Variety U.C. 82B (51.33). Treatment 5 did not differ significantly in other morphological measurements except for F50 where Variety Grande (28.67) had significantly higher ($p\leq0.05$) value than Variety U.C. 82B (23.00).

Table 4.4: Comparison between Variety Grande and U.C. 82B based on Concentrations

		Parameters										
Treat	Variety	D5	D8	LL	RL	NL	PSS	PL	F50	LW	NDM	NFP
T1	Grande	0.33± 0.33	8.67± 0.67	4.13± 0.87	1.44± 0.16	18.00± 4.16	86.67± 6.67	4.40± 0.96	28.33 ±0.33	2.40±0 .45	68.33 ±2.73	12.67 ±2.33
	UC 82B	1.33± 0.88	9.33± 0.67	6.30± 1.10	1.72± 0.07	23.00± 4.04	93.33± 6.67	5.46± 0.63	22.67 ±0.33	2.40±0 .42	53.67 ±2.33	11.67 ±0.33
	P-value	0.478	0.667	0.287	0.340	0.588	0.667	0.553	0.003	1.000	0.070	0.678
T2	Grande	1.33± 0.33	10.00 ±0.00	5.23± 1.25	1.58± 0.26	16.67± 0.67	100.00 ±0.00	5.77± 2.12	28.67 ±0.33	3.03±0 .83	67.67 ±2.60	14.33 ±0.88
	UC 82B	0.67± 0.33	9.67± 0.33	6.30± 1.42	2.30± 0.17	33.67± 8.37	96.67± 3.33	13.50 ±3.90	22.00 ±0.00	3.53±0 .0.82	51.33 ±2.33	19.67 ±2.33
	P-value	0.423	0.423	0.617	0.142	0.198	0.423	0.267	0.002	0.684	0.077	0.150
T3	Grande	0.67± 0.67	9.33± 0.33	5.10± 1.27	1.75± 0.08	30.00± 10.58	93.33± 3.33	5.53± 0.88	28.67 ±0.33	2.53±0 .59	62.00 ±1.00	20.00 ±4.16
	UC 82B	0.67± 0.33	9.67± 0.33	3.30± 0.20	1.75± 0.08	17.67± 0.88	96.67± 3.33	6.43± 0.64	22.67 ±0.33	1.93±0 .09	51.33 ±2.33	13.67 ±0.33
	P-value	1.000	0.423	0.293	1.000	0.331	0.423	0.574	0.004	0.471	0.085	0.248
T4	Grande	0.67± 0.33	9.67± 0.33	7.73± 2.53	1.99± 0.30	20.00± 4.16	96.67± 3.33	9.00± 2.80	28.33 ±0.33	3.83±1 .25	61.33 ±1.20	17.33 ±3.53
	UC 82B	0.67± 0.67	8.67± 0.67	6.40± 0.81	2.40± 0.20	30.33± 6.89	86.67± 6.67	14.57 ±2.03	22.00 ±0.00	3.23±0 .59	51.33 ±2.33	20.00 ±1.00
	P-value	1.000	0.225	0.720	0.491	0.430	0.225	0.323	0.003	0.764	0.049	0.601
T5	Grande	0.33± 0.33	8.67± 0.67	4.73± 1.80	1.59± 0.19	16.33± 2.96	86.67± 6.67	5.63± 1.89	28.67 ±0.33	2.43±0 .84	66.00 ±4.16	14.67 ±2.33
	UC 82B	1.33± 0.88	9.33± 0.67	4.17± 1.32	1.67± 0.10	19.67± 4.26	93.33± 6.67	6.07± 1.67	23.00 ±0.00	1.53±0 .20	56.00 ±0.00	12.00 ±3.00
	P-value	0.423	0.423	0.390	0.615	0.130	0.423	0.377	0.003	0.309	0.138	0.157

Conclusion

This work was to test the effect of mutagen as a means of generating variation and useful traits in two varieties of tomatoes. Colchicine have been proved to be valuable agents in induction of beneficial mutation, the result showed that, there were superior performances in 4.0mM concentration than the others including the control T5 in Rio Grande variety, which showed better performance with respect to germination, leaf length, root length, petiole length and leaf width in Rio Grande variety.

U.C82B variety the result showed that there was superior performance in 2.0mM concentration than the others including the control T5 which showed better performance with the respect for

germination, leaf length, root length, number of leaf, percentage of seedling survival, petiole length, 50% flowering, leaf width and number of days of maturity.

Thus 1mM and 4mM concentration of colchicines can be used for induction of beneficial mutants in tomato (*Lycopersicon esculentum*) varieties. Therefore, the use of 1mM and 4mM colchicines is recommended for inducing mutation to create variability and thus increase the possibility of isolating beneficial mutants. Also there is need to conduct the test concurrently with other procedures such as test for disease resistance, test resistance or resistance to environmental stress in order to improve tomato production in Nigeria.

Recommendations

The effect of the mutagen is significant in inducing variability that could be exploited in the improvement of highly important economic crops like tomato. It would be also recommended that since there was a significant improvement in yield, mutants and grafted tomato can be grown all the year round (both during the rainy and dry season) in order to ensure availability of the vegetable in all seasons.

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Offline Remote Learning Package Framework for Secondary School Students During and After COVID-19 Pandemic in Nigeria

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Abstract

About 1.37 billion students were out of schools, representing almost 80% of the global students' population with 3 out of 4 individuals/students alongside almost 60.2 million teachers not being able to go to school as of 24thMarch 2020 due to the global Covid-19 pandemic. This makes conventional teaching and learning unsustainable during the pandemic in Nigeria and other parts of the world. Many schools (including secondary schools) during the covid-19 pandemic were not able to provide all basic educational services and classroom activities in the same ways they used to offer before the pandemic. Schools' administrators and government educational authorities were admonished to go for remote learning which is mostly online, though students from wealthy backgrounds embraced remote learning compared to those from lower backgrounds who have no adequate access to the online devices and connectivity from homes. Lack of digital educational resources and devices, technical expertise, economic hardship, students' socio-economic status, dilapidated facilities, poor online connections among others makes it difficult for Nigeria to fully utilise online remote learning from homes. This calls for the need to look at this issue from a Nigerian point of view by proposing an offline remote learning package framework for secondary school students in the post-Covid-19 Pandemic in Nigeria which this proposed framework seeks to address.

Keywords: Offline Remote Learning Package, Secondary Schools, Students and Post Covid-19

Introduction

The latest global pandemic is Covid-19. It is an acute respiratory syndrome coronavirus which is an airborne, infectious disease and contagious respiratory illness that spreads from one person to another. It can be contacted through coughing or sneezing by an infected person or from one person to another through touching a surface that an infected person coughed or sneezed or by being too close to the infected person (Nigeria Centre for Disease Control, 2021). Basic information about the mode of its transmission and features is still changing. Covid-19 first emergence was in December 2019 in Wuhan city of Hubei province in China, which was strongly connected to Huanan Seafood Market (South China) that led to thespread of thedeadly infection to China, Europe and later to other parts of the world (Hafeez, Ahmad, Siddqui, Ahmad, & Mishra, 2020; Mulenga & Marbán, 2020). Up to 26 February 2020, several cases have been reported in other parts of the world outside China as a result of travelling (Bedford et al., 2020). The fear of spreading the disease in public places led to almost global schools' closure. Students, teachers and schools' administrators were forced to stay at home. In Nigeria, the issue is still the same. The Federal Government of Nigeria also banned all large gatherings of people as a precautionary measure. This action led to the closure of all educational institutions.

About 1.37 billion students were out of schools, representing 80% of the global studentpopulation with 3 out of 4 individuals/students alongside almost 60.2 million teachers not being able to go to school as of 24thMarch 2020 (UNESCO, 2020). Education waspartly or wholly interrupted. The disruption of the educational system led to the interruption of teaching and learning, homeschooling burden on parents, practising forceful online distance learning, high economic costs on parents' expenditure, increased pressure in schools from educational authorities, dropout cases, home violence, social physical distancing and isolations unaccredited home learning etc. (Ali, 2020; Cheng, 2020; UNESCO, 2020a). This makes conventional teaching and learning unsustainable during the pandemic.

Many schools (including secondary schools) during the covid-19 pandemic were not able to provide all basic educational services and classroom activities in the same ways they used to offer before the pandemic. Schools administrators and government educational authorities were admonished to go for TV/ radio instructions as well as onlineremote learning (Ali, 2020; Asanov, Flores, McKenzie, Mensmann, & Schulte, 2020; Chandler, 2020; Cheng, 2020; Cullinane & Montacute, 2020; GÜZel, Yildiz, EsentaŞ, & Zerengök, 2020; Huber & Helm, 2020; Mulenga & Marbán, 2020; Reich et al., 2020; Sá & Serpa, 2020; Safi, Wenzel, & Lee-Anne, 2020; Sullivan et al., 2020; Yao, Rao, Jiang, & Xiong, 2020; Young & Donovan, 2020; Zayapragassarazan, 2020). Remote learning at this time turns out to be one of the effective strategies to sustain teaching and learning during the pandemic. Remote learning is a technological platform that allows for educational instruction and learning outside the normal classroom (Zhao, Zhou, Liu, & Liu, 2020). It is an instructional strategy where students actively learn and directly participate using technological digital devices outside the classroom on a real-time basis or using the recorded educational resources. Some schools around the world during the outbreak had adopted the onlineremote learning classes using digital resources, internet connectivity and electricity. This educational approach is less risk of infection, safe, comfortable and also helps in preventing students from experiencing setbacks and ensures equity among students, real-time communication and student-centred instruction (Morgan, 2020).

Remote learning Instruction can be done using a laptop, desktop computer, tablet or mobile phone with strong internet connectivity, access, speed for those who can afford it, making students from wealthy backgrounds embrace online remote learning compared to those from lower socioeconomic status. It was reported in a study that 15% representing more than a third of students have no adequate access to the online device from homes, compared to only 2% in the private schools as complained by their teachers (Cullinane & Montacute, 2020). They also found that 12% of less privileged students felt of not having adequate internet access while those opportune, burdened their parents with incurring more cost for remote learning since the lockdown. In Nigeria particularly, there are inadequate online or digital educational resources across all levels of public schools. Teachers lack therequired training, skills, competencies, equipment, digital resources, building, effective and efficient online connections, for online remote learning (Huber & Helm, 2020; Sá & Serpa, 2020; Young & Donovan, 2020). Migrating to remote learning has shown the extent of educational facilities deficiencies in (public) schools (Young & Donovan, 2020)

Several researchers around the world strived harder toward seeing how effective online remote learning can be sustained to address the issue of school closure during the Covid-19 pandemic. Eventually, studiesrecently conducted on remote learning during the Covid-19 pandemic were

mostly from the USA (Bayham & Fenichel, 2020; Chandler, 2020; Reich et al., 2020; Safi et al., 2020), European countries (GÜZel et al., 2020; Huber & Helm, 2020; Mulenga & Marbán, 2020), Ecuador (Asanov et al., 2020), China (Yao et al., 2020) and none were found from Nigeria. Almost all the recent studiespaid more attention totertiary institutions as found in the work of Alade (2020); Ali (2020); Bayham and Fenichel (2020); Huber and Helm (2020); Mulenga and Marbán (2020); Reich et al. (2020); Safi et al. (2020) and few others were centred at secondary schools (Asanov et al., 2020; Chandler, 2020; Yao et al., 2020). Despite having some at the secondary schools' level, all the studies focused only on online remote learning in schools (Alade, 2020; Ali, 2020; Blake, Bermingham, Johnson, & Tabner, 2020; Chandler, 2020; Cullinane & Montacute, 2020; Huber & Helm, 2020; Reich et al., 2020; Yao et al., 2020) or laying more emphasis on affordable families and parents' qualifications toward supporting their children to using remote learning during the pandemic (Cullinane & Montacute, 2020).Other researchers reported a lack of extensive research on local access, equity issues (Safi et al., 2020) and offline development, validation and testing of instructional packages (Mansur, Babawuro, & Magnus, 2019).

However, it can be inferred that the development procedures, validation and reliability details of the online remote learning packages recently used during the pandemic from the aforementioned studies were completely limited or missing, which this study seeks to bridge the existing gaps in the literature by considering offline remote learning packages as one of the variables missing from the previous studies which will also address local issues of access and equity among students from different backgrounds with no need for internet connectivity before or during learning. In this regard, this write-up aimed at proposing a conceptual framework for the development, validation and testing of the efficacy of offlineremote learning packages on secondary school students' achievement in the post-Covid-19 Pandemic in Nigeria.

Statement of the Problem

Educational institutions not only in Nigeria faced a drastic setback due to schools' closure as a result of the Covid-19 global pandemic. School's closure disrupted the learning process and other vital schools' services. About 1.37 billion students were estimated to be affected worldwide in response to the pandemic (UNESCO, 2020b). In Africa, almost all students were asked to stay at home and schools close down. In Nigeria, about 40 million students were affected during the nationwide lockdown, of which 91% per cent were primary and secondary school students due to the pandemic that resulted in schools' closure (Obiakor & Adeniran, 2020). Education waspartly or wholly interrupted in Nigeria with only a few private tertiary institutions running online remote learning classes from home.

Lack of digital educational resources and device, technical expertise, economic hardship, students' socio-economic status, dilapidated facilities, poor online connections among others makes it difficult for Nigeria to fully utilise remote learning from homes. Efforts were made to test the effectiveness and efficiencies of remote learning around the world but were mostly from countries outside the African continent and they paid more attention to online learning intertiary institutions as found in the work of Alade (2020); Ali (2020); Bayham and Fenichel (2020); Huber and Helm (2020); Mulenga and Marbán (2020); Reich et al. (2020); Safi et al. (2020) and limited studies were conducted at secondary school level (Asanov et al., 2020; Chandler, 2020; Yao et al., 2020), apart from local access, equity issues as well as lack of offline packages, absence of detail information on the effectiveness of the development, validation and testing of the existing

instructional packages which this proposed framework seeks to bridge the gap and seeks to develop, validate and test the efficacy of offline remote learning package on secondary school students' achievement in post-Covid-19 Pandemic in Nigeria.

Scope of the Framework

The proposed framework will concentrate on all three levels of Senior Secondary (SS) school students in Nigeria, SS1 to SS3. This comprised of the Commercial and Art's students also known as the Humanities and Business students. These are field of studies at the senior secondary school level that requires very little or no practical at all compared to Science and Technical students that need to undergo direct and physical practice in the laboratories or workshops periodically. The senior secondary section was selected because they are those on the verge of completing secondary school who need extra classes or lessons for their final standardise examination. The specified students to be subjected to the experiment will only learn using the developed offline remote learning package outside the schools' environment. The proposed framework is further limited to a home learning strategy with no need for internet connectivity. Secondary students not studying in Nigeria are automatically excluded.

Literature Review

Theoretical Framework

The conceptual framework is informed by the theory of Interaction Multimedia Computer Assisted Instruction (IMMCAI) and TransactionalDistanceTheory (TDT). The Theory of Interaction Multimedia Computer Assisted Instruction (IMMCAI) was developed in 2008 by (Trirathanakul et al., 2008). It is an essential theory that guides the development, testing and evaluating the efficacy of any application to be used for teaching and learning using a computer, graphic display, imaging, animation, audio, sequential instruction, logical judgement, questions and assessment. Trirathanakul et al. (2008) posit five stages for the development of CAI packages namely: Analysis Stage; Design Stage: Development Stage: Implementation Stage and Evaluation Stage. Appropriate subjects and topics based on the curriculum content and behavioural objectives must be chronologically arranged in line with the provision of IMMCAI theory. IMMCAI theory helps in promoting students' participation, independent learning, less teacher's intervention, and a supplement to the conventional face to face instruction (Saidu, Dahiru, & Muhammad, 2019).

The second theory is the TransactionalDistanceTheory (TDT). The TDT theory was in existence since 1972 and was developed by MooreMichael Grahame (Moore & Diehl, 2019). He posits that TDT came about as a result of the increased numbers of students who cannot or will not be able to participate in the conventional classrooms and chose to learn without much intervention from their teachers. TDT theory advocates for highlystructured instruction with minimalteacher-student interaction (Moore & Diehl, 2019; Saba, 2016). The distance between the student and the teacher is not a geographic difference that can be measured but a psychological distance that varies in terms of three constructs: autonomy, structure, and autonomy (Moore & Diehl, 2019; Saba, 2016). According to Moore and Diehl (2019) dialogue based on the theory is the level at which an educational program, student and instructor can respond to each other based on the educational content or subject matter. The structure represents the educational program's openness to a student's needs based on the designed educational objectives, teaching strategies, and evaluation approaches while Autonomy is seen as the degree to which students decide on what to learn, how to learn and when to learn. Students at this level tend to define their own learning goals and pursue

the defined goals on their own emotional (i.e., self-struggling without seeking guarantee, affection or anyone's approval) and instrumental (i.e., independent learning without seeking anyone's help) (Moore & Diehl, 2019; Saba, 2016)

The two theories are essential to this proposed framework in two different ways. The IMMCAI theory is pivotal to this proposed framework as it provides insight and guidelines on the stages to be followed to prepare, assemble, design, develop and evaluate a computer-based instructional package for teaching and learning. At the same time, the TDT theory is essential to this proposed framework as it provides the guide on using an online or offline package by the students independently with little or no teacher's intervention at all. The combination of these two theories paves the way to be followed in the development, validation and testing of the efficacy and effectiveness of the remote learning package for students to use independently at their phases and time during and after the Covid-19 pandemic.

Covid-19:

The Concept

An epidemic is an outbreak of a disease that spreads rapidly and affects many people at the same time, municipal, environment or several countries (Bedford et al., 2020). They asserted that when an epidemic is widely spread to the whole country or spreading to other countries, then it is considered at that stage to being a pandemic and will require a quick response by thenational public health authorities. The latest global pandemic is the Covid-19, by the novel coronavirus SARS-CoV-2 virus that was discovered and reported in Wuhan, China (Sá & Serpa, 2020). Covid-19 is an acute respiratory syndrome coronavirus which is an airborne, infectious disease and contagious respiratory illness that spreads from one person to another. Knowledge of its transmission and features is still changing and the prediction models are not effectively reflecting the socioecological realities (Bedford et al., 2020; Cabore et al., 2020).

Covid-19 Impact of on Education (Secondary level)

Many schools (including secondary schools) during the covid-19 global emergency were not able to provide all essential educational services and classroom instructions in the same ways they used to provide due to safety measures or fear of spreading the virus within their institution of learning (Huber & Helm, 2020; Sá & Serpa, 2020; United States Department of Education, 2020; Yao et al., 2020; Zayapragassarazan, 2020). Education wascompletely interrupted, shutdown and schools were admonished to go for online education or remote learning instruction (Ali, 2020; Asanov et al., 2020; Chandler, 2020; Cheng, 2020; Cullinane & Montacute, 2020; GÜZel et al., 2020; Huber & Helm, 2020; Mulenga & Marbán, 2020; Reich et al., 2020; Sá & Serpa, 2020; Safi et al., 2020; Sullivan et al., 2020; Yao et al., 2020; Young & Donovan, 2020; Zayapragassarazan, 2020).

The disruption of the educational system during the pandemic resulted in interruption of learning, absence of school feeding programmes, mix-up and stress for teachers, home school burden on parents, sustaining distance learning, issues in childcare, high economic costs on parents spending, increased pressure in schools from educational authorities, rise in dropout cases, home violence, social distance and isolations, issues of validity and reliability of home learning etc. (Ali, 2020; Cheng, 2020; UNESCO, 2020a). Students' progress had drastically fallen behind the previous conventional teaching program before school lockdown during the outbreak due to the confusion of is ambiguity and disagreement about what to teach when to teach, how to teach, whom to teach

andwhere to teach (Ali, 2020; Sullivan *et al.*, 2020). Bayham and Fenichel (2020) argue that prolonged school closures may lead to an increase in drop-out rates and future schools' earnings. So also, they observed that school closures come with many interchanges to the school administrators, and can create unplanned child-care obligations. The school closure left an adverse social and economic burden on the parents and the general society at large (UNESCO, 2020a). Teachers and parents are struggling to provide an enabling environment for students to continue enhancing their educational opportunities during the Covid-19 pandemic. Some educators became reluctant toward providing distance learning instruction over the provision of the law that makes it difficult to run remote education (United States Department of Education, 2020).

Remote Learning:

The Concept of Remote Learning

Remote learning is a technological platform that includes all the hardware computing facilities required for educational instruction and learning outside the normal classroom (Zhao et al., 2020). It is an instructional strategy where students actively participate in the learning process and engage with teachers and colleagues using technological devices outside the classroom, mostly from homes (Teals Program, 2020). It requires a learning system designed for students to log in and patriciate on a real-time basis or use the recorded educational resources. It also provides the teacher and the students the same experiences depicted in the classroom using effective learning management systems andan audio/video meeting space (Teals Program, 2020). The learning management system is used to plan, deliver, and manage the learning content which may include images, documents, figures, chats, videos, learning objectives/ activities, and assessments among others (Teals Program, 2020). Remote learning is seen as a part of distance learning more especially where studentsindependently work, learnand access the educational resources while the teacher only facilitates the learning process (Saba, 2016).

The Benefits of Remote Learning

Many schools around the world in response to schools' closure and the Covid-19 outbreak had implemented remote learning educational approaches that can prevent students from experiencing setbacks (Morgan, 2020). Remote learning when properly implemented ensures equity among students, real-time communication and student-centred instruction (Morgan, 2020). Remote learning allows students fromthe online classroom to study from their homes using digital resources, internet connectivity and electricity on a real-time basis or from recorded instruction with fewer teachers' exhaustion (Mulenga & Marbán, 2020).

Remote learning compared with conventional instruction comes with some benefits including less risk of infection, safety adherence, comfortability,ease of using microphones, video, screen-sharing, recording of instruction for subsequent usage, no cost of transportation, more control andconcentration, no issue of class congestion, ease of disseminating of information and educational materials, chatting opportunity with instructors, ease of joining and leaving educational sessions, less anxiety and distraction, use small area, no obstruction of view and ease of tracking attendance (Kwon, Zhang, & VandenBussche, 2020; Zhao *et al.*, 2020). It also promotes student'sequity and the opportunity to read screens and materials, write and chat, discuss, ask questions, get feedback, solve problems and analyse issues on a real-time basis (Reich *et al.*, 2020; Zayapragassarazan, 2020; Zhao *et al.*, 2020).

Facilities for Using Remote Learning

Effective remote learning depends on teachers' technological experience in online engagement with students and the use of education equipment and software such as real-time broadcasting and videoconferencing software (Kwon *et al.,* 2020; Zhao *et al.,* 2020). Itis only effectiveoutside the classroom settings where and whenstudents have access to the hardware devices, software, and internet connectivity with speed and bandwidth as well as protecting students' data as provided by the law (Teals Program, 2020).

Using remote learning to interact with students during lockdown is vital, mostly via internet platforms likee-mails, online phone calls or via social media tools such asWhatsApp, Twitter, YouTube, Facebook, Instagram, Yahoo at the same time enabling students accessing learning materials via educational applications and resources like Zoom, Google Meet,Podcasts, Google Docs, Google Classroom,MOOC,video conferencing platforms, online course resources, theme website resources, Microsoft Teams,Google drive, periodicals resources, Seewo whiteboard, dropbox, cloud, Online field trips (VFTs), professional training resources,Testmoz, Voxvote, Google Forms, Seewo EN5,ClassMarker, Moodle Cloud, Edmodo, and related instructional sites like Simple Scripts, Colrd, Inkscape and Sketchpad (Ali, 2020; Morgan, 2020; Mulenga & Marbán, 2020; Sá & Serpa, 2020; Yao *et al.,* 2020; Zayapragassarazan, 2020; Zhao *et al.,* 2020). Other learning management systems include 'Agilix Labs, Blackboard, Desire2Learn, Moodle and Pearson Learning Solutions, Pearson Online Learning Exchange and Haiku Learning' (Young & Donovan, 2020, p. 2). Some countries moved further to launch digital textbooks, video resources, educational television programmes, interactive radio instruction and radio channelsfor remote learning especially for the marginalised communities (Cheng, 2020; World Bank, 2020).

In line with the availability of and accessibility of learning management systems, more than three-quarters of educated parents with higher degrees were reported to be confident about their children's remote learning, compared to less than half of parents with 'A' level or secondary qualifications (Cullinane & Montacute, 2020). Parents with a higher degree are seen to embrace online and remote learning compared to those with lower qualifications. Over half of secondary teachers recommend the provision of technological remote learning devices, stationery and curriculum resource packages to meet up with the disadvantaged students and carry them all alone (Cullinane & Montacute, 2020). Teachers are confident to embrace remote learning when provided with technological resources to continue their teaching activities (Ali, 2020).

On the use of digital devices for e-learning, a large number of the students were reported to have access to mobile phones and used them for browsing, texting, logging into social media sites and applications in addition to communicating with it (Ali, 2020). Sá and Serpa (2020) reported that 71.5% of Portuguese households have a computer with Internet connective, leaving behind one in every four of its citizens not having a computer at home while Asanov *et al.* (2020) reported 59% of students in Ecuador having both internet connection, computer or tabletat home with 74% participating in online or teleconferencing education. Caution ought to be observed for remote learning because prolong screen time could lead to 'headache, blurred vision, dry eye, and other physical health problems (Morgan, 2020, p. 136).

Digital learning requires students' self-regulatory skills during school closure (Huber & Helm, 2020). In that regard, the Chinese government has adopted a measure for home study during the

pandemic which is the "School's Out, But Class's On" technique that allows for the suspension of classes and continuation of learning via online learning instruction for students and turns out to be the largest online instruction having tens of millions of teachers and students in the world (Cheng, 2020; Yao *et al.,* 2020). This, in turn, attracted 2.28 million instructors, 3.14 million online courses gathered and 17,312 lessons recommended for the scheme yielding up to nearly 270 million schools running online instruction across all levels of education.

Package: Development, Validation and Testing

Instruction delivery packages or remote learning packages using a computer are mostly programmed on a web-based application using PHP computer language. The web-based application uses a Java Script/JavaFX. JavaScript is an object-oriented programming language that contains data and operations using Java Online Machine (JVM) (Dai, 2019). JavaFX runs on desktops such as Mac, Windows, Linux as well as other embedded devices like the Raspberry and also is positioned to allow the user interface of the Internet of things (IoT) (Bao, 2020; Vos, Chin, Gao, Weaver, & Iverson, 2018). They asserted that it also helps in the development and deployment of high-rich applications on certain devices such as cell phones, TVs, in-dash car systems, and browsers with a simple and stylish user interface (UIs) using a declarative programming style. JavaFX also allows the development and deployment of Android phone application software for iOS and Android OS using Java Modeling Language (JML)is a languageinterface requiredfor softwareprivacy, security and property (Vos *et al.,* 2018).

An Android application can be downloaded and used as an 'ask file zipped from a given remote server using a plug-in which allows the ability to update the content of the application (Bao, 2020). After the development and deployment of the desktop web-based app, Android and iPhone applications, there is the need to create a database to save the information and materials to be used within the app using *PHP*. *PHP* serves as a server-side programming language that is used in creating active Web pages applicable for different operating systems alongside having an *HTML* embedded in it and stores data in databases using *MySQL* (Oracle, 2018).

The development of an effective remote learning package for instruction requires some three components including content (i.e. curriculum, activities, policy or instruction), students' learning profile, current position and need (i.e. knowledge, skills, habits, background, interests, environment and psychosocial condition strengths and weaknesses) and lastly sequential learning design and implementation (i.e. creative,flexible, methodology, inclusive learning, professional, emotional and technical support) (Tan-Choi *et al.,* 2020). Content development is based on public interaction activities, and its evaluation requiring pre-test and post methods (Blake *et al.,* 2020). He posits that digital learning resource mostly exempts the approval of the ethics committee. Effective remote learning package must be able to clarify tasks and manage users' expectations at the beginning, monitor users' progress, learning, provide real-time feedback and support while using the package and finally, be able to evaluate the users' progress, provide assessment feedback and report on learning at the end (Tan-Choi *et al.,* 2020). Some proposed stages are available in Figure 3.

Teaching and Learning using Remote Package

A teacher using a remote learning package must consider the resources available to them and their students. Structuring remote learning depends on the content to be taught, the student's level,

teachers' capabilities and available educational resources in line with a standard curriculum, essential knowledge, skills and environment (Tan-Choi *et al.,* 2020). Learning using remote learning package can be in real-time known as Synchronous Learning where all students login simultaneously andjoin the audio/video package at the same time or Asynchronous Learning where students work, learnand access the educational materials at different times and locations independently (Teals Program, 2020; World Bank, 2020). An effective remote learning package should be able to meet the curriculum requirement, students' learning expectations, assessment and be able to run in both online and offline environments. A proposed sequence is available in Figure 4.

Challenges during Pandemic

It was reported that 15% representing more than a third of students have no adequate access to the online device from home, compared to only 2% in the private schools as complained by their teachers (Cullinane & Montacute, 2020). They further observed that 12% of less privileged students felt of not having adequate internet access while those opportune, left their parents of incurring more cost for remote learning since the lockdown. Many students reported a low level of willingness to learning from home during the school lockdown (Huber & Helm, 2020). Students from fewer family backgrounds were completely distanced from remote learning due to poverty (Asanov *et al.,* 2020).

Given the difficulty in face-to-face instruction, parents, educators, and administrators were encouraged to engage with students using remote learning instruction (United States Department of Education, 2020) though, a large number of people (especially in Africa) have no access to affordable computers, internet connectivity, computing devices and broadband, phones, laptops and tablets at home or school (Mulenga & Marbán, 2020; Reich *et al.,* 2020). In Nigeria particularly, there are unequal and inadequate educational resources in schools that will ensure qualitative education across all levels of public schools as a result of poor funding, inadequate ICT knowledge, government bad attitude towards education, insecurity and corruption in education among others (Alade, 2020; Etor, Ekanem, & Sule, 2020; Mansur *et al.,* 2019). Migrating to remote learning has depicted the extent of resource deficiencies in public schools (Young & Donovan, 2020).

Teachers lack the necessary training, competencies, equipment, digital resources, structure, a concurrent online connection seems tocontribute to unsuccessful remote learning instruction (Huber & Helm, 2020; Sá & Serpa, 2020; Young & Donovan, 2020).Despite the school closure and technical issues, students are expected to learn remote learning tools, even though many schools do not have enough digital resources at the same time not all students have devices and internet access at home (Morgan, 2020; Mulenga & Marbán, 2020; Young & Donovan, 2020). Other remote learning challenges include issues of connectivity resulting in poor image, audio and video, issue of hacking and scamming, poor students' engagement etc. (Kwon *et al.,* 2020).

Secondary School Education and Curriculum Contentin Nigeria:

The attainment of the desired teaching and learning of accounting education within secondary schools, rest largely entirely on the quality of teachers' competencies as well as their pedagogical content knowledge in disseminating effective and efficient knowledge to the learners. One of the

challenges associated with teaching in secondary schools includes evaluating gaps in the learners' knowledge, handling learners' language barriers and classroom management by the teachers.

A Curriculum is a prescriptive, descriptive program or plan of what ought to happen in the course of study (Glatthorn, Boschee, Whitehead, & Boschee, 2019). They also assert that the parts of a curriculum determine the fitting between what is taught and learned. An effective curriculum should have separate sections for content knowledge, pedagogical knowledge, and context knowledge. The Federal Republic of Nigeria (2013), through the National Policy on Education, stipulated that the Curriculum for Junior and Senior Secondary Education shall be as contained in Figures 1 and 2. Usually, an increased range of subject optionsenables students to acquire senior secondary school certificates with one of the National/international examination bodies we have in Nigeria such as JSCE, WAEC, NECO, NABTEB etc.

Remote Learning Package: Curriculum Content Development

Curriculum Content for Junior Secondary School Level

Level	Subjects	Topics	Lessons	Pretest	Instructional Objectives	Structured E– Learning materials	Students Activities	Posttest

Curriculum Content for Senior Secondary School Level

Level	Field of Study	Subjects	Topics	Lessons	Pretest	Instructional Objectives	Structured E– Learning materials	Students Activities	Posttest

Figure 4: Remote Learning Package: Curriculum Content Development Compiled by the Authors

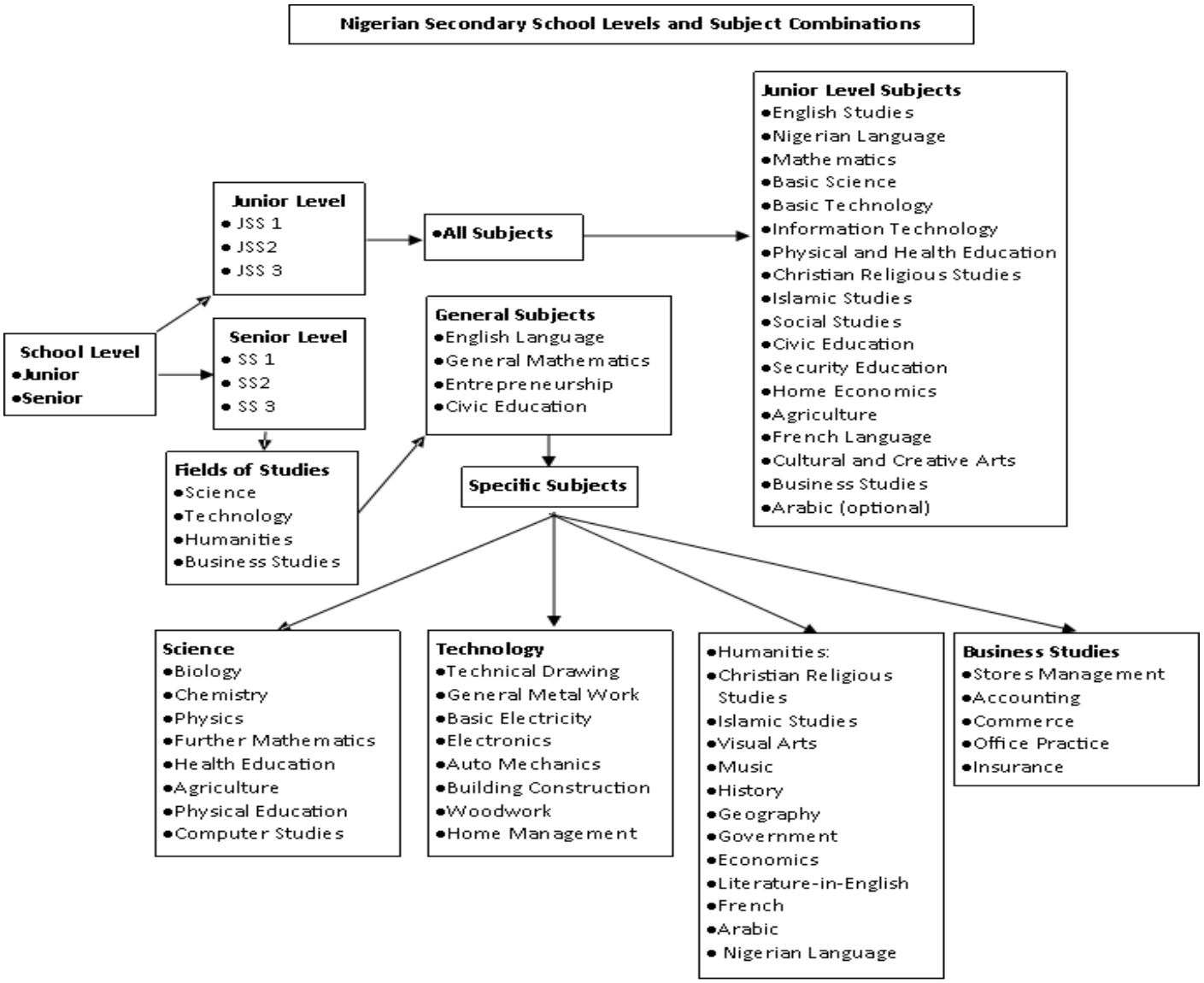

Figure 3: Nigerian Secondary School Levels and Subject Combinations
Source: Compiled by the Authors based on the NPE 2013

Empirical Review

Remote Learning Instruction

Alade (2020) found that show that many experienced teachers were involved in NTI programmes from a selected senatorial district in Nigeria. He found that ICT resources are relatively available for distance learning but inadequate and supervision and monitoring of the curriculum implementation NTI programmes is fairly carried. Ali (2020) found that most universities globally are moving to online learning. He observed that student accessibility and motivation play a significant role in online learning when integrated with resources, staff readiness and confidence. Chandler (2020) observed that male students participate more in remote learning sessions than females' students. He further asserts that male students have less propensity to interact with social media than female students.

Cullinane and Montacute (2020) found that 23% of pupils participating in online instruction daily at middle-class homes representing 30% with 16% at the working class. They further found that 51% of primary and 57% of secondary students participate in online lessons at private schools, doubling their counterparts at public schools in the UK. 60% of private schools and 37% of state schools make use of online teaching and learning platforms with about 45% of students opportune to virtually interact with their teachers in a given week. They further found that 50% of teachers in private schools received more than three-quarters of their work back, compared with 27% in the middle-class schools, and just 8% in the public schools.

Huber and Helm (2020) found that a large number of students reported a disturbingly low level of learning from home during school closure. Staff and school administrators reported a lack of technical and digital resources. Teachers reported low competencies toward the use of digital instruction. Real-time feedback and support during teaching and learning are reported to be key in online learning. The School's method of collaboration promotes the organisation of digital instruction. Students and school administrators reported the highest level of perceived stress compared to school staff with less perceived stress. Similarly, Mulenga and Marbán (2020) found that digital learning could be thebest response to COVID-19 school closure. They also found that teachers are more likely to show low skill levels in the use of digital technology and the use of social media in teaching their subjects during the outbreak. Yao et al. (2020) found that live broadcasting instruction with more teacher-student interaction is more effective than self-study-based recorded video instructionon students' academic performance.

Development and Testing e-package

Blake et al. (2020) developsan e-package to support the psychological wellbeing of healthcare workers during and after the COVID-19 pandemic using Agile methodology. The package was rate high in terms of delivery and engagement with the users and considered appropriate for health practitioners, academics and students. the content of the package was perceived to be relevant, meaningful and appropriate to the requirements of healthcare practitioners. Moreover, Saidu, Magnus, Babawuro, Dahiru, and Muhammad (2019) found that students taught using the CAI package had significantly higher academic achievement than those taught using the conventional teaching method. CAI package has a large effect size on students' achievement. They found a significant difference between thepretest and the posttest mean scores of students in the experimental group alone, also a significant difference between the posttest mean scores of students in the experimental and the control group and same with the between the mean gain scores

of students in the experimental and the control group. Mansur et al. (2019) developed a CAI package and found that all the respondents agreed with the content areas of a package for teaching in university. The nature of the package development using PHP computer language was agreed upon and accepted teaching purpose. The package was agreed to be valid and reliable for teaching in university.

Identified Gaps and Limitations

Studies previously conducted on remote learning during the Covid-19 pandemic were mostly fromforeign countries and almost all concentrated ontertiary institutions as found in the work of Bayham and Fenichel (2020); Huber and Helm (2020); Mulenga and Marbán (2020); Reich et al. (2020) and few others were centred at secondary schools (Asanov et al., 2020; Chandler, 2020; Yao et al., 2020). Despite having some at the secondary schools' level, all the studies focused only on online remote learning in schools (Alade, 2020; Ali, 2020; Blake et al., 2020; Chandler, 2020; Cullinane & Montacute, 2020; Huber & Helm, 2020; Reich et al., 2020; Yao et al., 2020) or laying emphasis on those from families and parents' qualifications to using remote learning (Cullinane & Montacute, 2020) during the pandemic.other researchers reported a lack of extensive research on local access, equity issues (Safi et al., 2020) and offline development and testing of instructional packages (Mansur et al., 2019). However, it can be inferred that developmental procedures, validity and reliability of the remote learning packages previously used during the pandemic from the aforementioned studies were completely limited or missing, which this framework seeks to bridge the existing gaps in the literature by considering offline remote learning as one of the variables missing from the previous studies. Conclusion Covid-19 has made a serious negative impact on almost everything in the entire world. From the time of its emergence to date almost every activity was brought to a halt in which schools were part of the heavily affected areas. A wealth of researches has indicated that there is an interruption in teaching and learning which makes it unsustainable during the pandemic. Remote learning turns out to be one of the effective strategies to sustain teaching and learning during the pandemic. But for Nigeria to achieve internet-based remote learning may not be feasible due to many hindrances. This calls for the researchers to bridge the existing gap among which is the local issues of access and equity among students from different backgrounds by proposing to develop, validate and test the efficacy of offline remote learning package for Nigerian secondary schools during and post Covid-19

pandemic. Conceptual Framework

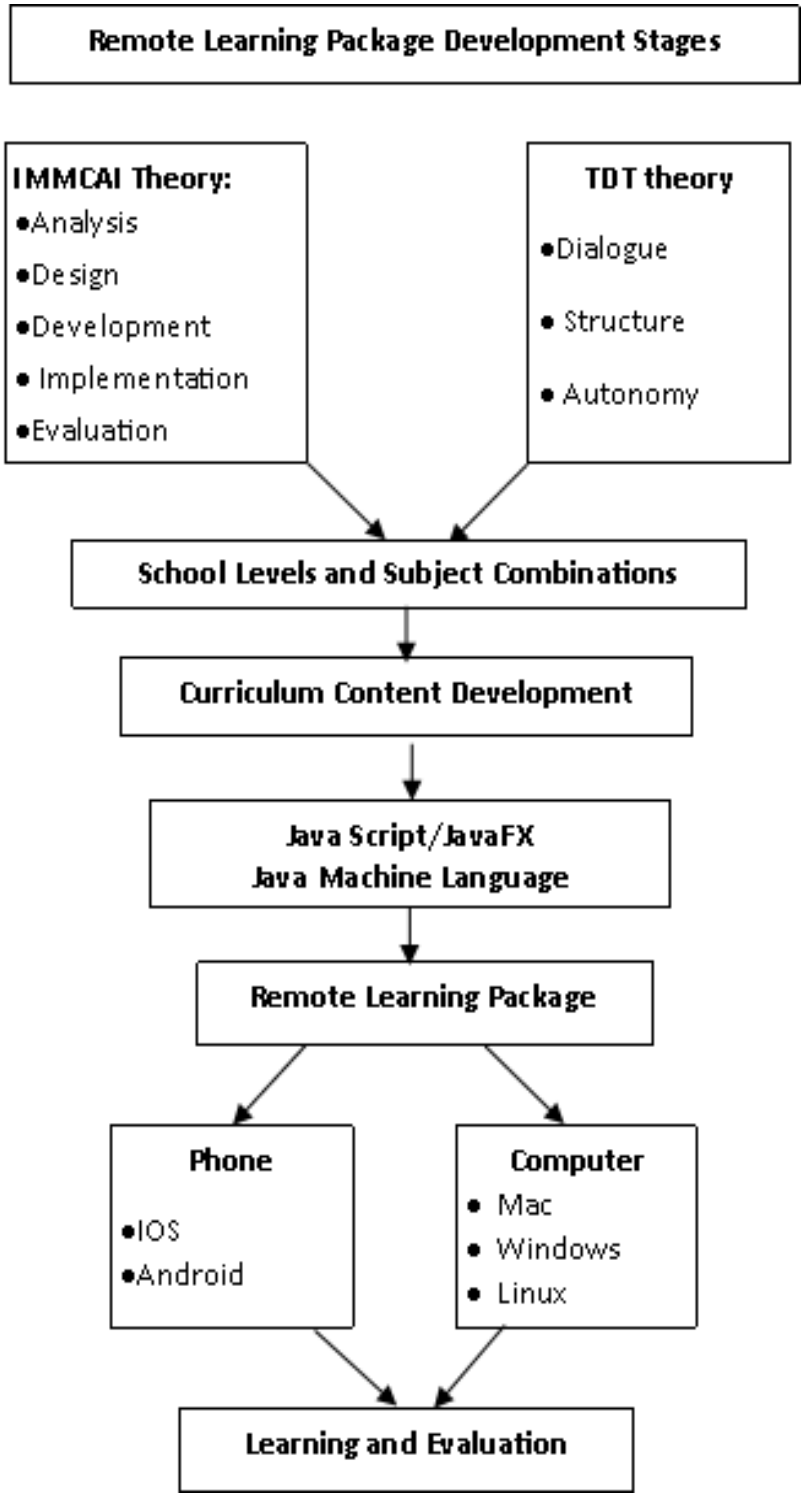

Figure 5: Remote Learning Package Development Stages
Source: Compiled by the authors in consideration of some theories fromMoore and Diehl (2019); Trirathanakul, Sombunsukho, Lertkulvanich, and Buranajant (2008)

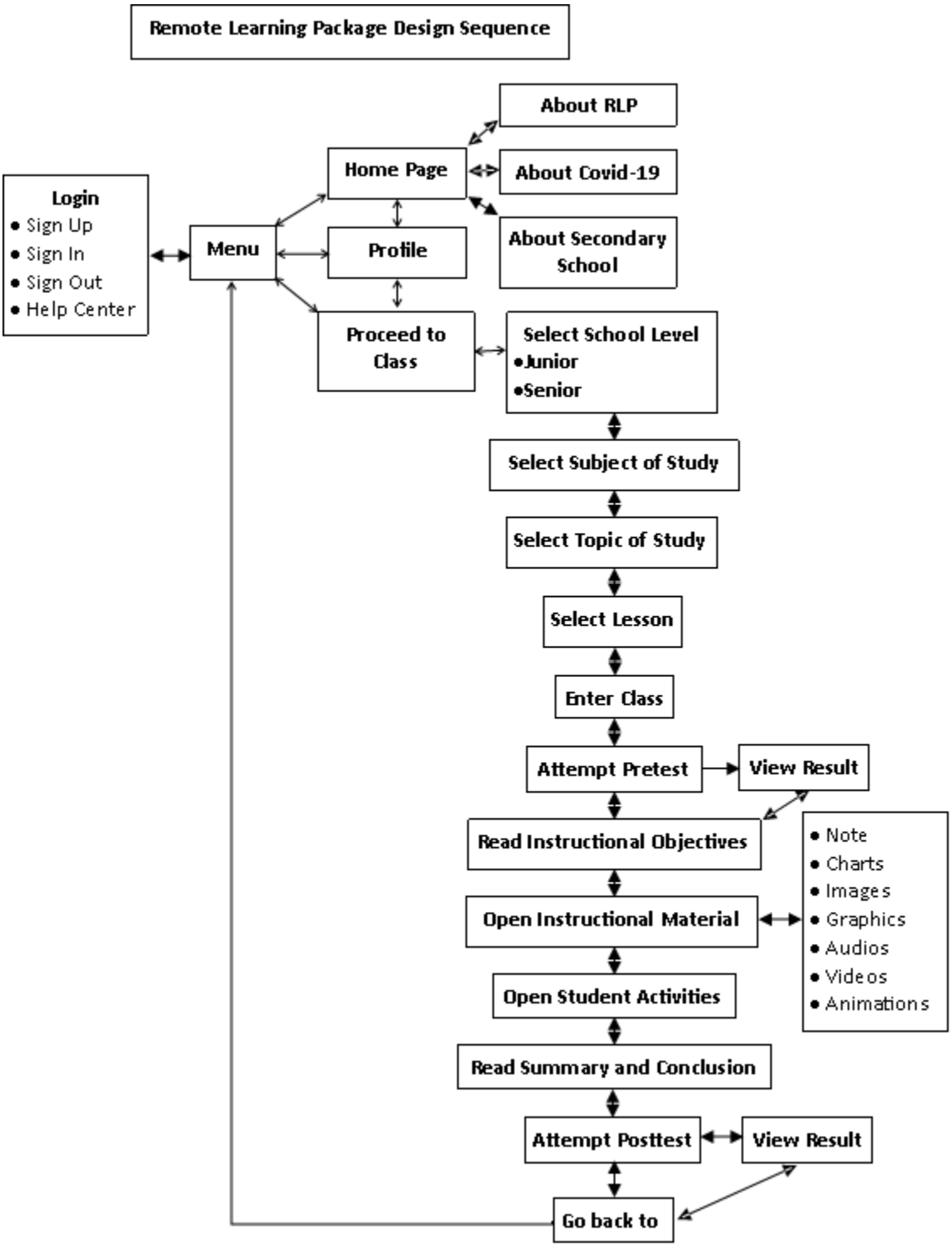

Figure 6: Proposed Remote learning package Design Sequence
Source: Compiled by the Authors

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Relative Bacteriological Assessment of Spoilt Fruits and Vegetables Sold in Minna, Niger State.

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Abstract
An investigation was carried to study the different bacterial species present in some spoiled fruits (orange and watermelon) and vegetables (spinach and tomato) sold in a Kasuwan gwari market. Samples were aseptically collected from the Kasuwan gwari market into a sterile universal container and a plastic bag, and were transported to the Microbiology Laboratory of Federal University of Technology Minna, Niger State. Samples were serially diluted and inoculation of these samples on various media was done via the pour plate method. The isolated bacteria were identified via Gram reactions and other biochemical tests. The antibiogram of the bacterial isolates was carried using various antibiotic discs. The highest bacteria count was observed in oranges ($1.56x10^4$), followed by tomatoes ($1.12x10^4$), spinanch ($1.08x10^4$) and then watermelon ($1.04x10^4$). The isolated bacteria were identified as Klebsiellapneumoniae (25%), *Streptococcus pyogenes (16.67%), Salmonella typhi(33.33%) and*Staphylococcus aureus (25%) respectively. The study revealed that the susceptibility of *Klebsiellapneumoniae to Gentamycin, Septrin and Reflacine was 100% while its resistance to Augmentin, Streptomycin, Tarivid and Penicillin was 100%. Streptococcus pyogenes on the other hand, also exhibited 100% susceptibility to Ofloxacin, Erythromycin and Augmentin, and 100% resistance to Cloxicillin, Ceftazidine and Ceftriaxone. SimilarlySalmonellatyphi and Staphylococcusaureus also exhibited 100% susceptibility to Ofloxacin, Erythromycin, Augmentin, Nalidixic acid, Streptomycin, Tarividand Septrin while 100% resistance to Gentamycin, Augmentin, Penicillin, Reflacine, Rifamipicin, Norfloxacin and Levofloxacin in Salmonellatyphi and Staphylococcusaureus was also observed. However due to the high resistant bacteria isolates, associated with the spoiled fruits and vegetables, it is therefore imperative to ensure that the Government enlightens thefarmers who harvest, package and transport various fruits and vegetables for public consumption,on the menace associated with microbial contamination of various fruits and vegetables to ensure that the microbial spoilage especially with resistant bacteria is controlled and curtailed adequately. In addition, the Government should also create adequate awareness on the misuse of antibiotics to ensure that the spread of resistant bacteria isolates in the environment (such as soil or water) is curtailed and controlled adequately.*

Keywords: Fruits, Vegetables, Antibiotics, Microorganisms

Introduction

Fruits and vegetables are edible substances which contain growth factors, such as vitamins and essential minerals that enablehumans live a healthy life (Al Hindi *et al*., 2011).

A fruit is basically the edible part of a matured ovary, of a flowering plant. They are usually eaten raw, and are classified as eitherfleshy or dry fruits. Fleshy fruits are furtherclassified into berry (such as orange, tomato,pineapple, pawpaw, and banana), drupes(such as plume, coconut, almond,

cherry) andpomes (such as apple and pear), while the dryfruits, are classified as dehiscent (such as pod, follicle and capsule) andindehiscent fruits (like achene, samara and cashew) (Jay, 2000).

Vegetables are considered as the leafy outgrowth of plants or plants shoot consumed as food by eitherhumans or other animals (Yusuf *et al.,* 2004). Basically they are protective foods used to maintain good health and prevent diseases.

Generally, the succulent nature of fruits and vegetables enables microbes to invade easily. The high content of various sugars, minerals, vitamins and amino acids in both fruits and vegetables enhances the proliferation and survival of various microorganisms (Bhale, 2011), thus bringing about microbial spoilage of these fruits and vegetables.

However, thesusceptibility of various fruits and vegetables to microbial contamination is mainly due to their various chemicalcompositions, pH or moisturecontents whichpredispose them to microbial spoilage. Basically, microbial spoilage is a condition that occurs when microbes such as fungi and bacteria grow and degrade tissues, such as pectins, thus presentingthe whole fruit into a slimy mass. The microbes also degrade starch and sugars, therebyproducing substances that alter the color, texture, flavour and odour of the food (Rawat, 2015).

Most microorganisms associated with the surfaces of either a fruit or vegetable are soil inhabitants (Janisiewicz and Korsten, 2002;Andrews and Harris, 2000).However, microbial contaminationof most fruits and vegetablescould also occur either during their growth season (via direct contact with contaminated manure, sewage, irrigation water, wastewater from livestock operations or wild and domestic animals) or during their harvest, handling, transportation, post-harvest storage, marketing or even after a purchase by a consumer (Eraky*et al.,* 2014; Rahman*et al.,* 2014; Pagadala*et al.,* 2015; Maffei*et al.,* 2016) (as seen in Figure 1)

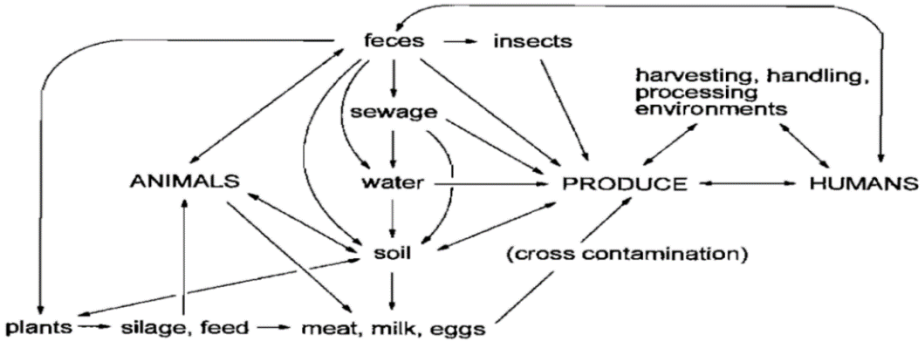

Figure1: Illustration on how farm produce get contaminated with pathogenic microorganism
Source: Maffei *et al.* (2016)

Based on the improper postharvest practices performed by most farmers, spoilage bacteria are introduced on most farm products during their harvest, packaging, storage or transportation. This thereby renders most farm product undesirable for consumption. Based on this, it is therefore necessary that bacteria associated with the spoilage of these farm produce are determined. This is the main focus of this study

Materials and Method

Study Area

Minna is a city, with an estimated population of 304,113. It's the capital of Niger State, one of Nigeria's 36 federal states, and is the headquarters of Chanchaga Local Government Area. The area surveyed wasKasuwangwari market.

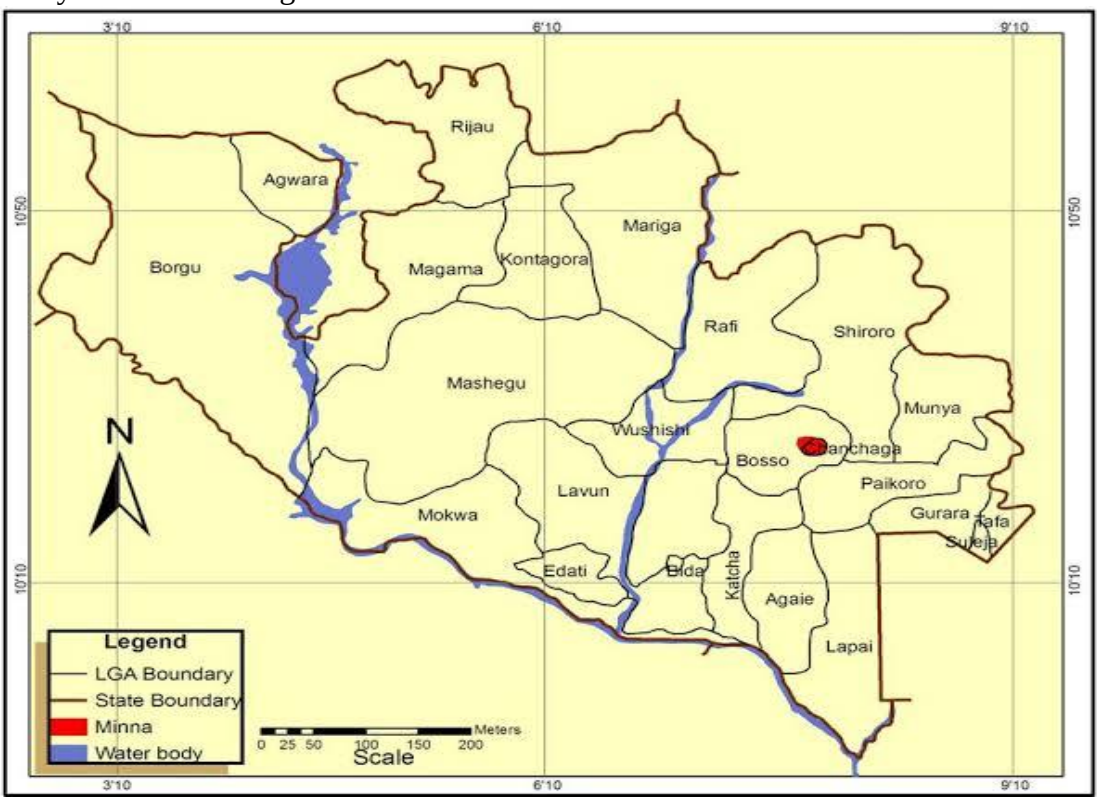

Figure 2: Map of Nigeria showing Minna Niger State
Source: Niger State Bureau of Statistics (2010)

Sampling Collection

A total of 12 samples [consisting of three (3) samples from two (2) spoilt fruits namely Oranges (*Citrus sinensis*) &Watermelon (*Citrulluslanatus*) and from two (2) spoilt vegetables namely Spinach (*Spinaciaoleracea*) and Tomato (*Solanumly copersicum*)] from Kasuwangwarimarket in Minna Niger State were collected in sterile universal containers and plastic bags and transported to microbiology laboratory for analysis.

Preparation of Media

The media used are: Nutrient agar, MacConkey agar and Salmonella Shigella agar. These media were prepared according to the manufacturer's instruction (28g/L, 52.55g/L, and 63g/L) respectively and were sterilized at 121^{o}c for 15 minutes in the autoclave except the Salmonella Shigella agar that was boiled with frequent agitation. After that all were allowed to cool and poured under aseptic condition into the Petri dishes.

Inoculation of samples

The spoilt areas of the fruits and vegetables were washed with sterile water; after which the spoilt areas were cut out and 5g of it was weighed. It was then put into sterile universal bottle containing 10ml of sterile water. The mixture was shaken and then serially diluted into five (5) test tubes to reduce the concentration of microorganisms in the test tube. Nutrient agar plates were inoculated with 1 ml from the serially diluted test tubes of 10^{-2}, using the Pour Plate Technique (to isolatevarious bacteria). The plates were allowed to solidify, inverted and incubated at 37ºC for 24hrs for bacterial colony formation. Thecolonies on Nutrient agar wereobserved, counted and recorded.Each colony was isolated in a pure form by sub culturing into a fresh Nutrient agar, MacConkeyagar and Salmonella Shigellaagar plate for further studies and identification.

Bacterial Identification and Biochemical Characterization

The discrete colonies from these sub cultured plates were identified by Gram staining techniques (Sherman, 2005; Prescott, 2002; Holt *et al*., 1994) and other types of biochemicaltests namely: Indole test, catalase test, coagulase test and so on.

Gram staining: a smear was made on a clean grease-free glass slide, the smear was heat-fixed and then flooded with crystal violet and allowed to stay for 60seconds. The smear was then diluted with Gram's iodine after 60seconds which acts as mordant on the smear. The smear was decolorizing with 95% ethyl alcohol for 1minute. After decolourization, the smear was counter stain with safraninand left for 60seconds. This was finally washed with distilled water and the slide was allowed to drain water. Finally a drop of oil immersion was placed on the slide and it was viewed at x100 (objective lens) using binocular microscope. The Gram positive bacteria retained the colour of the dye, crystal violet (dark purple) whereas the Gram negative retained the colour of the dye, safranin (reddish).

Indole Test: The test is used to determine the ability of the organisms to breakdown amino acids, tryptophan to indole. Peptone water broth rich in tryptone was dispensed in test tubes, autoclaved and inoculated with test organism. It was then incubated at 37 ^{0}C overnight. Few drops of Kovac's reagent were added and shaken. Red colouration which separated out in the alcohol interphase depicted a positive result while a yellow colouration depicted a negative result (Cheesbrough, 2010).

Catalase test: The test bacteria colony was picked and emulsified with 3% hydrogen peroxide on a clean glass slide and bubble formation was observed. If there is bubble formation, it is positive (+ve) and no bubble formation means it is negative (-ve).

Coagulase test: The test is used to differentiate coagulase positive *Staphylococcus aureus* from Coagulase Negative *Staphylococcus* (CONS). The test bacteria was picked and emulsified with a drop of blood serum on the slide and coagulation was observed. If there is coagulation it is positive (+ve) whereas no coagulation means negative (-ve).

Blood haemolysis test: Blood agar was prepared using 95ml sterile nutrient agar which was cooled to 45 ^{0}C and 5.0ml of blood was added and mixed thoroughly. The obtained blood agar was dispensed into sterile petri dishes and then allowed to solidify. The test organism (bacteria) was inoculated in the plate and incubated for 24hours. After 24hours of incubation, greenish and

creamy zones surrounding the colonies indicated alpha haemolysis, whitish and creamy zones surrounding the colonies indicated beta haemolysis and scanty whitish zones surrounding the zones indicated gamma haemolysis (Sherman, 2005 and Holt *et al*., 1994).

Antibiotic Sensitivity Testing

Antibiotic sensitivity testing was done using Kirby-Bauer method on Mueller Hinton Agar. 3.8 g of this agar was dispensed into a sterile conical flask. One hundred milliliter (100 mL) of distilled water was poured into the flask and stirred to dissolve the agar. The mixture was autoclaved and then poured into petri dishes. On gelling, a sterile swap stick was used to spread the standardized inoculums from a test tube, onto a Petri dish. After the inoculums have been spread, the positive and the negative antibiotic sensitivity discs were introduced using sterile forceps and then the plates were incubated for 24 hours at 37^0C.

Results and Discussion

Result

Out of all the spoiled fruits and vegetables analyzed, orange had the highest microbial count of $1.56x10^4$while spinach had the least microbial count of $7.8x10^3$

Table 1: Total plate count of 6 fruits and vegetables sampled in Kasuwan gwari market Minna, Niger state.

Sample	Microbial load (cfu/ml) 10^2		
	A	**B**	**C**
Orange	$1.04x10^4$	$1.24x10^4$	$1.56x10^4$
Watermelon	$9.2x10^3$	$8.4x10^3$	$1.04x10^4$
Spinach	$8.4x10^3$	$7.8x10^3$	$1.08x10^4$
Tomatoes	$9.6x10^3$	$1.16x10^4$	$1.12x10^4$

Table 2: Biochemical test of the Isolated Bacteria

Isolation Code	Cell Shape	Gram Reaction	Catalase	Coagulase	Haemolysis	Indole	Suspected Organism
KG1	R	-	-	-	-	-	*Salmonella typhi*
KG2	R	-	+	-	-	-	*Klebsiella pneumonia*
KG3	R	-	+	-	-	-	*Klebsiella pneumonia*
KG4	R	-	-	-	-	-	*Salmonella typhi*
KG5	C	+	+	+	-	-	*Staphylococcus aureus*
KG 6	R	-	+	-	-	-	*Klebsiella pneumonia*
KG7	R	-	-	-	-	-	*Salmonella typhi*
KG8	C	+	-	-	*β*	-	*Streptococcus pyogenes*
KG9	R	-	-	-	-	-	*Salmonella typhi*
KG 10	C	+	-	-	*β*	-	*Streptococcus pyogenes*

KG 11	C	+	+	+	-	-	*Staphylococcus aureus*
KG 12	C	+	+	+	-	-	*Staphylococcus aureus*

Key: KG= Kasuwangwari, C= Cocci, R= Rod, + = Positive, - = Negative, β = Beta haemolysis.

Twelve (12) bacterial isolates were obtained (as seen in Table 3). *Salmonella typhi* 4(33.33%) had the highest frequency of occurrence followed by *Klebsiella pneumoniae* and *Staphylococcus aureus* which had their frequency of occurrence to be 3(25%) and *Streptococcus pyogenes* 2(16.67%) had the least frequency of occurrence (Table 3).

Table 3: Frequency of Occurrence of Isolated Bacteria from Kasuwan gwari Markets.

Isolates	**Kasuwangwari (f / %)**
Klebsiella pneumoniae	3(25)
Streptococcus pyogenes	2(16.67)
Salmonella typhi	4(33.33)
Staphylococcus aureus	3(25)
Total	**12(100)**

Table 4.1 : Antibiotic Sensitivity of the Gram negativeBacterial Isolated.

Bacteria isolates	**Pattern**	**CN %**	**AU %**	**NA %**	**S %**	**OFX %**	**SXT %**	**PN %**	**PEF %**
Klebsiella pneumoniae	S	3(100)	0(0)	1(33.3)	0(0)	0(0)	3(100)	0(0)	3(100)
	I	0(0)	0(0)	1(33.3)	0(0)	0(0)	0(0)	0(0)	0(0)
	R	0(0)	3(100)	1(33.3)	3(100)	3(100)	0(0)	3(100)	0(0)
Salmonellatyphi	S	0(0)	0(0)	4(100)	4(100)	4(100)	4(100)	0(0)	0(0)
	I	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
	R	4(100)	4(100)	0(0)	0(0)	0(0)	0(0)	4(100)	4(100)

Key: OFX= Tarivid**,** PEF= Reflacine, AU= Augmentin, CN= Gentamycin, SXT= Septrin,NA= Nalidixic acid,S= Streptomycin and PN= Penicillin.

Table 4.2: Antibiotic Sensitivity of Gram positive Bacterial Isolated.

Bacteria isolates	Pattern	S %	CH %	E %	RD %	NB %	LEV %
Staphylococcusaureus	S	3(100)	3(100)	3(100)	0(0)	0(0)	0(0)
	I	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
	R	0(0)	0(0)	0(0)	3(100)	3(100)	3(100)
		OFL %	**ERY %**	**CXC %**	**CAZ %**	**CTR %**	**AUG %**
Streptococcuspyogenes	S	2(100)	2(100)	0(0)	0(0)	0(0)	2(100)
	I	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
	R	0(0)	0(0)	2(100)	2(100)	2(100)	0(0)

Key: S= Streptomycin, CH= Chloramphenicol, E= Erythromycin, RD= Rifamipicin, LEV= Levofloxacin, NB=Norfloxacin, CXC= Cloxicillin, ERY= Erythromycin, CAZ= Ceftazidime, AUG= Augmentin, CTR= Ceftriaxone, OFL= Ofloxacin

Discussion

This study revealed that high microbial count was observed in oranges compared to spinach. This could be based on the fact that, due to the presentation of most fruits especially oranges in a ready to consume form, most oranges sold in the market are easily prone to microbial contamination from the sellers due to inadequate use of personal protective wears and inadequate hand hygiene before and after peeling the oranges, thus enhancing rapid transfer of large microbial contaminants on the surfaces of these oranges, and this thereby leads to a high degree of microbial spoilage of these fruits.This finding is in agreement with the studies carried out by Muhammad*et al.*(2017).

This study also revealed that *Salmonellatyphi*4(33.33%) had the highest frequency of occurrence when compared to other bacteria isolated. This could be enhanced by the unhygienic packaging of most fruits and vegetables in the markets, which in turn encourages the transfer of feacal contaminants on the surfaces of these farm products through frequent perching ofinsects such as flies. This result is in line with the studies carried out by (Adebolu, 2001; Olayemi, 2007; Omemu, 2005; Tambekar, 2006; Uzeh, *et al.,* 2009).

*The study revealed that the isolated microbial contaminants were hundred percent (100%) resistant to*Augmentin, Streptomycin, Tarivid, Penicillin, Cloxicillin, Ceftazidine, Ceftriaxone, Gentamycin, Reflacine, Rifamipicin, Norfloxacin and Levofloxacin. This could be based on the fact that most microbial contaminants from various environmental sourcessuch as water, soil, animals or humansassociated with the microbial spoilage of these farm products were illegally exposed to most available antibiotics in the study area. This result conforms to the findings of Brown (2004).

Conclusionand Recommendations

This study revealed thatfour bacteria isolates namely; *Klebsiellapneumoniae,Streptococcus pyogenes, Salmonella typhi,* and *Staphylococcus aureus*wereisolated from the spoiled fruits and vegetables samples. However most of these microbial contaminants on these farm products were hundred percent (100%) resistant to most antibiotics used in this study, hence there is a need for Government to enlighten rural farmers on the need to practiceadequate precautions during pre-

harvest and post-harvest of these farm products to ensure that microbial contaminants, particularly resistant organisms associated with microbial spoilage are curtailed and controlled.

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In-Vitro Antioxidant Activity of Lycopene Extracted from *Citrulluslanatus* (WATER MELON) and *Lycopersiconesculentum Mill* (TOMATOES)

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Abstract
Lycopene makes up the majority of carotenoids in watermelon and tomatoes. Carotenoids are antioxidants responsible for preventing human diseases including cardiovascular diseases, cancer, and other chronic diseases. Lycopene was extracted using n-hexane and acetone from two species of watermelon (dark green and light green skin) and tomatoes (beefsteak and plum). The concentrations were determined using UV-Vis Spectrophotometer at 480 and 503 nm wavelength. The ferric reducing antioxidant power (FRAP) and 2, 2 –Diphenyl -1- Picrylhydrazyl (DPPH) free-radical scavenging activity of the extracted lycopene samples were also assessed. There were variations in the lycopene content in each of the tomato and watermelon species analysed. The average concentration of lycopene extracted from tomatoes and watermelon were 301 and 155.22 µg/g respectively. The average percentage inhibition activity for FRAP was 67.3 % for tomatoes and 61.75 % for watermelon while for DPPH, the average percentage inhibition activity were 62 and 58 % for tomatoes and watermelon respectively. The tomatoes samples had the highest lycopene content and the highest percentage inhibition activity compared to watermelon, however, Vitamin C (standard antioxidant) percentage inhibition activity was 90 %. The study revealed that the lycopene extracted from watermelon and tomato had an in-vitro antioxidant activity which is, however, lower than that of vitamin C. Lycopene in tomatoes and watermelon can, therefore, be used as a medicinal and functional food to manage diseases caused by free radicals and reactive oxygen species.

Keyword: antioxidant, free-radical, lycopene, tomato, watermelon

Introduction
Modern lifestyles prevent people from good dietary habits and from keeping their diet healthy. A lack of proper dietary intake or the consumption of unhealthy food products results in increased oxidative metabolism producing free radicals and reactive oxygen species the cause of chronic non-communicable diseases. At least 30 % of deaths in Africa are caused by non-communicable diseases, according to the World Health Organization (WHO, 2015). Prevalence of cardiovascular disease, chronic obstructive lung diseases, cancer, and diabetes mellitus is projected to be 15, 4, 4, and 2 (%) respectively, in Africa (Kazibwe *et al.,* 2021). The major effort to prevent non-communicable illnesses are by improving dietary habits, focus on the consumption of fruit and vegetables with good antioxidant and nutritional qualities. Antioxidants inhibit oxidation and help prevent non-communicable diseases. Antioxidants defend against harmful free radicals and decrease cardiac diseases and cancer (Kumar *et al.,* 2021). The main sources of natural antioxidant components are fruits and vegetables. Lycopene is the best carotenoid antioxidant and it is vital in vitamin A synthesis as an intermediary and β-carotene and β-cryptoxenthin, also for regulating growth (Swapnil *et al.,* 2021).

Lycopene gives fruits and vegetables their red colour and has antioxidant properties. It is a fat-soluble substance produced by plants and microorganisms. In epidemiological research, consuming lycopene-rich foods has been related to better health outcomes. The popularity of lycopene accumulation in plants is a popular topic for many scientists working in plant breeding and crop production (Ghidoli *et al.,* 2021). Regular consumption of lycopene-rich foods is critical for cancer prevention, lowers the chance of body tumors, particularly prostate cancer, according to research (Liu *et al.,* 2021). The antioxidants - vitamin E, selenium, and lycopene have all been found to lower the risk of prostate cancer as well as the reduction of low-density cholesterol and cardiovascular disease (Liu *et al.,* 2021; Aber *et al.,* 2021). Research has shown that lycopene works better than beta-carotene for persons with lung, breast, and endometrial cancer to delay the development of the cell cycle, therefore delaying tumors' cell production. It also impacts intercellular communication by changing a typical pathway associated with malignancy (Zamuz *et al.,* 2021).

Gac, tomatoes, watermelon, pink guava, pink grapes, papaya, apricots, and red bell pepper are all high in lycopene (Adetunji *et al.,* 2021). Watermelon and tomatoes are vastly considered to be rich in lycopene antioxidant that helps prevent non-communicable diseases. The capacity of lycopene to absorb singlet oxygen and trap peroxyl radicals is one of its most notable antioxidant abilities (Flieger *et al.,* 2021).

The potential to serve as an antioxidant is improved by the conjugation of the lycopene molecule, making it more effective for human health (Song *et al.,* 2021).

This study was conducted to determine the antioxidant properties of watermelon and tomatoes.

Materials and Methods

The following materials, chemicals and reagents were used- Weighing balance, measuring cylinder, Separating funnel, Double beam, Shimadzu UV-spectroscopy and 27AW-6 water bath. Methanol, acetone, n-hexane, calcium bicarbonate, silica gel, vitamin C (ascorbic acid), sodium phosphate buffer, potassium hexacyanoferrate (III), ferric chloride, TCA (Trichloroacetic acid), 2,2-Diphenyl-1-Picrylhydrazyl.

Sample Collection

Two different species of watermelon (*Citrulluslanatus*) and tomato (*Lycopersiconesculentum Mill*.) samples were obtained from the markets in Minna, Niger state, Nigeria in July 2021 and were identified at the department of Crop Production, Federal University of Technology, Minna.

Sample Preparation

The samples were washed, sliced with a knife into small pieces. The samples were homogenized into smooth juice consistency using a blender. The samples were then stored in air-tight containers for further experiments.

Extraction of Lycopene

Lycopene extraction method from watermelon and tomato samples described by Khamis*et al.* (2017) was used. Into a beaker, 50 ml of methanol, 1 g of calcium bicarbonate, and 5 g of silica gel, 20g of the homogenized material was placed.After which the sample was filtered with

Whatman no. 1 filter paper. Acetone and n-hexane were added in a 1:1 ratio (12.5 + 12.5 ml) and stirred vigorously to ensure proper mixing. The sample mixture was placed in a separating funnel and allowed to stand for 3 hours, until two layers were visible: one was deep yellow and the other was light. The lycopene was collected in a sample vial and was a deep yellow incolour.

Quantification of the Lycopene

The quantification of the lycopene sample was done using UV-Visible Spectrophotometer to get the absorbance of the samples. The blanks were n-Hexane (1 ml) and acetone (1 ml). Each sample was placed in a cuvette and placed in the UVspectrophotometer. Light was allowed to pass through the samples and absorbance was measured at 480 and 503 nm.

To calculate the concentration: **C = A / ε (epsilon) x d**

Where *C =The sample concentration in ug / mL,*

A = Absorbance

d = *Cuvette path length in cm*

E = (epsilon) sample specific constant (describing how much the sample absorbs at a given wavelength)

***In vitro* Antioxidant Assays**

DPPH (2,2-Diphenyl-1-Picrylhydrazyl) radical Scavenging Assay

The antioxidant activity of the plant extract was determined using method reported by Celiz*et al* (2020). Different concentrations of extracts and ascorbic acid (125, 250, 500, and 1000 ug/mL) were made from stock solutions, which were made by weighing and dissolving 0.01g of extracts and 0.01g of ascorbic acid in 10 mL of methanol, respectively. After which, 1 mL of the various doses of plant extracts and ascorbic acid were added to 2 mL of 0.004% DPPH in methanol separately. For 30 minutes, the reaction mixtures were incubated in the dark at 25°C. Using a twin beam Shimadzu UV-1800 series spectrophotometer, the absorbance of each test mixture was measured at 517 nm against a blank. Methanol (1 mL) with DPPH (1 mL) was used as blank. The experiment was repeated three times. The following formula was used to compute the % antioxidant activity:

$$\% \text{ Inhibition of antioxidant} = \frac{\text{blank} - \text{sample}}{\text{blank}} X100$$

FRAP (Ferric Reducing Antioxidant Power) Assay

The antioxidant activity of plant extracts was determined using a ferric reducing antioxidant power test, as described by Sethi*et al.* (2020). Different concentrations of 125, 250, 500, and 1000 g/L were produced from stock solutions of plant extracts and ascorbic acid (1000 g/mL).1 mL of each plant extract and ascorbic acid concentration were combined with 1 mL of 0.2 M sodium phosphate buffer and 1 mL of 1% potassium hexacyanoferrate in this test (III). The reaction mixtures were incubated for 20 minutes at 50ºC. Following that, 1 mL of 10% Trichloroacetic acid was added. The reaction mixtures were centrifuged at room temperature for 10 minutes. Each supernatant (1mL) was combined with 1 mL of distilled water, and 0.2 mL of 0.1% ferric chloride was added.The blank was made in the same way as the samples' extracts, but in this case, the extracts were substituted with distilled water. At 700 nm, the absorbance of the test mixtures was measured. The % antioxidant activity was computed formula below:

% Antioxidantactivity = $\frac{sample-blank}{sample} X100$

Results

Table 1 shows the concentration of lycopene extracted from *Citrulluslanatus (*watermelon*)* and *Lycopersiconesculentum Mill. (*Tomatoes*)* at 503 and 480 nm respectively. The crimson sweet (light green skin colour) watermelon had concentrations of 31.20 ug/g and 135.72 ug/g of lycopene at 503 and 480 nm respectively, while the dark green skin colourhad concentrations of 81.2 and 174.72 ug/g of lycopene at 503 and 480 nm respectively. For the tomato samples, beefsteak had a concentration of 21.84 ug/g at 503 nm and 274.56 ug/g at 480 nm. The Plum tomatoes had a concentration of 29.64 ug/g and 308.88 ug/g at 503 nm and 480 nm respectively. The lycopene concentration best detected at 480 nm wavelength for both watermelon and tomatoes.

Table 1: Lycopene Concentration of Two Species of *Citrulluslanatus* (watermelon) and *Lycopersiconesculentum Mill.* (tomatoes).

Sample	Wave length (nm)	Concentration (ug/g)
Water Melon		
Crimson sweet	503	31.20
	480	135.72
Kaolack	503	81.12
	480	174.72
Tomato		
Beefsteak	503	21.84
	480	274.56
Plum	503	29.64
	480	308.88

Antioxidant Activity

2,2-Diphenyl-1-Picrylhydrazyl (DPPH) radical Scavenging Activity of Lycopene from *Citrulluslanatus*(watermelon)and *Lycopersiconesculentum Mill.* (tomatoes)

Figure1: shows the antioxidant activity of the different species of *Citrulluslanatus*(watermelon)and *Lycopersiconesculentum Mill.* (tomatoes) using 2,2-Diphenyl-1-Picrylhydrazyl (DPPH) radical Scavenging activity at concentrations of 125, 250, 500 and 1000 ug/ml.

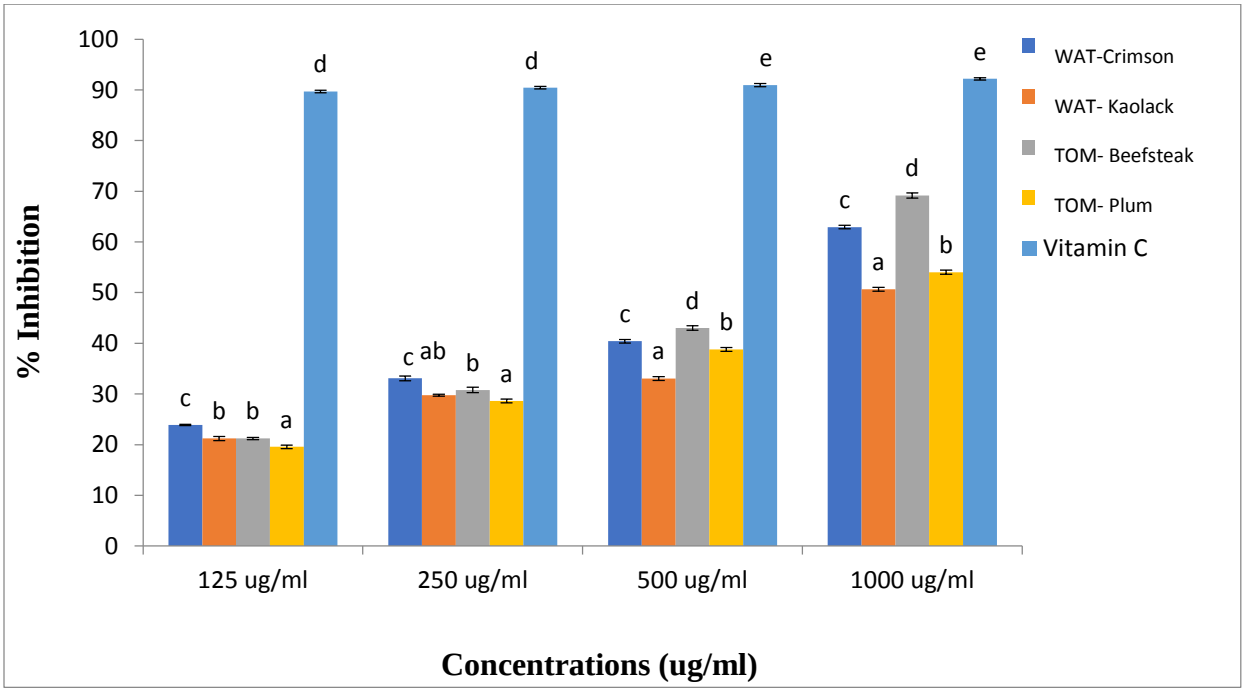

Figure 1: 2,2-Diphenyl-1-Picrylhydrazyl) radical Scavenging (DPPH) Antioxidant Inhibition of Lycopene in *Citrulluslanatus*(watermelon)and*Lycopersiconesculentum Mill.* (tomatoes)

IC_{50} (ug/ml)- Wat-Crimson sweet = 3.30, Wat-Kaolack = 4.28, Tom- Beefsteak = 3.07, Tom-Plum = 3.98, Vitamin C = 0.45

Figure 1, shows the 2, 2-Diphenyl-1-Picrylhydrazyl) radical Scavenging (DPPH) Antioxidant Percentage Inhibition of Lycopene from*Citrullus lanatus* (watermelon) and *Lycopersicon EsculentumMill.* (tomatoes). As the concentration increases, there was also an increase in percentage inhibition. At a concentration of 125 ug/mL, there was no significant difference in kaolack and beefsteak but there was significant difference in crimson sweet and plum as compared to vitamin C (standard antioxidant). At concentrations of 500 and 1000 ug/mL, there was significant difference between crimson sweet, kaolack, beefsteak and plum when compared to standard. Beefsteak showed better antioxidant activity with an inhibition concentration of 3.07 ug/ml when compared to the standard vitamin C with an inhibition concentration of 0.45 ug/ml.

Ferric Reducing Antioxidant Power (FRAP) Activity of Lycopene from *Citrulluslanatus*(watermelon)and *Lycopersiconesculentum Mill.* (tomatoes)

The figure 2 below shows the antioxidant activity of lycopene from the different species of *Citrulluslanatus*(watermelon)and *Lycopersiconesculentum Mill.* (tomatoes) using Ferric Reducing Antioxidant Power (FRAP) at concentrations of 125, 250, 500 and 1000 ug/ml.

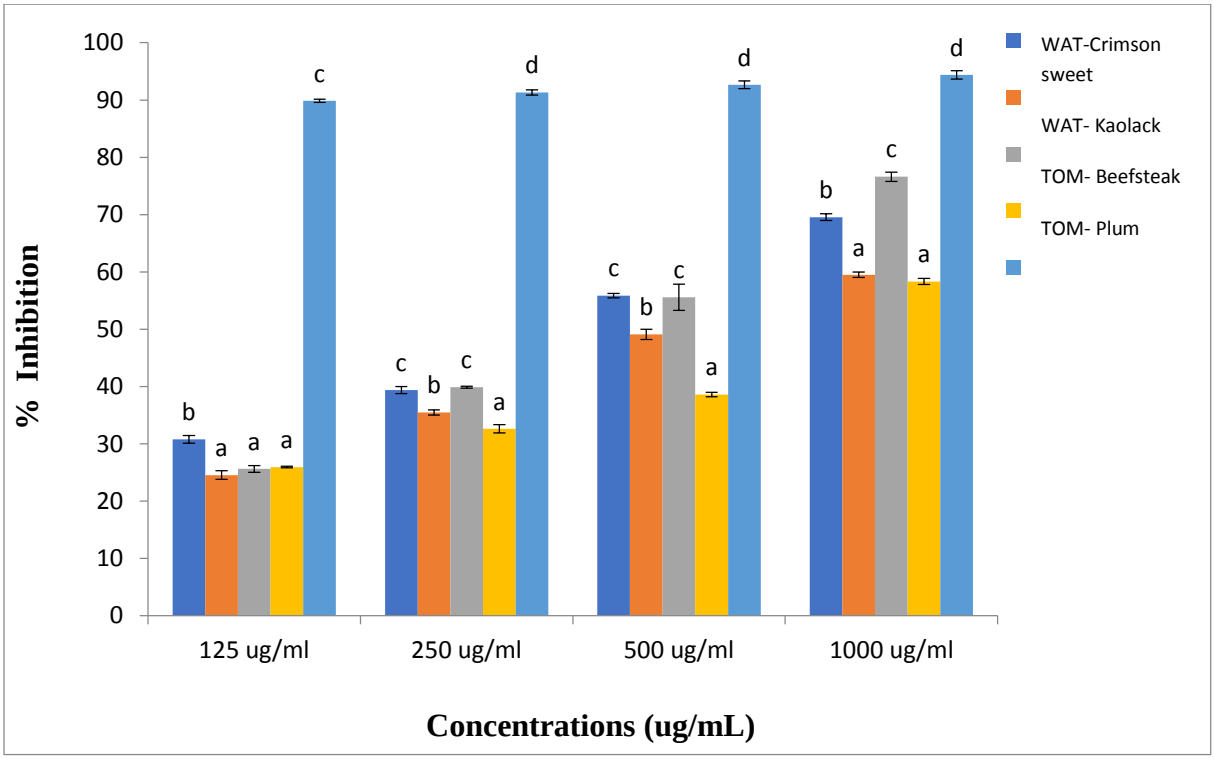

Figure 2:Ferric Reducing Antioxidant Power Assay (FRAP) Antioxidant Inhibition of Lycopene in *Citrulluslanatus* (watermelon)and *Lycopersiconesculentum Mill.* (tomatoes)sample

The percentage inhibitionincreases with concentration for each of the sample, as shown in figure 1. IC_{50}(ug/ml)- Wat-Crimson sweet = 2.58, Wat-Kaolack = 3.16, Tom-Beefsteak= 2.54, Tom-Plum = 3.58, Vitamin C = 0.83.The lower the IC_{50}, the higher the antioxidant activity of the tested samples. There was no significant difference between Wat- kaolack, Tom-beefsteak, or Tom-plum at a concentration of 125 ug/ml, however, there was a significant difference in Wat-crimson sweet when compared to the standard.There was no significant difference between Wat-crimson sweet and Tom-beefsteak at concentrations of 250 and 500 ug/ml, but there was significant difference in Wat-kaolack and Tom- plum when compared to the Vitamin C standard antioxidant, while at 1000 ug/ml, there was no significant difference in Wat-kaolack and Tom-plum but there was significant difference in Wat-crimson sweet and Tom-beefsteak when compared to the standard antioxidant (Vit. C). When compared to standard vitamin C, which had an inhibition concentration of 0.83 ug/ml, Tom-beefsteak showed lower antioxidant activity with an inhibition concentration of 2.54 ug/ml.

Discussion

The lycopene content of watermelon and tomato that is shown in Table 1 is within the reported concentration range. Wambugu (2020) found that the concentration of lycopene in fresh tomatoes ranged from 70.25 to 147.29 ug/g. This is comparable to Takeok *et al.* (2001) - 25-2000 ug/g, but lower than that which was reported by Dewanto *et al.* (2002) - 3110-6700 ug/g). The differences could be related to variations in agricultural and geographical systems and settings and also in different fruit ripening stages (Thompson *et al.,* 2000). The oxidation of lycopene by light and heat

leads to low lycopene content, and this is the primary cause of lycopene degradation. This is in line with Zhao *et al.,* (2019) findings on the effects of light and heat on the stability of lycopene.
The antioxidant activity of the selected fruit samples differed according to the method of determination (FRAP and DPPH activities) possibly because no single method can accurately quantify the total antioxidant capacity of fruits due to the fact that different antioxidant compounds may function i*n-vivo* differently. The antioxidant DPPH activity demonstrated the antioxidant sample's ability to quench free radical cat-ion, while the FRAP activity assessed the samples' reducing potential on reactive oxygen species. Dasgupta *et al.* (2007) reported the highest and lowest FRAP antioxidant concentrations in *V. unguiculata* seed to be 71.22 mmol/100 g and 0.58 mmol/100 g respectively.

The lower the IC50, the better the antioxidant activity, the DPPH antioxidant activity with the tom-beefsteak is the most promising of the samples investigated. The antioxidant activity with DPPH radical has been linked to the hydrophilic and lipophilic extract constituents, Al-Yousef *et al.* (2017) discovered that hydrophilic extract had a higher DPPH radical scavenging ability, whilst lipophilic extract had a higher OH scavenging ability.

The antioxidant efficacy of tomato and watermelon to scavenge free radicals was found to be higher than that of other food plants such as spinach and red pepper studied by Chu *et al.* (2002). Furthermore, it's also difficult to compare results from different studies because any wild growing plant is affected by a variety of factors, including the habitat, climate, and harvest time (Howard *et al.,* 2003).

Conclusion

In conclusion, watermelon and tomato are good sources of lycopene with an effective antioxidant activity that can aid in reducing the risk of oxidative stress-related conditions. From this study, the tomato had stronger antioxidant activity than watermelon, the antioxidant activity of tomato was, however, lower when compared to vitamin C. *Citrullus lanatus* (watermelon) and *Lycopersicon esculentum Mill*. (tomatoes) showed antioxidant activity, they can be utilized as a food supplement or as a functional/ medicinal food to treat or prevent specific ailments and diseases in general.

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Occupational Safety and Health Practice in Building Construction Sites in Minna

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Abstract
This study was carried out to identify the occupational safety and health practice in building construction sites in Minna. Specifically, this study determined: the level of occupational safety and health knowledge of construction workers in building construction sites in Minna; the level of compliance of occupational safety and health practices of construction workers in building construction sites in Minna and the impact of occupational safety and health knowledge and compliance among construction workers in building construction sites in Minna. Three research questions were answered and three null hypotheses were formulated and tested at 0.05 level of significance to guide the study. The descriptive survey approach was used and the target population for this study was made up of Architects, Builders and Engineers within Minna metropolis. Twenty-eight (28) item questionnaires were used as instruments for data collection which were analyzed according to research questions. The questionnaire was validated by three experts in building technology. The reliability of the instrument was found to be 0.87 using Cronbach alpha statistics. The data collected from the respondents were analyzed using mean and analysis of variance (ANOVA). The findings among others include: the use of personal protective equipment by workers is paramount in the construction site, scaffoldings should be properly inspected and fix before mounting and ladders fixed and secured in position before ascending them and occupational safety and health knowledge and compliance among construction workers in building construction sites in Minna revealed that it reduces construction site accidents and increase productivity. It was recommended among others that during the training of the site workers by the building engineers or the project managers with regards to the knowledge of the causes of injuries on the building construction sites, emphasis should be given to the hazards from excavations and other sub-structural works, roof works, manual handling of block walls and the assembling of other parts of superstructures, and the use of plants and pieces of machinery since hazards from them were significantly rated high.

Keywords: Building construction sites, health practice and occupational safety

Introduction
A construction site is any workplace where construction activities are carried out. The activities include among others; erection of buildings, fittings and installation work, assembly and disassembly of prefabricated elements, demolition, alteration and repairs, redevelopment and maintenance and other general construction activities. However, construction sites are very dangerous with potential hazards from falling materials, collapsing foundations, scaffolds, movement of people inside the construction site. According to Alfred and Pao-Chi (2019) construction sites is a very hazardous place, therefore each year a lot of workers both skilled and unskilled lost their lives, injured and even lost their bodily parts on sites in building construction. Building construction is the technique involved in the assembly and erection of structures which is primarily to provide shelter. It is an ancient human activity that began with the functional need for a controlled environment to moderate the effects of climate. However, construction remains

the most dangerous land-based work sector in the world (Alcumus Group, 2014). The construction industry has continued to occupy an important position in the nation's economy. According to the National Bureau of Statistics (NBS) (2015a), the sector contributed about ₦121,900.86 million to the Gross Fixed Capital Formation and employed 6,913,536 personnel excluding the casual workers in 2012 and in 2014, its share the total GDP was 3.82%. However, the range of professions in the construction industry includes not only the workers and managers on the site but also the architects, designers, engineers and other specialist professions. Conversely, these workers are killed, injured or suffer ill health than in any other industry (NBS, 2015b; Peter, *et.al.*, 2016). It is, however, disheartening that despite several efforts towards improving the health and safety status of these workers in the construction industry, continuous increases in the number of accidents both reported and unreported on construction sites still go unabated.

Furthermore, the rate of accidents recorded in Minna metropolis was attributed to lack of effective monitoring, reporting and control practices. Added to this problem is the incessant collapse of building in the country. Although there has been a dramatic improvement in recent decades, the construction industry safety record has continued to be one of the poorest (Olutuase, 2014). Adeogun and Okafor (2020) believe that improving occupational safety and health practices in the construction industry. Thus, occupational safety and health practice in the construction industry starts from the designing phase and continue throughout the construction phases until the safety and health of end-users is ensured due to the complexity of the industry and the hazards it contains (Udo, et al., 2020).

Minna, the state capital of Niger State is a state on the transition that is witnessing tremendous infrastructural development, especially to building projects. Almost all these projects are being handled by the local contractors and construction workers (Baba, 2017). In recent times, there has been an increased case of construction sites accidents in the state. Thus, the issue of whether these workers have adequate knowledge on health and safety issues and whether they comply with health and safety rules and guidelines on site come to the forefront. According to the Federal Republic of Nigeria (FRN) (2015), safety and health have become an integral component in the workplace as employers, labour unions and others engage in training and procedures to ensure compliance with safety standards and also to keep a healthy workforce. Vitharana et.al., (2015) assert that the increasing rate of construction accidents has increased the level of awareness of construction health and safety, thereby involving its inclusion as part of project performance criteria. It is against this background that this work investigates the occupational safety and health practice in building construction sites in Minna to determine the:

1. Level of occupational safety and health knowledge of construction workers in building construction sites in Minna
2. Level of compliance of occupational safety and health practices of construction workers in building construction sites in Minna
3. Impact of occupational safety and health knowledge and compliance among construction workers in building construction sites in Minna.

Statement of the Problem

Building construction activities and accidents on construction sites are significantly rated high in Nigeria (Peter, John and Fidelis, 2016). Because of the rapid rate of construction in Nigeria, it became obvious that more workers are needed and for this to be achieved, people must be in good

health and must also engage in construction activities and jobs which do earn them as much as to be comfortable with and also leave them with little or no health hazards. Excessive exposures to certain substances/agents during building construction may result in acute injury, chronic illness, permanent disability or even death (Abrar, Cheema, Saif and Mahmood, 2017; Occupational Safety and Health Council, 2004). In addition to this problem, loss of concentration at construction work and fatigue arising from poor health conditions may increase the risk of accidents as well (Okeola, 2019). Thus, to reduce this problem, this study is therefore aimed at determining the occupational safety and health practice in building construction sites in Minna metropolis are being affected by the construction activities by taking into consideration, the sources of responsible hazards, to generate guidelines to reduce hazards in construction sites in Nigeria.

Research Questions

The study provides answers to the following research question:

1. What is the level of occupational safety and health knowledge of construction workers in building construction sites in Minna?
2. What is level of compliance of occupational safety and health practices of construction workers in building construction sites in Minna?
3. What is the impact of occupational safety and health knowledge and compliance among construction workers in building construction sites in Minna?

Hypotheses

The following null hypotheses were formulated and tested at 0.05 level of significance

HO_1 There is no significance difference between the mean response of the respondents on the level of occupational safety and health knowledge of construction workers in building construction sites in Minna

HO_2 There is no significance difference between the mean responses of the respondents on level of compliance of occupational safety and health practices of construction workers in building construction sites in Minna

HO_3 There is no significance difference between the mean response of the respondents on the impact of occupational safety and health knowledge and compliance among construction workers in building construction sites in Minna

Methodology

In carrying out this study, the descriptive survey approach was used, where questionnaires are used to determine the opinion of the respondents on the issue under investigation. Uzoagulu (2011) defined survey research as the gathering of information about a large number of people or objects by studying a representative sample of the entire group through the use of questionnaires. In support of this, Kumar (2011) stated that research design is a plan or blueprint which specifies how data relating to a given problem should be collected and analyze. Therefore, the survey research was considered suitable since the study seeks information from a sample that was drawn from a population using a questionnaire. The study will be conducted in Minna Metropolis. The target population for this study was made up of 33 architects, 42 engineers and 47 builders in Minna. This population was chosen because they are the range of professions in the construction industry. Since the population is manageable, no sampling will be adopted in the study.

The instrument used for data collection was a structured questionnaire developed by the researcher. It consisted of two (2) parts in which the first indicate the introductory part of the respondents and the second part is divided into three (3) sections A, B and C respectively. All items are to be responded to by indicating the appropriate respondent's best perception using four-point rating scales. The instrument was validated by 3 experts from the Department of Industrial and Technology Education, Federal University of Technology, Minna.

Cronbach alpha statistics was used to determine the internal consistency of the instrument. This was chosen to determine the reliability of the instrument for this study because the items are non-dichotomous scored and the result was found to be 0.87. The analysis of data for the research questions and hypotheses was accomplished using mean and Analysis of Variance (ANOVA). The mean was used to determine the degree of acceptance or rejection in research questions, while ANOVA was used to test the hypotheses of the groups of respondents at 0.05 level of significance. Real limits of values of number was used to determine the occupational safety and health practice in building construction sites in Minna with numerical values of:

3.50 – 4.00 as **SA-** Strongly Agree	**VHL-** Very High Level	**HC-** Highly Complied
2.50 – 3.49 as **A-** Agree	**HL-** High Level	**C-** Complied
1.50 – 2.49 as **D-** Disagree	**LL-** Low Level	**LC**= Low Complied
0.50 – 1.49 as **SD-** Strongly Disagree	**VLL-** Very Low Level	**NC**= Not Complied.

Therefore, if the P-value is less than α-value (P< α) the null hypothesis will be rejected; this implies that there is a significant difference. However, if the P-value is greater than the α-value (P> α), the null hypothesis will be accepted; this implies that there is no significant difference.

Results

Research Question 1: What is the level of occupational safety and health knowledge of construction workers in building construction sites in Minna?

Table 1: Mean response of the respondents on the level of occupational safety and health knowledge of construction workers in building construction sites in Minna

N_1=33, N_2=42, N_3=47

S/N	Items	X_1	X_2	X_3	X_a	Remarks
1	Construction safety laws and regulations	3.48	3.25	2.73	3.15	HL
2	First aid	2.96	2.96	3.87	3.26	HL
3	Positive safety attitudes	3.84	3.87	2.77	3.49	HL
4	Proper housekeeping	2.48	2.55	2.98	2.67	HL
5	Proper use of ladders	2.55	2.56	2.73	2.61	HL
6	Proper use of scaffoldings	2.45	2.50	3.87	2.94	HL
7	Safety equipment acquisition	3.62	3.60	3.28	3.50	VHL
8	Safety equipment maintenance	2.71	2.70	2.92	2.78	HL
9	Safety records	3.86	3.82	3.87	3.85	VHL
10	Safety training	2.71	2.74	2.53	2.66	HL
11	The use of personal protective equipment	2.92	2.96	2.92	2.93	HL
12	Welfare facilities	2.52	2.57	2.55	2.55	HL
	Xg				**3.03**	**HL**

Keys: X_1 = Mean response of architects; X_2 = Mean response of builders; X_3 = Mean response of engineers; X_a = Average of Mean response of the respondents; Xg = Grand Average of Mean response of the respondents; N_1 = Number of architects; N_2 = Number of builders; N_3 = Number of engineers; VHL- Very High Level; HL= High Level; LL= Low Level and VLL= Vey Low Level.

The result in table 1 shows that two (2) out of the twelve (12) items dealing with the level of occupational safety and health knowledge of construction workers in building construction sites in Minna are very high level. Conversely, ten (10) items are rated high level and none of the items is rated as low level and very low level. Based on the grand average mean value (3.03) which is between the mean range of 2.50 – 3.49, this gives the impetus to conclude that the level of occupational safety and health knowledge of construction workers in building construction sites in Minna is high.

Research Question 2: What is level of compliance of occupational safety and health practices of construction workers in building construction sites in Minna?

Table 2: Mean response of the respondents on the level of compliance of occupational safety and health practices of construction workers in building construction sites in Minna

N_1=33, N_2=42, N_3=47,

S/N	Items	X_1	X_2	X_3	X_a	Remarks
1	Adequate communication of safety issues to all concerned	3.84	3.75	3.80	3.79	HC
2	Availability of first aid	3.55	3.68	3.62	3.61	HC
3	Availability of welfare facilities	3.42	3.7	3.56	3.56	HC
4	Compulsory use of personal protective equipment	2.66	2.77	2.72	2.71	C
5	Construction equipment handled with utmost care	3.76	3.57	3.65	3.66	HC
6	Ladders fixed and secured in position before ascending them	3.73	3.86	3.81	3.80	HC
7	Possession of basic safety training	2.11	2.04	2.08	2.07	C
8	Scaffoldings properly inspected and fix before mounting	2.56	2.66	2.59	2.60	C
9	Strict monitoring of safety policy	3.74	3.61	3.74	3.69	HC
10	Strict monitoring of safety records	3.55	3.59	3.53	3.55	HC
11	Working environment always free from all objects that can cause injury	3.71	3.82	3.79	3.77	HC
	Xg				**3.45**	**C**

Keys: X_1 = Mean response of architects; X_2 = Mean response of builders; X_3 = Mean response of engineers; X_a = Average of Mean response of the respondents; Xg = Grand Average of Mean response of the respondents; N_1 = Number of architects; N_2 = Number of builders; N_3 = Number of engineers; HC- Highly Complied; C= Complied; LC= Low Complied and NC= Not Complied.

The result in table 2 shows that eight (8) out of the eleven (11) items dealing with the level of compliance of occupational safety and health practices of construction workers in building construction sites in Minna highly complied. Conversely, two (2) items are rated complied and

none of the items is rated as low complied and not complied. Based on the grand average mean value (3.45) which is between the mean range of 2.50 – 3.49, this gives the impetus to conclude that the level of compliance of occupational safety and health practices of construction workers in building construction sites in Minna is complied.

Research Question 3: What is the impact of occupational safety and health knowledge and compliance among construction workers in building construction sites in Minna?

Table 3: Mean response of the respondents on the impact of occupational safety and health knowledge and compliance among construction workers in building construction sites in Minna

N_1=33, N_2=42, N_3=47,

S/N	Items	X_1	X_2	X_3	X_a	Remarks
1	Increase productivity	2.54	3.01	2.99	2.85	A
2	Increase efficiency	3.01	3.79	3.73	3.51	SA
3	Improve industry's reputation	2.86	3.67	3.62	3.38	A
4	Reduce project cost	3.17	3.58	3.62	3.46	A
5	Reduce construction site accidents	3.65	2.55	2.57	2.92	A
	Xg				**3.22**	**A**

Keys: X_1 = Mean response of architects; X_2 = Mean response of builders; X_3 = Mean response of engineers; X_a = Average of Mean response of the respondents; Xg = Grand Average of Mean response of the respondents; N_1 = Number of architects; N_2 = Number of builders; N_3 = Number of engineers; SA- Strongly Agreed; A= Agreed; D= Disagreed and SD= Strongly Disagreed.

The result in table 3 shows that one (8) out of the five (5) items dealing with the impact of occupational safety and health knowledge and compliance among construction workers in building construction sites in Minna is strongly agreed. Conversely, four (2) items are rated agreed and none of the items is rated as disagreed and strongly disagreed. Based on the grand average mean value (3.22) which is between the mean range of 2.50 – 3.49, this gives the impetus to conclude that the impact of occupational safety and health knowledge and compliance among construction workers in building construction sites in Minna is agreed.

Hypothesis 1

HO_1 There is no significance difference between the mean response of the respondents on the level of occupational safety and health knowledge of construction workers in building construction sites in Minna

Table 4: Analysis of Variance (ANOVA) between the respondents on the level of occupational safety and health knowledge of construction workers in building construction sites in Minna

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*
Between Groups	0.048067	2	0.024033	0.088299	0.915702
Within Groups	8.981933	33	0.27218		
Total	9.03	35			

Keys: df= degree of freedom, F= F-calculated, P-value= Probability value, MS= Mean Square
Table 4 shows F=0.088299, df (35). Since the P-value (0.915702) is greater than α (0.05) (P>α), the null hypothesis is accepted, this implies that there is no significant difference between the mean responses of the respondents on the level of occupational safety and health knowledge of construction workers in building construction sites in Minna

Hypothesis 2
HO_2 There is no significance difference between the mean responses of the respondents on level of compliance of occupational safety and health practices of construction workers in building construction sites in Minna

Table 5: Analysis of Variance (ANOVA) between the respondents on the level of compliance of occupational safety and health practices of construction workers in building construction sites in Minna

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*
Between Groups	0.00817	2	0.004085	0.011442	0.988627
Within Groups	10.71002	30	0.357001		
Total	10.71819	32			

Table 5 shows F=0.011442, df (32). Since the P-value (0.988627) is greater than α (0.05) (P>α), the null hypothesis is accepted, this implies that there is no significant difference between the mean responses of the respondents on the level of compliance of occupational safety and health practices of construction workers in building construction sites in Minna

Hypothesis 3
HO_3 There is no significance difference between the mean response of the respondents on the impact of occupational safety and health knowledge and compliance among construction workers in building construction sites in Minna

Table 6: Analysis of Variance (ANOVA) between the respondents on the impact of occupational safety and health knowledge and compliance among construction workers in building construction sites in Minna

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*
Between Groups	0.23812	2	0.11906	0.511969	0.611834
Within Groups	2.79064	12	0.232553		
Total	3.02876	14			

Table 6 shows F=0.511969, df (32). Since the P-value (0.611834) is greater than α (0.05) (P>α), the null hypothesis is accepted, this implies that there is no significant difference between the mean responses of the respondents on the on the impact of occupational safety and health knowledge and compliance among construction workers in building construction sites in Minna

Findings

The results of the findings indicated that:

5. The level of occupational safety and health knowledge of construction workers in building construction sites in Minna is high.
6. The level of compliance of occupational safety and health practices of construction workers in building construction sites in Minna is high
7. The impact of occupational safety and health knowledge and compliance among construction workers in building construction sites in Minna is high.
8. There is no significance difference between the mean response of the respondents on the level of occupational safety and health knowledge of construction workers in building construction sites in Minna
9. There is no significance difference between the mean responses of the respondents on the level of compliance of occupational safety and health practices of construction workers in building construction sites in Minna
10. There is no significant difference between the mean response of the respondents on the impact of occupational safety and health knowledge and compliance among construction workers in building construction sites in Minna

Discussion of Findings

The findings on the level of occupational safety and health knowledge of construction workers in building construction sites in Minna revealed that the use of personal protective equipment by workers is paramount in the construction site. This is in line with Abrar et.al., (2017) that building engineers or project managers that all workers should have protective clothing, to minimize injuries during construction activities on the building construction sites. The study also revealed that construction safety laws and regulations reduce occupational hazards in the building construction site. This concurs with Daniel (2015) that the enactment of laws by the government of Nigeria can reduce the injuries due to construction activities at building construction sites.

The findings on the level of compliance of occupational safety and health practices of construction workers in building construction sites in Minna revealed that scaffoldings were properly inspected and fix before mounting and ladders fixed and secured in position before ascending them. This finding coincides with Ellie (2017) that Inspecting all scaffold components before assembly to ensure that components used are of similar material and in good repair before becoming a part of the completed scaffold.

The findings on the impact of occupational safety and health knowledge and compliance among construction workers in building construction sites in Minna revealed that it reduces construction site accidents and increase productivity. This finding concurs with Ahmad et.al., (2016) that safety measures at construction sites helps to prevent unforeseen accidents and enhances workout and productivity.

Conclusion

Building construction was overviewed as an ancient human activity that began with the functional need for a controlled environment to moderate the effects of climate. However, it remains the most dangerous land-based work sector in the world. To this end, various building construction sites in Minna metropolis were studied and the aim was to determine the extent to which the health of

workers are being affected by the construction activities by taking into consideration, the sources of responsible hazards, to generate guidelines to reduce hazards in construction sites in Nigeria. This study further averred that health and safety knowledge and compliance alone cannot substantially improve project performance, this implies that knowledge and compliance alone are not enough to cause behavioural changes required for safety performance but certain aspects of safety culture are required. These other essential safety factors include enforceable regulatory framework, management commitment, workers involvement, which must also be considered for improved project performance.

Recommendations

Based on the findings of the study, the following recommendations were proffered:

1. Since almost all the construction works going on in Minna, Niger State are being handled by the local contractors and construction workers, this study has highlighted the need for effective and enforceable health and safety regulations in the State. Based on the result of this study, this would serve as a wakeup call to agencies responsible for ensuring strict implementation of safety rules on construction sites, if any in the State.
2. Provisions of National Building Code as regards to health and safety on construction site is very obvious, adherence to that provisions will maximize safety performance of our construction sites.
3. During the training of the site workers by the building engineers or the project managers with regards to the knowledge of the causes of injuries on the building construction sites, emphasis should be given to the hazards from excavations and other sub-structural works, roof works, manual handling of block walls and the assembling of other parts of superstructures, and the use of plants and pieces of machinery since hazards from them were significantly rated high.

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Economic Order Quantity Model with Shortages Not Allowed and the Application to the Production Industry: A Case Study of Dana Pharmaceutical Company Minna

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Abstract
A statistical study has shown that the company does not make use of any formal inventory model, but traditional methods and experience. The Economic Order Quantity (EOQ) model is one of the most used classic production-schedule models. The mathematical EOQ models have been established within the scope of the management's operations to determine or control the optimal inventory level. A survey was conducted on the inventory system of the pharmaceutical company. An EOQ model with shortages not allowed was used to study the inventory of the company. The two major raw materials are Magnesium trisilicate and Paracetamol used by the pharmaceutical company for producing Paradana and Danacid (Antibiotic). The result shows that, using the traditional method or experience, the total cost of inventory when shortages are allowed for magnesium trisilicate is about ₦84 million and when a formal EOQ model was implemented on the same data, the total cost of inventory reduced to about ₦31 Million in the same period of cycle. Thus, the result indicates that a minimal total inventory cost is obtained using the formed EOQ model. The company is therefore advised to make use of the formed EOQ model for the inventory system. This will enable it to meet the increasing demand of customers, also on the other hand, strives to obtain minimum inventory costs, as well as demand by her parent companies in Nigeria for a faster profit turnover, also, that finished products must be delivered as required.

Introduction
Inventory as defined by many researchers and or textbooks, is that stock kept at hand for later usage, which has economic value. In the case of production or later exchange activities or services, inventory is very vital. Since inventory represents one of the biggest numbers in a company's balance sheet, the effective inventory and control is a critical function to help indemnify the persistent and continued success of operational, distribution and manufacturing of modern business entities Michalski, (2009). Inventory has also been defined by or referred to as the amount of equity capital available for corporate growth. Inventory could be defined as a stock of goods which is kept in hand for smooth and efficient running of future affairs of an organization. Tom Jose *et al* (2013), states that Inventory control is the most important function of inventory management, and it forms the nerve center in any inventory management organization. Every company, whether in service sector or manufacturing, involves decision making of various kinds. At this point in time, we will discuss decision making related to inventory control and the factors involved in it. Andersson *et al.*, (2010).

Since inventories are stocks or commodities you cannot do without for the successful operation of manufacturing and retailing organization or institutes. It is true that inventory may need some applied methods to control or manage it.The method or ways of maintaining the stocked item for continuous efficient operation at deserved level is called ***Inventory Control.*** This deals with the collection, storing of the inventories, that is, it is carried out for the availability of the inventory when needed.Inventory control management is a vital aspect in the control of materials and goods

that are expected or needed to be kept (held) or stored for a time to come. Consumption in the case of production and or later activities of exchange in services.

The priority or the aim of inventory control is to balance or stabilize an economy that is conflicted with not desiring to hold too much stock.

It is also known that the objective of most or all of an organization is to make profit. But since time, being a dynamic factor, reasons to hold large stock, to have backorders or even run into shortages may occur, and when it does, that is not the end of the road for such organization, if the necessary actions are taken. Also, problems of too big or too small inventory quantities can lead to failures in business i.e. if for example, the manufacturer experiences out-of-stock on an important inventory and the production process halts, shortage in inventory can be explained as when a customer is expecting a retailer to deliver an item, and the item is not stocked or it is readily not available for delivery as expected by the consumer, the retailer might lose the customer.

Therefore, the conclusion that could be deduced from the above is that, effective and efficient inventory control will go a long way to make an important contribution to any company or organizations profit and

The Economic Order Quantity (EOQ) Model is given as:

$$\boldsymbol{Q}^* = \sqrt{\frac{2C_oD}{h}}$$

Where:
Q* = Economic Ordering Quantity
C_o = Cost of Ordering
D = Annual Demand
h = Holding or Carrying Cost

This was imperatively carried out by minimizing the total average system cost per unit time, so as to know or identify the probable number or sizes to be ordered to avoid unnecessary holding of inventory, thereby incurring cost for unwanted shortage. Shortages occur in different ways and different actions leads to shortage, in as much as a service is not met and a loss is incurred in the management of an inventory.

First, a company, which neglects its management of inventory runs, the risk of production bottlenecks and subsequently unable to maintain the minimum investment it requires to maximize profit. (S.L. Adeyemi & A.O. Salami, 2010)

Secondly, inventories that are inefficiently managed may apart from affecting sales create an irreplaceable loss in market for companies operating in highly competitive industry (S.L. Adeyemi & A.O. Salami, 2010). Keth in their text also stated that the major objective of inventory management and control is to inform managers how much of goods to re-order, when to re-order the goods, how frequently orders should be placed and what the appropriate safety stock is, for minimizing stockouts. Thus, the overall goal of inventory is to have what is needed, and to minimize the number of times one is out of stock, Keth et al (1994).Since a company should not keep excess inventories to avoid unnecessary tying down of funds and so as not to lead to spoilages

and obsolescence of inventories, therefore, the fact that improper inventory control affects virtually the organizational objectives has necessitated this research work.The aim of this study is to apply the inventory model to production company and a case study of Dana pharmaceutical company in a Minna, to check if they are using the formal inventory control method to operate and to provide the Total Inventory Cost (TIC) for the company when traditional method/experience is used and when formal EOQ model with shortages allowed is used.

Keywords and Phrases: Economic Order Quantity, Cost of Ordering, Annual Demand, Holding or Carrying Cost, Inventory Management, Inventory Model, Order Size, Order Numbers, Purchasing Cost, Total Inventory Cost, Optimization.

Short History of Dana Pharmaceutical Company

Dana Pharmaceuticals Limited commenced manufacturing of intravenous fluids in 1996. The factory has been expanded with the setting up of a formulation plant for the manufacture of a wide range of pharmaceutical formulations. With the motto "a commitment to healthcare" in mind and one of the best technologies in hand, it is devoted to the production of quality and genuine products that are offered at the most affordable prices nationwide.

Method of Analyzing the Data

The data obtained (collecting) for analysis was analyzed by application of two major qualitative instruments. The Chi-Square distribution method, the Economic Order Quantity model with planned shortages not allowed.The Economic Order Quantity model with planned shortages not allowed would be used to identify if the organization has been using the EOQ model to analyze their record so far.The chi-square distribution was applied to draw inference about the distribution's variance with each of the distribution determined by 4 degree of freedom.

EOQ Model with Planned Shortages Not Allowed

Knowing that the policy of every company is to operate at maximum profit without shortages, we will calculate their efficiency in terms of production and the level of their inventory optimality i.e., if they operate with the use of EOQ or just on ordinary grounds.

The EOQ model planned shortages not allowed Assumptions

1. Demand is known and constant. 2. Lead time is zero. 3. The replenishment of material is instantaneous. 4. Shortages are not allowed

The Model Notations

Q = The Ordered quantity per unit per order, T = The total cost per unit of time, h = The holding cost of the inventory per cost unit per time, d = The demand rate per cycle period, K + cQ = The setup cost or the production cost.

The model is given as follows:

$$\mathbf{Q^*} = \sqrt{\frac{2dK}{h}}$$

(*Source***:** Chapter 19 Inventory Theory (unicamp.br)**)**

Calculating The Expected Value

During this research, calculating the expected value will be done by taking the average of the Economic Order Quantity for the five years.

Calculating the Degree of Freedom
γ = (r-1) (c-1) where $\gamma =$ degree of freedom

The decision rules states:
If the table value is greater than the calculated value, thus, we shall accept the null Hypotheses (H_0) and then reject the Alternative Hypotheses (H_1), else, accept the Alternative Hypotheses (H_1).

The Confidential Interval
α = 5% (0.05)

Hypotheses Testing
The statistical test is the $\chi^2 = \sum \frac{(V_0 - V_e)^2}{V_e}$

Results and Discussion
Data Representation
Chi Square Test Whether or Not the Company Uses Formal EOQ Model

The Decision Rules:
If the table value is greater than the calculated value, thus, we shall accept the null Hypotheses (H_0) and then reject the Alternative Hypotheses (H_1), else, accept the Alternative Hypotheses (H_1). Where r is the number of rows of the calculated table, which are the number of years the extracted data have been obtained. They are 2015 – 2019 (Five years), and c is the number of columns for the data of the observed value (V_o) and expected value (V_e). The variables used in this case are the Ordering cost per unit ordered, Demand and the Holding cost.

Then,

$$\gamma = (4)(2) = 8$$

This implies the degree of freedom of 8 will be used to calculate (compare) the value of the chi-square test.

Hypotheses Testing

The statistical (Chi) test is $\chi^2 = \sum \frac{(V_0 - V_e)^2}{V_e}$

Findings of this research
The findings from the above representation in all the two cases shows that we have failed to reject the null hypotheses, and the alternative hypotheses has been rejected since using Magnesium Trisilicate as parameter, the analysis depicts the x^2 calculated value of 0.8727, which of course is lower when compared with the table value of chi-square of 15.507 also, using Paracetamol as parameter, the analysis depicts the x^2 calculated value of 1.6240, which of course is lower when compared with the table value of chi-square of 15.507. The above information also shows that the

company runs a policy of making orders almost every month or every month within a year. It can also be observed that the pharmaceutical company does not adopt the EOQ model in ordering for its raw materials, this is the reason for the variation between the calculated optimized order and the expected optimized order of the pharmaceutical company.

Implementation of the Economic Order Quantity

This will be carried out by extracting a recent one-year (2019) production record for both raw materials from the data base of the company. The parameters needed for this section are:Total demand for the year (d).The cost of purchase for each item (cQ).The cost of placing the order (K).And the cost of storage for each item per year (h).

The EOQ model with planned shortages not allowed Assumptions

1. Demand is known and constant 2. Lead time is zero 3. The replenishment of material is instantaneous 4. Shortages are not allowed

The Model Notations

Q = The Ordered quantity per unit per order, T = The total cost per unit of time, h = The holding cost of the inventory per cost unit per timed = The demand rate per cycle period.
The model is given as follows:

$$Q^* = \sqrt{\frac{2dK}{h}}$$

$$N^* = d/Q^*$$

Table 1: Data of Material Stocked-in (Purchased) and used (Demand) in 2019

	MAGNESIUM TRISILICATE			PARACETAMOL		
	DEMAND (d)	**2019 (Q)**	**Safety stock**	**DEMAND (d)**	**2019 (Q)**	**Safety stock**
TOTAL	**183,691**	**172,075**		**88,312**	**96,550**	
NUMBERS OF ODERS		**7**			**9**	
AVERAGE PURCHASE		**14,340**			**8,046**	
B/F			**48,595**			**6,605**
AVERAGE DEMAND	**15,308**			**7,359**		

Data for Purchasing in 2019

From the data above, it is observed that Magnesium Trisilicate was ordered seven (7) times, and Paracetamol was ordered nine (9) times, though the number of times the raw materials were ordered is not a determinant factor for the quantity of the average purchase for the year, where

Magnesium Trisilicate was ordered seven (7) times with average purchase of 14,340kg and Paracetamol was ordered nine (9) times with average purchase of 8,046kg.

Also, the average usage of the magnesium trisilicate per month is 15,308kg, while paracetamol is 7,359kg per month.

Ordering Costs:
The cost of the raw material ordering is connected with the cost of material transportation, calls, booking at the head office and all forms of paperwork associated with the transfer of raw materials from the head office. The cost of raw material in 2019 is ₦ 800/kilogram for Magnesium trisilicate and ₦ 950/kilogram for Paracetamol.

Table 6: Ordering Cost table for the Raw materials

	Magnesium Trisilicate	Paracetamol
	2019 (K)	**2019 (K)**
TOTAL	**137,660,000**	**91,722,500**
AVERAGE PURCHASE	**11,471,667**	**7,643,542**

The ordering cost was obtained by multiplying each purchased quantity per month by their respective cost prices. The cost of purchasing a kilogram of Magnesium Trisilicate in 2019 is ₦800/Kg as seen in Table 6 and the cost of purchasing a kilogram of Paracetamol is ₦950/Kg as seen in table 7.

Table 8: Economic Ordered Quantity Result

Information	Magnesium Trisilicate	Paracetamol
Quantity of demand (kg/Year)	**183,691**	**88,312**
Purchased Cost (₦)	**11,471,667**	**7,643,542**
Holding cost per year (₦)	**230.82**	**230.82**
EOQ of Kilogram	**135,124**	**76,478**

Analysis
In the table above, the optimized raw material quantity to be ordered for each time the company is to make order for Magnesium Trisilicate = 135,124 kilograms and for Paracetamol = 76,478 kilograms. We can also deduce from the table that the optimal number of ordering time for Magnesium Trisilicate and Paracetamol is

N* = $\frac{183,691}{135,124} = 1.4 \sim 2\ times$ **orders and N* =** $\frac{88,312}{76,478} = 1.1 \sim 2\ times$ **respectively.**

Total Inventory Costs

EOQ Model (New) **TIC =** $\sqrt{2.d.K.h}$

Company (Old) Practice of **TIC = (Average demand/month (d) x Holding cost (h)) + (Ordering cost (k) x Number of yearly orders (K))**

From the above equation we will evaluate the policies to see the best policy for the pharmaceutical company.

For Magnesium Trisilicate

EOQ Policy

TIC = $\sqrt{2 \times 183{,}691 \times 11{,}471{,}667 \times 230.82} = ₦31,189,537.00$

Company Policy

TIC = $(15{,}308 \times 230.82) + (11{,}471{,}667 \times 7) = ₦83,835,062.00$

For Paracetamol

EOQ Policy

TIC = $\sqrt{2 \times 88{,}312 \times 7{,}643{,}542 \times 230.82} = ₦17,652,609.00$

Company Policy

TIC = $(7{,}359 \times 230.82) + (7{,}643{,}542 \times 9) = ₦70,490,482.00$

Table 9: The data of the Total Inventory Control

Information	Magnesium trisilicate	Paradana
TIC on EOQ Method (₦)	**31,189,537.00**	**17,652,609.00**
TIC on Company policy (₦)	**83,835,062.00**	**70,490,482.00**
Numbers of Ordering time	**2**	**2**

Analysis

It is observed from the above table that, if the company continues with the raw material purchasing policy, then they are likely to shut down the Minna branch of the Company, and the number of times to order for raw material is not necessarily 7 or 9 times as seen in table 8 above, they can place their orders twice in a year and still achieve the goals of their production, even with the above optimum purchase amount.

Table 10: Comparing the Company policy to the EOQ policy on Magnesium Trisilicate

Information	Company	EOQ
Quantity of stock in (Purchase) (kg)	15,308	135,124
Number of Order	**7**	2
Total Inventory Cost (₦)	**83,835,062.00**	**31,189,537.00**

Table 11: Comparing the Company policy to the EOQ policy on Paracetamol

Information	Company	EOQ
Quantity of stock in (Purchase) (kg)	7,359	76,478
Number of Order	9	2
Total Inventory Cost (₦)	**70,490,482.00**	**17,652,609.00**

From table 10 and 11 above, it can be seen that the EOQ methods calculation is much more optimal, the reason being that the total inventory cost is cheaper (EOQ cost is equal to ₦31,189,537.00, while the company policy is ₦83,835,062.00) since the number of orders in the traditional method is more than that of the EOQ, so if the cost of the material is to be large, this will directly affect the total cost of inventory. This is also the same as Paracetamol, the EOQ cost is ₦17,652,609.00 while the calculated company policy is ₦70,490,482.00, explaining that applying the EOQ method is much better than the company's policy of operation.

Findings of this research

The findings from the above representation shows that, the EOQ model without shortages can be applied in the pharmaceutical. The above information provided also shows that the company can run a policy of making orders twice within a year, reducing the cost of ordering and other holding cost attached to each cycle of placing an order. It has become necessary that the pharmaceutical company adopt the EOQ model method in ordering for its raw materials, this is to control the variation in the cost of their inventory handling. From the above, the pharmaceutical company, without EOQ model was operating with the total inventory cost of Magnesium trisilicate to be ₦83,835,062.00 compared to the EOQ model with shortages not allowed which is ₦31,189,537.00, observing that it is on the safer side to produce Danacid while applying the EOQ models. The above information also shows that the pharmaceutical company, operates was operating with the total inventory cost of Paracetamol to be ₦70,490,482 compared to the EOQ model with shortages not allowed which is ₦17,652,609.00, observing that it is on the safer side to produce Paradana while applying the EOQ models

Conclusions

The pharmaceutical company, traditionally was operating its production with the total cost of inventory for Magnesium trisilicate to be ₦83,835,062.00 compared to the EOQ model with shortages not allowed which is ₦31,189,537.00, observing that it is on the safer side to produce Danacid while applying the EOQ models. The above information also shows that the pharmaceutical company, was producing with the total cost of inventory for Paracetamol to be ₦70,490,482 compared to the EOQ model with shortages not allowed which is ₦17,652,609.00, hence, it is safer for the company to produce Paradana using the EOQ models.

It has also become necessary that the pharmaceutical company adopt the EOQ model method in ordering raw materials, this is to control the variation in the cost of their inventory handling and to ensure the absolute control of loss and wastages and also,incurring unnecessary carrying costs.

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Assessment of Motor Vehicle Used Oil Management Practices in Kaduna Metropolis of Kaduna State, Nigeria

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Abstract
For a long time, used oil has been reused or disposed in methods that contaminated the environment or not recycled to maintain its resource value. In Nigeria, it is estimated that 200 million gallons annually are poorly disposed by pouring on the ground, being taken to dumpsites or discharged down sewers and storm drains. One gallon of used oil can contaminate up to one million gallons of clean water. Used oil also end up in lakes, rivers and streams where they threaten aquatic life. This study explored the handling, management and disposal of used oil. The study also sought to identify the current uses and disposal methods of used oils and make recommendations that could help other entities to effectively manage used oil.Findings reveal that proper management of used oil not only prevents environmental degradation but can also results in significant economic benefits. In Nigeria, used oil is transported to cement factories where it is used for heating. Used oil can be processed into fuel oil, re-refined into lubricants or used as raw materials for refining and petrochemical industries.

Introduction
Used oil is generated from a broad variety of sources within the transportation, construction and industrial sectors and consists of lubricating oils [motor and transmission oil] and industrial oils[hydraulic and cutting oils].The petroleum industry has grown at a very fast rate since its inception and became an indispensable element of society particularly in urban communities. Besides the fact that petroleum and crude oil are inexhaustible resources, waste products resulting from this these industries present a hazard to human health and the environment. As such, proper management of the waste oil is necessary to prevent its adverse environmental impacts associated with these practices.Strategies for proper waste oil management are then proposed in the context of prevailingpublic perception and environmental awareness. Finally, the economic feasibility of waste oil recycling as a management option is discussed, taking into consideration country-specific technical and socio-economic characteristics.The united states Environmental Protection Agency [EPA] defines the term 'used oil' as 'any petroleum or synthetic oil that has been used, and as a result of such use is contaminated by physical or chemical properties' [EPA,2017]. The EPA uses three pronged criteria to define all used oil: 1. Origin 2. Use, 3. contaminants.

The origin criterion posits that for any substance to qualify as used oil, it must have originated from crude oil or synthetic materials [Ogbeide 2010]. Thus, vegetable and animal oil do meet the definition of used oil as they originated from different sources.

The used criterion suggests that for any substance to fit the definition of used oil, it must have been put to some use such as lubricants, buoyant, heat transfer fluids, hydraulic fluids, and other purposes. Thus, virgin oil recovered from spills does not qualify as used oil because this oil has never been 'used'.The contaminants criterion demands that for a substance to qualify as used oil, it must be contaminated by either chemical or physical impurities due to usage [zitte, Waadu, &okorodike,2016]. Examples of contaminants include dirt, sawdust, metal shavings, saltwater, halogens, solvents, and residues.

The main generators of used oil are small generators [do-it-yourself [DIY] for motor vehicle, farm machinery and other equipments], vehicle repairs and servicing, industrial activities and shipping operations [zitte etal.,2016]. The quantity of used oil generated from these sources is difficult to quantify.Oil change in machines is a regular activity which is carried out in facilities equippedfor the job [formal garages], open air garages or on site [Ogbeide,2010]. On site oil changes are carried out by do-it-yourself[DIY] in service and repair of motor vehicles and farm machineries. These sources of used oil are regarded as small used oil generators and basically produce less than 10 litres of used oil at any one time. There is no proper used oil collection and disposal system.The amount of oil changed at petrol service station is quite low compared with those changed in open air garages where multiple services are offered at the same time hence the preference by some motorists[Abro etal.,2013]. The latter practice poses a great environmental risk since the grounds are pervious and there is no proper prevention of spillages. The branded service station has established a Safe Waste Oil Disposal[SWOD] initiative whereby a common truck collects the used oils and transports it to a treatment plant. In an open air garages, the used oil is collected in drums or other small containers and there is no clear chain of custody of the oil after collection. Hence, the oil may be used in other applications rather than being re-refined as recommended.

Used oil is also generated from petroleum refineries, other industrial sources such as metal working industries, industrial machines, transport industry [Railway, ships, aviation] petroleum tank cleaning, bulk petroleum storage tanks and heat transfer e.g, electric transformers [Abro etal.,2013]. One of the key sources of oily wastes is the sludge discharged from petrol storage tanks. The sludge that is often formed by high pressure water jet cleaning of storage tanks comprise of iron oxide, corrosion products, and sediments containing organic and inorganic compounds mixed with fuel[EPA,2017]. The used oil from industrial sources is reprocessed at recycling factories while that which is generatedfrom petroleum tank cleaning operations is used for energy recovery or disposed off through weathering site. For many decades, motor oil has been salvaged or discharged in ways that neither conserve the environment nor sustained its resource value. In Nigeria alone, an estimated 377 million litres of used motor oil were generated in the year 2003[Muia, 2004]. Most of this volume is inappropriately disposed of by being discarded on the ground, thrown in the trash[ending up in landfills], and dispensed down storm sewers and drains. The rest is used for timber treatment, upgrading of dusty roads, and mosquito control in ponds, irrigation areas and swampy areas. Some insignificant amount is recycled for burning in cement kilns.

Applying the cradle-to-grave concept, manufacturers of products must follow them up from production, to their use, until their final disposal. Lubricant manufacturers should be the first ones to be concerned with measures to be taken in order to capture the cradle to grave concept in use of lubricants.

In Nigeria most of the used oil generated is disposed in ways that pose serious threats to the environment and this can partly be attributed to the slack legislation regarding its disposal and ignorance of persons about the health risks it poses during handling of used oil[Muai,2004]. This therefore poses major challenge to not only the government but also the oil manufacturers that supply other users, as well as on consumers who actually generate used oil from their equipment to come up with disposal methods that are environmentally suitable.

Disposal of used oil through drainage system, storm water drains or simply dumping on the ground is common especially as the roadside mechanics garages against the regulation of waste management regulatory agency [muai,2004].

Major oil marketers who market their lubricants alongside petrol fuel have a way of collecting used oil through use oil underground tanks or drums in their service stations but still face difficulties on disposal. The tanks are connected to the pit stop bays where vehicles are serviced[kamau,2016]. The oil is then drained into used oil underground tanks or drums where underground tanks are not installed. The stations

are designed with oil water interceptors/seperators connected to the drainage system within the station that drains into storm water drains. The interceptor is a system of chambers that filter out the oil and allows only clear water to drain off into storm water drains. The oil left in the interceptor is schemed or scooped off into the used oil storage.

However, most independent roadside garages in Kaduna metropolis do not have this interceptor system and hence used oil is dumped on the ground and continues to flow and to be washed off by rain into storm water [kamau,2016]. In addition, it has been established that even oil marketers that have the interceptor system do not have laid down procedure of handling the oil once the tanks are full. This has led to disposing it through un-environmentally friendly ways including selling to third parties who use it in various ways including dust suppression, swampy areas treatment, to mention but a few. All these methods of oil disposal pose serious threats to the environment, more adversely to water.

Research questions

The following research questions guided the study:

1. What are the collection practices of motor vehicle used oil in Kaduna metropolis of Kaduna state?
2. What are the disposal practices of motor vehicle used oil in Kaduna metropolis of Kaduna state?
3.

Hypotheses

Two research hypotheses were formulated for the study and tested at 0.05 level of significance;

Ho1 There is no significant difference in the mean responses between registeredMotor vehicle mechanics master craftsmen and officials of all the waste managementregulatory agencies in Kaduna metropolis of Kaduna State as regards the collection practices of motor vehicle used oil waste management in Kaduna metropolis of Kaduna State, Nigeria.

Ho2 There is no significant difference in the mean responses between registered Motor vehicle mechanics master craftsmen and officials of all the waste managementregulatory agencies in Kaduna metropolis of Kaduna State as regards the disposal practices of motor vehicle used oil management in Kaduna metropolis of Kaduna State, Nigeria.

Methodology

The research design adopted for this study was a descriptive survey research design. In the view of Anyakaoha [2009], a descriptive survey employs the use of questionnaires, interviews and direct observation to ascertain the opinions, attitudes, perception and preference of individuals under study. This study was carried out in Kaduna metropolis of Kaduna state. The targeted population for this study consists of 388 respondents comprising of 208 registered automobile mechanics master craftsmen in the formal workshops and 180 officials of the all motor used oil waste management regulatory agency in Kaduna metropolis who were randomly selected using stratified sampling method.

A structured questionnaire was the instrument for data collection. The instrument was face and content validated by two experts, one from the department of industrial and technology education automobile technology option, Federal University of Technology Minna, Niger state and the other from Kaduna state wastemanagement Agency. To determine the ability and reliability of the instrument, it was pilot-tested on 30 respondents in Minna,Niger state that was not part of the study. Cronbach Alpha was used to determine the internal consistency of the instrument and it yielded a reliability co efficiency of 0.84. Thus the instrument was considered appropriate for use by the researcher. The questionnaire was administered by the researcher with the help of five research assistants and 347 instruments were retrieved and analysed.A four [4] rating scale was used in the study from Strongly Agreed[SA]-4 pointsto Strongly Disagreed [SD]-1 point. The decision rule was based on the theory of true limit class limits of numbers with numerical

values:Strongly Agreed [SA] =3.50-4.00, Agreed [A] =2.50-3.49, Disagreed[D] =1.50-2.49, Strongly Disagreed [SD] =0.50-1.49. Therefore, the mean responses of the respondents were interpreted based on the true limits of numbers as highlighted above. The data collected from the study were analysed using mean and standard Deviation. The two null hypotheses were tested using z-test at 0.05 level of confidence.

Results

Research question 1

What are the collection practices of motor vehicle used oil in Kaduna metropolis of Kaduna state?

Table 1: Mean Responses of Registered Motor Vehicle Mechanics Master Craftsmen and Officials of all the Motor Vehicle Used Oil Management Regulatory Agencies in Kaduna Metropolis of Kaduna State as regards the Collection Practices of Motor Used Oil Management.
N1=187,N2=160

S/N	Statements	X_1	X_2	X_T	SD_1	SD_2	SD_T	Decision
1	Oil rags are placed in a sealed container for ease of collection	2.10	2.10	2.10	0.54	0.49	0.52	Disagree
2	Hazardous automobile waste are usually stored in closed containers for collection by licensed agencies	2.06	2.02	2.04	0.50	0.46	0.49	Disagree
3	Used solvent are kept in sealed drums for collection	2.01	1.98	2.00	0.48	0.43	0.45	Disagree
4	Used oil filters are crushed for collection by metal recycler	2.09	2.02	2.05	0.64	0.50	0.57	Disagree
5	Waste oils are stored in separate drums for collection	2.10	2.07	2.09	0.61	0.34	0.47	Disagree
6	Only metallic scraps of automobile waste are collected by waste pickers	2.71	2.88	2.79	0.78	0.83	0.80	Disagree
7	There are modern waste collection facilities for automobile waste in all the local governments	2.04	2.02	2.03	0.40	0.51	0.45	Disagree
8	Registered private waste collectors provide services for the collection of automobile waste	2.01	2.04	2.02	0.35	0.47	0.41	Disagree
9	Informal waste pickers collect metallic scraps of automobile waste from mechanic shops, vehicle users and dump sites	2.51	3.00	2.76	0.87	0.45	0.66	Disagree
10	There is curb side used oil collection programme for oil recycling incentives	1.95	2.08	2.02	0.38	0.45	0.41	Disagree
11	Waste antifreeze is stored in separate closed container for collection	2.07	2.06	2.07	0.45	0.38	0.42	Disagree
12	Catalytic converters are taken to a catalytic converter collection centres for profit	2.13	2.15	2.14	0.54	0.54	0.54	Disagree
13	Bad batteries are stored separately from other flammable hazardous chemical for collection by recycler	2.12	2.26	2.19	0.63	0.60	0.61	Disagree

14	Drip pans are kept under stored vehicles with oil leaks for collection during repair work	3.08	3.14	3.11	0.63	0.35	0.49	Strongly Agree
15	Used refrigerants from vehicle are collected in approved recovery equipment for off-site reclamation	2.06	2.10	2.08	0.59	0.45	0.52	Disagree
16	Used tyres are collected for landfilling	2.13	2.14	2.13	0.58	0.47	0.53	Disagree
17	Punctured and emptied aerosol cans are stored in a container for ease of collection by scrap merchants	2.11	2.18	2.14	0.56	0.53	0.54	Disagree
18	Metals such a lead, copper, aluminium and steel are stored in a secure container for collection by a metal recycler.	2.07	2.21	2.14	0.49	0.59	0.54	Disagree

Table 1 above presents the results on collection practices of motor vehicle used oilmanagement in Kaduna metropolis. The results revealed that Registeredmotor vehicle mechanics Master Craftsmen and Officials of all the Waste ManagementRegulatory Agencies in Kaduna metropolis agreed that only three items which are items 4, 8 and 16 are the major ways by which motor vehicle used oil are being collected in Kaduna metropolis of Kaduna state. This implies that other items suggested are not widelypractised within the state understudy. The average standard deviation rangesfrom 0.26 to 0.81 which inferred that the respondents were closer to each otherin their responses to the items.

Research Question 2

What are the disposal practices of motor vehicle used oil management in Kaduna metropolis?

Table 2; Mean Responses of Registered Motor Vehicle Mechanics Master Craftsmen andOfficials of Motor Vehicle Used Oil Management Regulatory Agencies in Kaduna Metropolisof Kaduna State as regards the Disposal Practices of Motor Vehicle Used Oil

S/N	Statements	X_1	X_2	X_T	SD_1	SD_2	SD_T	Decision
1	Automobile waste dumping sites around the workshop are demarcated for disposal	2.03	2.08	2.05	0.39	0.31	0.35	Disagree
2	Used oil drained into drip pans are disposed into waste oil drum or tank separately	2.24	2.21	2.23	0.58	0.51	0.54	Disagree
3	Waste antifreeze is discharged into land rivers/streams/drains/canals for disposal	3.02	3.11	3.06	0.52	0.31	0.42	Strongly Agree
4	Used oil filters are punctured, drained and crushed for disposal	2.11	2.26	2.18	0.43	0.62	0.52	Disagree
5	Mechanics workshops do not have sink drain for wastewater	2.94	3.07	3.00	0.53	0.36	0.44	Strongly Agree
6	Used oils generated from mechanics workshop are disposed around their workshop to control dust and weeds	3.04	3.13	3.09	0.27	0.49	0.38	Strongly Agree
7	There are public landfills for disposing automobile waste	2.00	2.04	2.02	0.21	0.36	0.28	Disagree
8	Automobile wastes such as plastics, used tyres, rags or absorbents are disposed through burning	3.06	3.23	3.15	0.25	0.42	0.33	Strongly Agree

9	Battery charger discharge used acid anywhere around their shop	3.00	3.03	3.01	0.18	0.40	0.29	Strongly Agree
10	Vehicle air conditioning refrigerants are discharged into the air	3.02	2.85	2.93	0.26	0.70	0.48	Agree
11	Automobile wastes such as polymer bumper, glass, dash board, seat foam and clothing are disposed with domestic waste	3.03	3.10	3.06	0.24	0.54	0.39	Strongly Agree
12	Automobile mechanics workshop, vehicle users, dealers, and automobile industries are responsible for their wastes disposal	3.01	3.09	3.05	0.32	0.51	0.42	Strongly Agree
13	Used oils are discharged to the ground, sewers, drainage, ditches, septic tanks or streams.	3.04	3.08	3.06	0.19	0.41	0.30	Strongly Agree
14	Used motor oils are exchange for new oil from refinery agents at reduced price for disposal	2.02	2.14	2.08	0.21	0.40	0.30	Disagree
15	Used oils are burnt for fuel.	2.11	2.43	2.27	0.33	0.52	0.43	Disagree
16	Lead wheel (tyre) weight unused are returned to supplier and not put in dumpster	2.04	2.16	2.10	0.29	0.50	0.39	Disagree
17	Un-deployed airbags are sold for reuse.	2.03	2.08	2.06	0.37	0.56	0.47	Disagree
18	Catalytic converters are specially sell to core buyers	2.05	2.13	2.09	0.29	0.45	0.37	Disagree

The result of analysis as presented in Table 2 on the disposal practices of motor used oilmanagement in Kaduna metropolis of Kaduna State, Nigeria showed that therespondent disagree with items 1, 2, 4, 7, 14, 15, and 16 as well as items 17, and18 as regards the disposal practice adopted in managingautomobile waste. This is evident from the mean results which shows that all the items indicated have. Theiraverage mean not less than 1.50 and not more than 2.49. This implies thatother items presented in the table are the disposal practice of motor vehicle wasteadopted in Kaduna metropolis of Kaduna State, Nigeria. A grand average showed a standard deviation (SD) of 0.308-0.702 indicating that the respondents are not too far from the mean and not from one another in their responses.

Hypothesis One

There is no significant difference in the mean responses between registeredMotor vehicle mechanics master craftsmen and officials of all the motor vehicle used oil managementRegulatory Agencies in Kaduna metropolis of Kaduna State as regards the collection practices of motor vehicle used oil waste management in Kaduna metropolis of Kaduna State, Nigeria.

Table 3: z-test analysis of significant difference in the mean responsesbetween registered motor vehicle mechanics master craftsmen and officials of all the motor vehicle management regulatory agencies in Kaduna metropolis of Kaduna State as regards the collection practices of motor vehicle waste management in Kaduna metropolis of Kaduna State.

N_1 = 187, N_2 = 160

Hartley Test for Equal Variance z-test for Equality of Means									
				Std Error				95% confidence for interval (2 difference tailed)	
	F	Sig	Mean Diff	Diff	z	Df	Sig. tailed)	Lower	Upper
Equal Variance Assumed	0.31	0.04	-0.060	0.057	-1.053	345	0.293	-0.172	0.052
Equal variances not assumed			-0.060	0.056	-1.064		0.288	-0.171	0.051

Table 3 shows the z-test analysis of differences in the responses of RegisteredMotor vehicle mechanics Master Craftsmen and Officials of all the Waste ManagementRegulatory Agencies in Kaduna metropolis of Kaduna State as regards the Collection Practices of motor used oil Management. The table reveals that the probability valueobtained was found to be 0.288 which is greater than the probability value of0.05 in comparison. The null hypothesis was therefore accepted. Therefore,there is no significant difference in the mean responses of RegisteredMotor vehicle mechanics Master Craftsmen and Officials of all the Waste ManagementRegulatory Agencies in Kaduna metropolis of KadunaState as regards the Collection Practices of Motor used oil Management in Kaduna metropolis of Kaduna State.

Hypothesis Two

There is no significant difference in the mean responses between registeredMotor vehicle mechanics master craftsmen and officials of all the waste managementRegulatory Agencies in Kaduna metropolis of Kaduna State as regards the disposal practices of motor vehicle used oil management in Kaduna metropolis ofKaduna State, Nigeria.

Table 4: z-test analysis of significant difference in the mean responsesbetween registered motor vehicle mechanics master craftsmen and officials of all the waste management regulatory agencies in Kaduna metropolis of kaduna State as regards the disposal practices of motor vehicle used oil management in Kaduna metropolis of Kaduna State.

Hartley Test for Equal Variance z-test for Equality of Means									
				Std Error				95% confidence for interval (2 difference tailed)	
	F	Sig	Mean Diff	Diff	z	Df	Sig. tailed)	Lower	Upper
Equal Variance Assumed	2.48	0.00	0.000	0.046	0.0003451	3451.000		-0.091	0.091
Equal variances not assumed			0.000	0.048	0.000		1.000	-0.094	0.094

Table 4 shows the z-test analysis of differences in the responses of RegisteredMotor vehicle mechanics Master Craftsmen and Officials of all the Waste Management Regulatory Agencies in Kaduna metropolis of Kaduna State as regards the Collection Practices of motor vehicle used oil Management. The table reveals

that the probability valueobtained was found to be 1.000 which is greater than the probability value of0.05 in comparison. The null hypothesis was therefore accepted. Therefore,there is no significant difference in the mean responses of RegisteredMotor vehicle mechanics Master Craftsmen and Officials of all the Waste Management Regulatory Agencies in Kaduna metropolis of Kaduna State as regards the Disposal Practices of Motor vehicle used oil Management in Kaduna metropolis of Kaduna State.

Findings /Discussion

Findings on the collection practices of motor vehicle used oil management revealedthat hazardous motor vehicle used oil are not usually stored in closed containersneither collected by licensed agencies in the study area this might be as a resultof lack of knowledge on their potential hazards on the part of automobilemechanics. This finding is in support of Abarca*etal,* (2013); Agarwal *etal*,(2015) who reported that the risk of exposure to automobile waste is influencedby poor management practice or neglect characterised by ineffective collection,unsafe disposal and absence of good polices. The findings of this study alsoshows that used waste motor oils, waste antifreeze and other material are notneither properly kept nor collected for appropriate disposal but subsequentlydumped in every available space and places, especially around automobilemechanics workshops. Lack of information and public enlightenment on healthimplication of improperly collected and disposed automobile waste might be responsible for this. This might also be attributed to lack of regulatoryframework specifically for motor vehicle used oil in general and stateenvironmental laws, standards and regulation. European Commission (EUC)(2010); Modak*etal*, (2012); Abarca*etal*, (2013) corroborated this finding thatthe waste management regulatory agencies must encourage the prevention orreduction of automobile waste and its impacts on the environment by encouraging the development of recycling and recovery technologies, improved eco-friendly products and disposal techniques in line with global practices.Abdhallahi (2015); Warlito&Charlie (2015) suggested that to avoid exposureto risk from automobile waste requires stringent management practices withadherence to safety standards in handling automobile waste particularly liquidwaste.

The findings also revealed that used solvent generated in the cause of repairs and maintenance work by automobile mechanic shop is properly stored and not collected by licensed agency but disposed irregularly. Solvent can causedamage to our skin, eyes, nose and throat, and respiratory system as well, whichcan result in chronic bronchitis and lung disease. In support of thisCommonwealth of Massachusetts (2017) explained that cleaning liquid wastesare hazardous and therefore require proper treatment and disposal. CIWMB (2003) opined that mineral spirits containing volatile organic compounds(VOC) contributed to smog formation and may be toxic when inhaled oringested. The finding also revealed that automobile air-conditioning repairmechanics do not have recommended recovery equipment for used refrigerantslet alone sending it for reclamation but usually vents it into the air. This trend isnot acceptable because refrigerants vent into the air is one of the chemicals known to destroy the ozone layers, causing a rise in skin cancer and cataractsproblems or permanent blindness. Also toxic fume from burned refrigerant isconfirmed to be poisonous. According to Hazardous Waste Experts (2017)recycling and reclamation are the two methods usually used to managerefrigerant rather than disposing it improperly. In support of this CIWMB(2003) advocated that Freon gas is one of the chemicals known to destroy theozone layers, our planet's protection against harmful rays from the sun and thuscausing a rise in skin cancer and cataracts problems and can result to frostbiteor permanent blindness. It has therefore become very necessary for the automobile mechanics and others specialties in automobile maintenance sector including technical staff in automobile industries to be aware of the consequences of discharging automobile air-conditioning refrigerant into the air rather than properly contained it.

Findings on the disposal practices of motor vehicle used oil management revealedthat automobile wastes such as plastics, used tyres, rags or absorbents aredisposed through burning. This trend is not only unhealthy but contributed toair pollution which is a threat not only to the environment, but also residentsthat live in close proximity to the location of burning. The finding is inconformity with the observation of

Abdhalah*etal.*, (2016) which stated that theparticulates matter released form uncontrolled burning of automobile waste hasbeen proven to affect lungs especially people with asthma, heart disease,allergies and climate change. This observation is also in harmony with theopinion of Al-Delaimy*etal.*, (2014) who noted that most often automobile wastegenerators, informal collectors (waste scavengers), those working or living neardisposal sites, waste management staff be it government or private sector andthose living near or working in waste treatment or recycling facilities are at highside to these risks. That is why it is important to give automobile waste propermanagement it deserves.

The finding also indicated that used motor oils generated from mechanics workshop are disposed around their workshop to control dust and weeds; usedoils are discharged to the ground, sewers, drainage, ditches, septic tanks orstreams; used oil filters are not punctured, drained and crushed for disposal. Itshould be noted that waste motor oil discharged into the soil has been confirmedto be the single largest source of ground water contamination which is toxic tohuman health. This finding is in consonant with Jonathan and Elaine (2012) who reported that improperly managed motor oil is the major largest source ofoil pollution that results in major environmental damage. For example, thebenzene based aromatic component in oil can cause cancer and other healthproblems if the oil is inhaled or ingested. Therefore, all used oil drained, shouldbe collected and properly managed. The finding further disclose that batterycharger discharge used acid was found littered around their shops. This practice is againstrequirement for managing used acid from battery because it is hazardous andcan pose serious environmental and health risk. This finding is in agreementwithCossu (2013); Commonwealth of Massachusetts (2017) who reported thatalthough, automobile waste contains considerable quantities of valuablematerial such as metal but some are potentially hazardous if improperlydisposed for instance discarded batteries, air conditioners parts when disposedin landfills produce hazardous substance like acids, mercury andchlorofluorocarbon (CFC) which leaches the soil, contaminating and pollutingthe ground water in the process. The result is also in conformity with submission made by Utamge*etal.,* (2013) who concluded that improperly handled ordiscarded automobile waste can affect the PH value of water both surface andunderground, pollute and reduce the quality of water; threatening terrestrial andaquatic life, cause soil acidification, and effects on human health. However theobjectives of environmentally sound automobile waste disposal cannot beachievable if automobile waste is continually disposed improperly.

Conclusion

This study on the assessment of motor vehicle used oil management practices inKaduna metropolis of Kaduna State, Nigeria, It is concluded that the motor vehicle craftsmen officials, and officialsof all the waste management regulatory agencies are not aware of the effects of improperdisposal of motor used oils. It is in this regard that the motor vehicle mechanics craftsmen and government waste regulatory agencies officials haveto be enlightened on the effects of improperly collected and disposedMotor used oil especially liquid wastes. Therefore the various environmentalagencies responsible for effective management of motor used oil should putappropriate monitoring and assessment system in place for the management ofautomobile waste in order for our environment to be secured. It is necessary thatany mechanics workshop alleged for environmental pollution be sanctioned in line with environmental laws.

Recommendations

1. Training of the Motor vehicle mechanics master craftsmen should be conducted or organized by environmental agencieson motor vehicle used oil best management practices, and this could beachieved through their association.
2. There should be Periodical monitoring and assessment of motor vehicle used oil management by environmental agencies as stipulated by law, andworkshops alleged for environmental pollution be sanctioned.
3. The unhealthy motor used oil generated by automobile mechanics workshops should always be removed by licensed personnel under the supervision of environmental agencies.

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Evaluation of Environmental Health and Safety Status in Public Secondary Schools in Minna, Niger State

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Abstract
Poor maintenance of school environment can cause or worsen illnesses among school children. The aim of this study was to evaluate the environmental health and safety status in public secondary schools in Minna, Niger state. The objective of this study was to assess the healthfulness of school environments of public secondary schools within the rural and urban areas of Minna.Multistage sampling was used to select the sample population. The participating schools were inspected and both the students and principals interviewed using a questionnaire. Scores were awarded using the school Health Program Evaluation Scale. This study was conducted in 30 public secondary schools in Minna the Niger state capital. Parameters assessed included water source, hand washing, toilet and classroom facilities, waste management, food service areas, fire control (extinguishers and alarms), dangers from animals, floods and vectors/pests and buildings/infrastructure around the schools. The study concludes that school environment of public secondary schools situated in both rural and areas in Minna, Niger State is fairly friendly and fairly healthy. From the findings of this study, it recommends that school principals should initiate preventive measures and promote awareness in order to cope with environmental health and safety, stimulus perception and provide sufficient safeguard to the environmental health and safety in secondary schools.

Key words: Evaluation, Environmental health and safety, Public secondary schools.

Introduction
Adequate drinking water, sanitation and hygiene are crucial concerns for non-household settings, such as health care facilities, work places and schools**.** Protecting children's health and advancing environmental health and safety justice are critically important goals for the Environmental Protection Administration (EPA), as reflected in EPA's strategic plan (WHO 2018) when the school environment is of a poor condition. U.S Environmental protection agency (2018) Poor indoor environments can affect a child's health; dirt, allergens, chemicals and other contaminants can trigger or further aggravate allergies and illnesses Hauptman and Phipatankau (2015).Foodborne illnesses are the major food safety concern in primary schools. In Southeast Asia, non-typhoid *Salmonella*, pathogenic *Escherichia coli* and norovirus (WHO 2015)can occur in storage facilities for food items generated under poorfood handling conditions and training, with the use of untreated water for non-drinking purposes and/or poor sanitation and hygiene; these factors are the primary risks for food poisoning Malm*et al*. (2015).Many schools in developing and developed countries lack adequate water and sanitation services, and this phenomenon has potential detrimental effects on health and school attendance Freeman (2011). Thus, there is a high prevalence of water-borne diseases that cause particularly children to fall ill or even die (UNICEF and WHO 2018). Improved sanitation conditions include access to enhanced latrines, latrine upkeep and fecal sludge managementKontingo*et al*. (2014). Additionally, waste

management is one of the most important environmental aspects with regards to educational institutions Sales *et al*. (2006)]. Waste management, related to resource and water consumption, can help reduce waste quantityDascalak and Sermpetzoglou (2011), depending on students and educational staff numbers, site and infrastructure technical characteristics (including buildings) and institutional management Patel and Handu (2010).

A safe school is physically and psycho-socially secure. The most visible aspects of a school's physical environment are the quality of the security and maintenance of school buildings and grounds. Adequate facilities indicate a clean and safe environment that is conducive to education and has protected property, adequately maintained buildings, furniture and equipment, clean toilets, water, a green environment and the absence of harassment, Squelch (2001)].

In Minna, the Ministry of Education and the Niger state ministry of Health are making effortsto promote health education in schools. They are attempting to promote a state of perfect happiness in four dimensions: physical, mental, social and intellectual. In particular, the Niger state government has begun promoting healthy schools. This shift towards a greater emphasis on health education and environmental sanitation in schools follows World Health Organization (WHO) guidelines (SAMED 2016). This study aimed to evaluate the status of environmental health and safety in public primary schools in Minna province and to study how individual factors such as sex, education and length of work and training time affected perceived levels of environmental health and safety status in the teachers who are partially responsible for environmental health in public primary schools.

Methodology

Participating schools

This was a cross-sectional study of selected secondary schools in Minna the Niger state capital. It comprised of public schools. These schools were located in both the rural and urban parts of Minna.

Study instrument

The school Health and Safety Program (SHP) evaluation scale was used to assess the schools. Assessment of SHP has been quantitative. The first first SHP Evaluation scale was developed by Anderson and cresswell (1980) in the UK. This has been modified to suit the Nigerian environment and level of economic development Akani and Nkanginieme (2007). The scale has also been validated for use in SHP evaluation in Nigeria.

Procedure

multistage sampling method was used to select schools that participated in the study. Thirty (30) schools were selected for this study, twenty (20) within the urban areas of Minna and ten (10) from the rural areas of Minna. The researcher visited the selected schools and inspected the environment- water supply, refuse disposal system, sewage disposal, school plan (walls, roofs, ventilation, lightning, furniture sitting comfort, food service and nuisance), evidence of maintenance and healthful living. Scores were awarded using the SHP evaluation scale.

Data analysis

This was done using the statistical package for sciences software (SPSS) (IBM, Chicago IL, USA) version 20.

RESULTS

Design

Water supply

The ten (10) public secondary schools selected in the rural areas of Minna had no access to any form of water supply, while five (5) out of the twenty (20) public secondary schools selected within the urban areas of Minna had boreholes inside the school premises which supply water to both students and teachers, ten (10) of the schools have wells, three (3) have pipe-borne water, the remaining two (2) schools had more than one source of water supply. From the schools sampled only the ten (10) public secondary schools located at the rural areas of Minna had their water source > 200m from the schools, the twenty (20) public secondary schools within Minna had their water source had water in their school compounds and only go out in search of water when there is scarcity and the distance is usually not <200m from the schools.

Refuse disposal

All the ten (10) public secondary schools situated in the rural areas dump their refuse openly. The remaining twenty (20) public secondary schools within the urban areas of Minna bag their refuse, which is then collected by Niger state waste management authority for onward disposal by controlled tipping.

Sewage disposal

All the public secondary schools have no sewage disposal structures. The twenty (20) public secondary schools within the urban areas all have sewage disposal structures, none of the public secondary school situated within the urban areas have water cistern they all use pit latrines. The urban public secondary schools have a toilet usage ratio of 1:>90 for both students and teachers.

School plan

Buildings

All the ten (10) public secondary schools situated in the rural areas were dilapidated, five (5) among the twenty (20) schools situated within the urban areas have their school buildings made of strong walls and good roofs, ten (10) out of the twenty (20) schools have their school buildings made of strong walls but with minor cracks, the remaining five (5) have old walls and leaking roofs.

Floor

All the ten (10) public secondary schools situated in the rural areas haveworn-off and dusty floors and they had no standard floor spaces per child. Ten (10) among the twenty (20) schools situated within the urban areas have no standard floor spaces per child and all the schools had flat and nonglossy floor finishing and all the floors had potholes in them. The remaining Ten (10) schools sampled had standard standard floor spaces per child and also had flat and nonglossy floors.

Ventilation

All the thirty (30) public secondary schools sampled in both rural and urban area were adequately ventilated. Ventilation was controllable.

Lighting
All the thirty (30) public secondary schools sampled in both rural and urban area have good lighting system.

Insulation from heat
None of the public secondary school situated in the rural areas was properly ceiled; five among the twenty public secondary school situated in the urban areas were partially ceiled, five other schools had no ceiling while the remaining ten schools were properly ceiled.

Sitting comfort
In all the public schools visited and sampled both in rural and urban areas all the students were not comfortably seated because the sitting chairs and desk were inadequate so only few were comfortably seated as some were found sitting on the windows, some others were standing and majority were found sitting on the floor.

Food service area
None of the public school secondary schools sampled had a food cafeteria. All of them had food vendors sell food within the school premises.

Safety patrol team
None of the schools sampled had a safety patrol team.

Fencing
All the ten (10) public secondary schools situated in the rural areas had no perimeter fencing, while the other twenty (20) schools situated in the urban areas had perimeter fencing.

Fire extinguisher
All the ten (10) public secondary schools situated in the rural areas had no perimeter fencing, while the other twenty (20) schools situated in the urban areas had perimeter fencing.
Fire protection
None of the schools are made of prefabs or some fire-resistant materials.
Nuisance/ health hazard
There were neither open drainages nor incidences of flooding in any of the schools. Vectors/ pests (sandflies, snakes and rats) were occasionally a nuisance that affects the schools.

Maintenance
Evidence of maintenance
There were no evidences of maintenance in all the schools visited situated in the rural and urban areas.

Healthful living
The emotional climate was adequate in all the schools visited in both the urban and rural areas. All schools have sport fields, all the schools were not having toilet rolls, the schools situated in the urban areas had soaps available for handwashing while the ones in the rural areas had none. None of the schools had wash hand basins in their classes, the schools in the urban areas had dustbins

and in some cases empty cartoon for disposing of refuse while the schools in the rural areas had none as we could visibly see trash littered everywhere the surrounding and classes.

Discussion

The ten (10) public secondary schools selected in the rural areas of Minna had no access to any form of water supply, while five (5) out of the twenty (20) public secondary schools selected within the urban areas of Minna had boreholes inside the school premises which supply water to both students and teachers, ten (10) of the schools have wells, three (3) have pipe-borne water, the remaining two (2) schools had more than one source of water supply. From the schools sampled only the ten (10) public secondary schools located at the rural areas of Minna had their water source > 200m from the schools, the twenty (20) public secondary schools within Minna had their water source had water in their school compounds and only go out in search of water when there is scarcity and the distance is usually not <200m from the schools. All the ten (10) public secondary schools situated in the rural areas dump their refuse openly. The remaining twenty (20) public secondary schools within the urban areas of Minna bag their refuse, which is then collected by Niger state waste management authority for onward disposal by controlled tipping. All the public secondary schools have no sewage disposal structures. The twenty (20) public secondary schools within the urban areas all have sewage disposal structures, none of the public secondary school situated within the urban areas have water cistern they all use pit latrines. The urban public secondary schools have a toilet usage ratio of 1:>90 for both students and teachers.All the ten (10) public secondary schools situated in the rural areas were dilapidated, five (5) among the twenty (20) schools situated within the urban areas have their school buildings made of strong walls and good roofs, ten (10) out of the twenty (20) schools have their school buildings made of strong walls but with minor cracks, the remaining five (5) have old walls and leaking roofs.All the ten (10) public secondary schools situated in the rural areas have worn-off and dusty floors and they had no standard floor spaces per child. Ten (10) among the twenty (20) schools situated within the urban areas have no standard floor spaces per child and all the schools had flat and nonglossy floor finishing and all the floors had potholes in them. The remaining Ten (10) schools sampled had standard standard floor spaces per child and also had flat andnonglossy floors. All the thirty (30) public secondary schools sampled in both rural and urban area were adequately ventilated. Ventilation was controllable. All the thirty (30) public secondary schools sampled in both rural and urban area have good lighting system. None of the public secondary school situated in the rural areas was properly ceiled; five among the twenty public secondary school situated in the urban areas were partially ceiled, five other schools had no ceiling while the remaining ten schools were properly ceiled.In all the public schools visited and sampled both in rural and urban areas all the students were not comfortably seated because the sitting chairs and desk were inadequate so only few were comfortably seated as some were found sitting on the windows, some others were standing and majority were found sitting on the floor.None of the public school secondary schools sampled had a food cafeteria. All of them had food vendors sell food within the school premises and none of the schools sampled had a safety patrol team. All the ten (10) public secondary schools situated in the rural areas had no perimeter fencing, while the other twenty (20) schools situated in the urban areas had perimeter fencing.All the ten (10) public secondary schools situated in the rural areas had no perimeter fencing, while the other twenty (20) schools situated in the urban areas had perimeter fencing.None of the schools are made of prefabs or some fire-resistant materialsThere were neither open drainages nor incidences of flooding in any of the schools. Vectors/ pests (sandflies, snakes and rats) were occasionally a nuisance that affects the schools.

There were no evidences of maintenance in all the schools visited situated in the rural and urban areas. The emotional climate was adequate in all the schools visited in both the urban and rural areas. All schools have sport fields, all the schools were not having toilet rolls, the schools situated in the urban areas had soaps available for handwashing while the ones in the rural areas had none. None of the schools had wash hand basins in their classes, the schools in the urban areas had dustbins and in some cases empty cartoon for disposing of refuse while the schools in the rural areas had none as we could visibly see trash littered everywhere the surrounding and classes.

Conclusion

The school environment of public secondary schools situated in both rural and areas in Minna, Niger State is fairly friendly and fairly healthy. Based on the results in this study, secondary school headmasters should implement preventive measures and educate participants in order to cope with and provide sufficient environmental health and safety in secondary schools

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Assessing the Impact of COVID-19 Pandemic on Technical and Vocational Education and Training in Kwara State

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Abstract
Before the breakout of COVID-19 pandemic, authors reported that the availability and adequacy of educational resources in technical and vocational education and training (TVET) institutions will undoubtedly lead to the production of skilled manpower which will help the country to meet its industrial needs. Sadly, till the emergence of the pandemic, these educational resources remain unavailable, which had crippled academic achievements of many students in these institutions. In view of this, this study presumed that if the situation was abysmal before the pandemic, is there any significant change during the pandemic? And what are the way forward to bridging the existing gaps. Therefore, to provide answers to these questions, this study specifically assessed the impact of COVID-19 pandemic on TVET in Kwara State, while raising four (4) other purposes. The study adopted a multistage sampling technique to sample size 216 TVET teachers across the 3 Local Government Areas in Ilorin, Kwara State. A validated researcher-designed questionnaire with a reliability value 0.87 was employed to gather relevant data for this study. Both frequency distribution and mean were used to answer the research questions while, t-test was used to test all the hypotheses at 0.05 level of significance. The study found out that both before and during the COVID-19 lockdown, TVET teachers had access to technological resources but at varying level. Also, COVID-19 had positive impacts on TVET teachers, and there was no gender-biasness in the assessment of the impact of COVID-19 on TVET in Kwara State. The study therefore concluded thatCOVID-19 pandemic has changed the narrative of how TVET teachers can now appropriately adopt technological resources for TVET teaching in Nigeria. Therefore, the study recommends that TVET educators should be encouraged to utilise technological resources in order to engage students in an engaging, open, and self-paced manner. This is because, one of the primary purposes of technological resources in learning is to make education for all citizenry.

Keywords: TVET; Technological Resources; COVID-19; Impact; Pandemic.

Introduction
In less than two years, Coronavirus (COVID-19) changed the world of work and educational structure of the world. It challenged all humansto adapt to new modalities in all spheres of life, especially the use of face shield, nose mask, hand sanitizers and social distancing. These modalities provided new approaches to all phase of education including technical and vocational education and training (TVET). In this regard, within the span of two years, TVET educators and experts examined and provided insights on the role of TVET in response to COVID-19 pandemic. In response to the ravaging situation across the world especially in Nigeria where unemployment rate keeps increasing and worsened., especially during the COVID-19 lockdown,TVET can be well-placed to develop important skills needed to mitigate the impacts of the pandemic. TVET's focus on practical skills, and its potential to deliver short-term, targeted and modular training can be

harnessed to rapidly empower, reskill and upskill individuals to live successfully in the new normal.

The institutional lockdown due to COVID-19 did not exempt TVET learning centers. Thus, teaching and learning moved from classrooms to remote means, facilitated by the internet, television, radio, or print materials, but the degree to which learning hands-on courses or subject such as TVET remotely especially among low-income and vulnerable students remains particularly challenging. In Nigeria, TVET systems face challenges in responding quickly and adequately to the demands placed by the new shift. To help address the substantial economic disruptions caused by the pandemic, it will be especially important that that training programs and skill development systems are appropriately reimagined, reset and reworked, as well as examinations on the views and reactions of population towards restructuring the TVET system to fit into the new normal and emerging community. A great opportunity is opening up that should not be wasted to accelerate TVET system reforms that reinforce the demand-orientation of programs so they can respond quickly to shifting patterns of skill demand.

The Nigeria National Policy of Education (Federal Republic of Nigeria, FRN, 2014) described TVET as the educational process involving the study of technologies and related sciences and acquisition of practical skills, attitudes, understanding and knowledge relating to occupations in various sectors of economic and social life. Other authors such as Momoh (2012) defines TVET as a form of education whose primary purpose is to prepare persons for employment in recognized occupation. In the same vein, Okoye and Arimonu (2016) described TVET as a skill-based program which is designed for skill acquisition and focus on specific vocations for entry into defined workplace and provides general technical knowledge.

Technical Vocational Education and Training (TVET) as defined by the United Nations Education Scientific and Cultural Organization (UNESCO) in Badawi (2013) is a comprehensive term referring to those aspects of the educational processes involving, in addition to general education, the study of technologies and related sciences and the acquisition of skills, attitudes, understanding and knowledge relating to occupations in various sectors of economic and social life. In the same vein, Adepoju (2014) defines TVET as an educational training which encompasses knowledge, skills, competencies, structural activities, abilities, capacities, and all other structural experiences for securing jobs in the various sectors of the economy or even enabling one to be self-dependent by being a job creator.

The importance of TVET underlines the fact that changes in any nation's economy is required to prepare young people for the jobs of the future of which technical and vocational education have crucial roles to play (Nuru, 2007). Most analysts Yang (2008) and Okoye and Arimonu (2016) agree that employers of labour today demand more skills than they did in the past. Furthermore, Raimi and Akhuemonkhan (2014) opined that for Nigeria to meet up with industrialized nations, it must deploy adequate human and material resources into TVET as a viable education orientation to meet up the right skilled manpower need of the industries.

Ojerinde (2015) submitted that TVET helps in the preparation of local manpower for the nation's industries, thereby cutting down on over-dependence on foreigners for the industrial development of Nigeria. Asogwa and Diogu (2007) and Ojimba (2012) argued that TVET is very much still

neglected in Nigeria. This is evidence in the number of meagre resources allotted to TVET in Nigeria, which consequently are robbing the country of the economic development to be contributed by graduates of technical/vocational education. With the realities set by the new normal, there is an urgent need for Nigeria's attention to be redirected towards self-reliant and sustainable means of livelihood which TVET provides. Kazaure (2020) explained that as far back as 2016, TVET sector in Nigeria had prepared for situtaions of emergencies by implementing the adoption of Open Distance and Flexible eLearning (ODFeL). This was informed based on the need to expand access to TVET in view of the large number of secondary school leavers seeking for entrance into Nigeria tertiary institutions.

Kazaure (2020) stated further that TVET sector cannot cater for up to 50% of those wanting to enroll. As a result, National Board for Technical Education (NBTE) partnered with private organization to achieve the goals of ODFeL. Perhaps, with the outbreak of COVID-19, questions such as: was the effect of ODFeL experienced during the lockdown? Are the strategies and resources implemented impactful before and during the lockdown? These are questions that needed adequate responses to achieve the goals of TVET in Nigeria.

Similarly, Abdullahi (2018) reports that TVET education is targeted at the technological advancement of Nigeria by producing skilled professionals for all aspectsof human endeavor. TVET centers such as Polytechnics are technology institutions that produce skilled technicians and technologists for the industries (Owo,2020). Although, the ideals of the Nigerian TVET system as seen in the previous statements of experts are superb as they are all geared towards the economic and technological advancement of Nigeria, however, either pre-COVID-19 as posited by Onyesom and Ashibogwu (2013) or post-COVID-19 as posited Owo (2020), TVET system in Nigeria has continuously been faced with diverse challenges which affected its progress in diverse perspectives. Kazaure (2018) further revealed that these challenges include but not limited to inadequate funding, poor budgetary allocation to TVET, inadequate supply oftraining facilities to TVET institutions, poor educational planning, poor research and developmentfunding, lack of synergy between TVET institutions and the industries,among others.All these negative encounters hamper TVET's contributions to the growth of Nigeria's economy. These identified factors and many more serve as constraints to effective TVET in Nigeria.

Statement of the Problem

The main essence of TVET in Nigeria is to offer required technical and vocational education to citizens that will revolutionize the improvement of the nation's industries through the acquisition of lifelong skills that are relevant to human endeavors in line with the demands of the labour market, thereby supporting thecountry in its quest to achieve economic recovery. Studies before the COVID-19 pandemic such as the study of Owo (2018)reported that the availability and adequacy of educational resources in TVET institutions will undoubtedly lead to the production of skilled manpower which will help the country to meet its industrial needs. Sadly, till the emergence of the pandemic, these educational resources remain unavailable, which had crippled academic achievements of many students in these institutions. In view of this, this study presumed that if the situation was abysmal before the pandemic, is there any significant change during the pandemic? And what are the way forward to bridging the existing gaps. Therefore, to provide answers to these questions, the main purpose of this study was to assess the impact of COVID-19 pandemic on TVET in Kwara State. Specifically, the study focused on:

1. determiningTVET teachers' access to technological resources for teaching TVET subjects before COVID-19 pandemic in Kwara State;
2. examiningTVET teachers' access to technological resources for teaching TVET subjects during COVID-19 pandemic lockdown in Kwara State;
3. assessing the impact of COVID-19 pandemic on TVET in Kwara State.

Research Questions

In this study, the following research questions were answered:

1. Do TVET teachers have access to technological resources for teaching TVET subjects before COVID-19 pandemic in Kwara State?
2. Doe TVET teachers have access to technological resources for teaching TVET subjects during COVID-19 pandemic lockdown in Kwara State?
3. What is the impact of COVID-19 pandemic on TVET in Kwara State?

Research Hypotheses

The following research hypotheses were tested in this study at 0.05 level of significance:

H_{01}: There is no significant gender difference in the assessment of assessed the impact of COVID-19 pandemic on TVET in Kwara State.

Methodology

This study adopted a quantitative research design of a survey type, while targeting TVET subject teachers in secondary schools in Kwara State. Multistage sampling technique was employed to select the sample size; namely: a stratified sampling technique was employed to select 3 local government areas (LGAs) in Kwara State (Ilorin East, Ilorin South and Ilorin West); then,purposive sampling technique was employed to select the 24 schools per LGA, making a total of 72 secondary schools; the last stage involved simple random sampling technique to sample 216 TVET teachers across the sample locations.

The instrument for this study included a validated researcher-designed questionnaire with a reliability value 0.87 to gather relevant data for this study. The questionnaire contained three sections (A, B and C); Section A elicited demographic information of respondents: Section B contained items to examine TVET teachers' access to technological resources for teaching TVET subjects before and during COVID-19 pandemic in Kwara State; and Section C contained items to assess the impact of COVID-19 pandemic on TVET in Kwara State. Section B was rated on a Boolean scale of Accessible (Acc) and Not Accessible (NAcc); while Section C were rated on a modified Likert Mode Scale of Strongly Agree (SA), Agree (A), Strongly Disagree (SD), and Disagree (D) with weighted value of 4 to 1 in terms of scoring. The data collected were analysed using descriptive and inferential statistics with the use of Statistical Package for Social Sciences (SPSS) software version 23.0. Frequency distribution and mean were used to answer the research questions while, *t*-test was used to test all the hypotheses at 0.05 level of significance.

Results

Demographic Information

Table 1: Distribution of Respondents Based on Gender

emographic Data	**requency**	**ercentage**
ender		
[ale	34	2.0
:male	2	3.0
otal	**16**	**00**

As indicated in Table 1, the proportion of male TVET teachers that were involved in the study was greater than that of female teachers **(62.0%>38.0%).**

Research Question One: Do TVET teachers have access to resources for teaching TVET subjects before COVID-19 pandemic in Kwara State?

Table 2: TVET Teachers Access to Technological Resources for Teaching TVET before COVID-19 Pandemic

N	**TEM**	**ccessible req. (%)**	**ot Accessible req. (%)**
1.	omputer/Laptop	37 (86.6)	9 (13.4)
2.	irtual Laboratories	01 (46.8)	15 (53.2)
3.	pen Educational Resources	3 (45.4)	18 (54.6)
4.	ternet Connectivity	59 (78.2)	7 (21.8)
5.	earning Management System	5 (39.4)	31 (60.6)
6.	ocial Collaborative Platforms	2 (38.0)	34 (62.0)
7.	amification	7 (7.9)	09 (92.1)
8.	pen-Source Textbooks	2 (24.1)	54 (75.9)
9.	[ultimedia Resources	33 (84.7)	3 (15.3)
otal		**74 (50.1)**	**70 (49.9)**

Table 2 revealed TVET teachers access to technological resources for teaching TVET subjects before COVID-19 pandemic in Kwara State. As revealed in Table 2, 86.6% of the teachers claimed that they access to a computer or laptop, 84.7% had access to multimedia resources, and 78.2% had access to internet connectivity. Sadly, majority had no access to technological resources such as gamification (92.1%), open-source textbooks (75.9%), social collaborative platforms (62.0%), learning management system (60.6%), open educational resources (54.6%), and virtual laboratories (53.2%). Based on the benchmark of 50.0% of a Boolean scale, the percentage total of 50.1% which is greater than the 50% benchmark and skewed towards accessible implies that only 50.1% of the sample size had access to technological resources for teaching TVET subjects before COVID-19 pandemic in Kwara State.

Research Question Two: Do TVET teachers have access to technological resources for teaching TVET subjects duringCOVID-19 pandemic in Kwara State?

Table 3: TVET Teachers Access to Technological Resources for Teaching TVET during COVID-19 Pandemic

N	TEM	ccessible req. (%)	ot Accessible req. (%)
1.	omputer/Laptop	)4 (89.8)	2 (0.9)
2.	irtual Laboratories	52 (75.0)	4 (25.0)
3.	pen Educational Resources	45 (67.1)	l (32.9)
4.	ıternet Connectivity	)6 (95.4)	) (4.6)
5.	earning Management System	78 (82.4)	3 (17.6)
6.	ɔcial Collaborative Platforms	42 (65.7)	4 (34.3)
7.	amification	31 (60.6)	5 (39.4)
8.	pen-Source Textbooks	)3 (47.7)	l3 (52.3)
9.	[ultimedia Resources	)9 (96.8)	(3.2)
	Total	**470 (75.6)**	**74 (24.4)**

Table 3 revealed TVET teachers access to technological resources for teaching TVET subjects during COVID-19 pandemic in Kwara State. As revealed in Table 3, majority of the teachers have access technological resources such as multimedia resources (96.8%), internet connectivity (95.4%), computer/laptop (89.8%), learning management system (82.4%), virtual laboratories (75.0%), open educational resources (67.1%), social collaborative platforms (65.7%), and gamification (60.6%). Meanwhile, only 47.7% claimed that they accessed open-source textbooks during COVID-19 pandemic in Kwara State. Based on the benchmark of 50.0% of a Boolean scale, the percentage total of 75.0% which is greater than the 50% benchmark and skewed towards accessible implies that 75.6% of the sample size had access to technological resources for teaching TVET subjects during COVID-19 pandemic in Kwara State.

Research Question Three: What is the impact of COVID-19 pandemic on TVET in Kwara State?

Table 4: Impact of COVID-19 Pandemic on TVET in Kwara State

N	TEM	lean
1.	OVID-19 caused an impact on TVET student engagement compared to the :ademic year before the Covid-19 pandemic	54
2.	ıe unexpected emergence of COVID-19 provided a gap for TVET teachers impact skills directly on students.	03
3.	OVID-19 provided avenue for massive and compulsory adoption of chnological resources in teaching TVET	21
4.	sing technology to overcome new and unexpected educational challenge ıused by the COVID-19 pandemic gives opportunity to think out of the box	13
5.	ıe practical approach to teaching TVET was hardly employed during the ındemic, compare to the regular and conventional approach.	99
	Grand Mean	**16**

Table 4 revealed the assessment of the impact of COVID-19 pandemic on TVET in Kwara State. The teachers claimed that COVID-19 caused an impact on TVET student engagement compared to the academic year before the Covid-19 pandemic (3.54); COVID-19 provided avenue for massive and compulsory adoption of technological resources in teaching TVET (3.21); Using technology to overcome new and unexpected educational challenge caused by the COVID-19 pandemic gives opportunity to think out of the box (3.13); The unexpected emergence of COVID-19 provided a gap for TVET teachers to impact skills directly on students (3.03); and the practical approach to teaching TVET was hardly employed during the pandemic, compare to the regular and conventional approach (2.99). Based on the benchmark of 2.5 of a 4-point Likert scale, the grand mean of **3.16>2.50** revealed that the impact of COVID-19 pandemic on TVET in Kwara State was positive

Hypothesis Testing

Research Hypothesis One: There is no significant gender difference in the assessment of the impact of COVID-19 pandemic on TVET in Kwara State.

Table 5: *t*-test Analysis of Gender Difference in the Assessment of the Impact of COVID-19 Pandemic on TVET in Kwara State.

ender			**D**	f		g. (2-tailed)	**emark**
lale	34	32	8				
				14	207	3	**ccepted**
emale	2	35	9				

From Table 5, it can be deduced that there was no significant difference between male and female TVET teachers'assessment of the impact of COVID-19 pandemic on TVET in Kwara State. This is reflected in the findings of the hypotheses tested df (214), t= -.207, p>0.05. Thus, the hypothesis which states that "there is no significant is no significant gender difference in the assessment of assessed the impact of COVID-19 pandemic on TVET in Kwara State" is accepted.

Discussion of Findings

The findings of this study revealed that almost an aggregate proportion of TVET teachers could not access technological resources for teaching TVET subjects before COVID-19 pandemic in Kwara State. This outcome supports the assertions of Kazaure (2018) and Onyesom and Ashibogwu (2013) who asserted that TVET system in Nigeria has continuously been faced with diverse challenges which affected its progress in diverse perspectives, and this affected the level at which TVET teachers access technological resources. This finding is against the position of Kazaure (2020) who claimed that as far back as 2016, TVET sector in Nigeria had prepared for situations of emergencies by implementing the adoption of Open Distance and Flexible eLearning (ODFeL). This was informed based on the need to expand access to TVET in view of the large number of secondary school leavers seeking for entrance into Nigeria tertiary institutions. Sadly, the implementation of this novel idea failed, this is as evidenced in the response of the participants. Perhaps, with the outbreak of COVID-19, the findings of this study showed that there was significant improvement in the access to technological resources during the lockdown. The findings of this study revealed that larger percentage of the participants had access to technological resources during the lockdown as they had to continue with teaching the students. This study corroborates the findings Owo (2020) who reported that TVET education is targeted at the

technological advancement of Nigeria by producing skilled professionals for all aspects of human endeavor. The author emphasized that such as the emergency situation of COVID-19, most TVET teachers are forced to adopt technological resources during the lockdown to engage their students. However, they were limited by time and students' engagements was literally low.

This study also found out that the impact of COVID-19 pandemic on TVET in Kwara State was positive. This findings could be ascribed to the positive responses of the participants which they claimed that COVID-19 caused an impact on TVET student engagement compared to the academic year before the Covid-19 pandemic; it provided avenue for massive and compulsory adoption of technological resources in teaching TVET; the use of technology to overcome new and unexpected educational challenge caused by the COVID-19 pandemic gives opportunity to think out of the box; the unexpected emergence of COVID-19 provided a gap for TVET teachers to impact skills directly on students; and the practical approach to teaching TVET was hardly employed during the pandemic, compare to the regular and conventional approach. This finding supports the earlier finding of Kazaure (2020) who stated that the impact of COVID-19 onTVET sector cannot be overemphasized.The researcher stressed that COVID-19 brought a lot of changes to the TVET sector which were never imagined.

Similarly, the findings of this study indicated that gender difference did not exist in the assessment of the impact of COVID-19 pandemic on TVET in Kwara State. This finding is against the outcome of the study Agbatogun, (2010) who provided that gender disparity is seen in the teachers' assessment of the impact of COVID-19 on TVET. The researcher claimed that with the adoption of technology, equal opportunity was given to both male and female teachers, even though more females were engaged in domestic activities. However, there was no gender disparity or biasness. In the observation of Wajcman, (2016), the researcher observed that many feminists believe that western technology embodies patriarchal values. The researcher argued that most female are reluctant to use technology because of the sex-stereotyped definition of technology as an activity appropriate for men.

Conclusion

In conclusion, this study revealed that due to COVID-19, TVET schools and training centres are closed as a measure to counter the COVID-19 pandemic. In a few places where training centres remained partially opened, students follow the health regulatory recommendations on infection prevention and control. However, training attendance has been largely affected due to government restrictions to public transportation. In addition to this, uncertainty contributed to demotivation among students. To salvage the situation, several approaches were employed to continue TVET system such as online learning and other solutions to deliver training, including TV, radio and mobile applications. The implemented solutions are mainly based on asynchronous learning, and rely on environments prepared as quick solutions for the download of training materials. Although they do not support instant interactions among students and with instructors, and also do not involve components for practice-based learning, which are of particular importance in competence-based training for TVET. Importantly, the COVID-19 pandemic has changed the narrative of how TVET teachers can now appropriately adopt technological resources for TVET teaching in Nigeria.

Implications

Based on the findings of this study, the following implications can be drawn. The findings of this study have great implications on the TVET educators. The outcome of this study indicated that the use of technological resources could be harnessed for teaching TVET, thereby providing synchronous and asynchronous platform for TVET learners,that would improve students' practical performance and retention of learning contents even in emergency situations. Equally, if TVET teachers are encouraged to utilise technologies for teaching purpose strictly, there would be better achievement of goals. This study also has an implication on the manner at which TVET educators approach instruction, if technological resources made available to students through proper channels, better academic achievement would be achieved, thus, achieving institutional goals would be made easier.

Recommendations

Based on the findings and conclusions of this study, the following recommendations were made:

1. TVET educators should be encouraged to utilise technological resources in order to engage students in an engaging, open, and self-paced manner. This is because, one of the primary purposes of technological resources in learning is to make education for all citizenry.
2. Technological resources utilisation should be encouraged among TVET educators. This will provide avenue for both educators and students to learn in a personalised, individualised, and self-paced level, which will in turn translate to better academic performance.

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Effect of Collaborative Learning Approach During Covid-19 Pandemic on Secondary School Students' Academic Achievement in Financial Accounting in Bauchi State, Nigeria.

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Abstract
This study determined the effect of collaborative learning approaches on secondary school students' academic achievement in financial accounting in Bauchi state, Nigeria. A quasi-experimental design with pre-test and post-test was adopted for the study. Two hypotheses were also formulated and tested at 0.05 level of significance. The population comprised of 725 students from 17 senior secondary schools in Bauchi State.A total of 109 SSII students were used for the experiment. The samples were selected using simple random sampling technique. The instruments for data collection was Financial Accounting Achievement Test I (FAAT- 1) which was used as pre-test and Financial Accounting Achievement Test 2 (FAAT – 2) which was the post –test. All the instrument is valid based on the standardization criteria. All the instrument is reliable based on the standardization criteria. Data collected were analyzed using mean, standard deviation, t-testto answer the two hypothesis and to test the null hypothesis at 0.05 percent level of significance. The findings revealed that there was no significant difference between the pretest mean scores of students taught Financial Accounting using Collaborative learning approach and those taught using Conventional teaching method in Senior Secondary School in Bauchi state. In addition, it was revealed that Collaborative learning approach is more effective on student academic performance than Conventional teaching method. Based on these findings the study recommended that teachers teaching Financial Accounting at the Senior Secondary School in Bauchi state should adopt Collaborative learning approach in teaching the subject.

Keywords: Collaborative learning approach, Financial Accounting, Students, Academic Achievement

Introduction
The Corona virus (COVID-19) a global pandemic as acknowledged by the World Health Organisation (WHO) continues to spread across the globe. More than 207 countries/territories have already been affected, there is no any otherorganisation or person across the globe not affected by this menace. As most of the countries are in lockdown bringing the two most essential sectors to a standstill, economy and education (Khan, Rabbani, Eleftherios, & Atif, 2021). The education sector has been affected intensely by the pandemic. The author also lamented that the lockdown imposed on most countries resulted in the immediate closure of universities, colleges and secondary schools and also to remote delivery of all academic activities and related support/ancillary services(Sangster, Stoner, & Flood, 2020).

In addition, for remote learning to work effectively, Information Communication Technology resources must be available and fully working also at school, and teachers must be skilled enough

in teaching remotely(Murat & Bonacini, 2020). Remote learning has been well below standard of what could have been expected from our developing countries(Murat & Bonacini, 2020). As a result of school shortages of ICT devices, digital platforms, skilled teachers, lack of power supply, inadequate library infrastructure, inadequate and poor access to the Internet facilities and poor ICT infrastructure that could hinder the effectiveness of E-learning in Nigeria (Omeluzor, Dolapo, Agbawe, Onasote, & Abayomi, 2017). Due to acute shortage of power supply and ICT gadgets that would facilitate remote learning in Nigerian secondary education sector, most schools seem to have insufficiency for textbooks and reference books and physical facilities such as classrooms, desks and chairs which paved the way of pooracademic achievement of the students in Community Secondary Schools(Sephania, Jackson, & Kipng, 2017). In addition to covid-19 protocol and social distancing, Nigerian schools could not achieve much as result of overcrowding of students in class which led to problems such as indiscipline, behavioral problems, health problems, and stress on teachers and increase in drop-out rate of students(Muhammad & Kani, 2017). This necessitate public secondary schools in Nigeria to group students into various classes from morning to evening class, this move could not be achieved without using appropriate teaching methods that will accommodate group learning in teaching financial accounting.

Financial accounting is a subject offered in senior secondary school that equips students with the necessary relevant skills and knowledge needed for occupation in accounting field (Olorode & Jimoh, 2016). The author also stressed that financial accounting is the process of identifying, measuring, and communicating economic and financial information in order to enable informed judgments and decision by the users of the financial information. In short, Financial Accounting is the process of summarizing financial data taken from an company accounting records anddissemination in the form of annual reports for the benefit of people outside the company(Saoud, 2011).

The major objective of offering financial accounting in senior secondary school is to impart the necessary skills and knowledge for accomplishment of financial duties in any business organization and provide students with technical and professional skills needed to handle financial accounting subject in both secondary and tertiary institutions including colleges of education(Olorode & Jimoh, 2016). In the light of this, Financial accounting discloses transaction classification and recording, but it is also important for business decision making process(Erika & Edita, 2018). The authors also lamented that financial accounting disclose the fact that the main aim of financial accounting is to collects and transforms monetary transactions and recording process. Information presented in the annual account, Application system of accounting rule. The authors also viewed Financial accounting as an important subject that discloses the size of resources of main activities or investment. Financial accounting also serve as avenue where Cash flow is acting as a self-financing margin. The financial accounting information could be changed into financial indicators, which are one of the company's analysis means for managerial decision. In spite of this vast, importance of financial accounting. The academic achievement of senior secondary is very poor when compared to other subject (Oladunni, 2015).

The poor performance of senior secondary school in financial accounting could be attributed to conventional teaching (Inuwa, Abdullah, and Hassan, 2017). The conventional teaching approach which was generally, referred to as traditional "chalk and talk" method of teaching which was persistantly used by financial accounting teachers at secondary school level have not yield

meaningful result when compared with the more modernteaching methods (Tumba, Chinda, & Andeyarka, 2014). The authors also found that mostly secondary school teachers and students that the conventional lecture method in classroom is of limited usefulness in both teaching and learning. The authors also viewed traditional passive of learning involves situations where teaching material is delivered to students using a lecture-based procedure,unlike modern view of learning is constructivism where students build their own form of reality rather than simply fascinating versions presented by their teachers. The method of teaching having these qualities is collaborative learning approach.

Collaborative learning Approach

Collaborative learning (CL) refers to instructional arrangements that comprise two or more students working together on a shared learning goal(van Leeuwen & Janssen, 2019)

Collaborative learning is a teaching method that includes a small group of students working together in order to develop the educational experience to the extreme extent possible(Al-kaabi, 2016). Collaborative learning (CL) is an educational method of teaching and learning that involves groups of students working together to solve a problem, complete a task, or create a product. In the CL environment, the learners face difficulties both socially and emotionally as they listen to different perspectives, and need to clear and defend their ideas. To achieve this, the students begin to create their own exceptional conceptual frameworks and not rely solely on an teachers or a text's framework (Laal and Laal, 2012). The author further laments that CL provide learners with the opportunity to converse with peers, exchange diverse beliefs present and defend ideas, question other conceptual frameworks, and are actively engaged.

Laal and Laal, (2012) also pointed out that CL represents a significant shift away from the traditional teacher-centered or lecture-centered setting in secondary classrooms. In collaborative classrooms, the lecturing/ listening/note-taking process may not vanish entirely, but it lives together with other processes that are based in students' discussion Coupled with active work on the course material.

In another development, a study conducted on Collaborative Learning for Educational Achievement viewed collaborative learning as an individual philosophy, not just a classroom strategy (Ritu, 2015). The author further lamented that in all situations where people come together in groups, it is a way of dealing with people with respect to individual group members' abilities and contributions. There is a sharing of authority and acceptance of obligation among group members for every group action. The underlying standard of collaborative learning is based upon cooperation by group members. For the effective application of Education for sustainable development , suitable teaching and learning strategies need to be selected and used, Collaborative learning is an educational method for teaching and learning that involves groups of learners working together to solve a problem, complete a task, or create a product. The main features of collaborative learning are: small group learning, co-operative behaviour;a common task or activity; individual responsibility;interdependence and accountability.

This has resulted in the need for future accountants to be forward thinkers, skilled strategists and team players(Zraa, Kavanagh, and Hartle 2011).In respect of this, collaborative learning strategy which were evolved by Vygotsky as a strategy of teaching, is gradually being recognised as a

technique for improving learning outcomes. The authors pointed out that Collaborative learning allows students to advance beyond what they would have been able to learn alone by sharing mental models and perceiving the thought processes of others. As opposed to direct instruction, collaboration allows students to actively partake in problem solving processes by communicating about the conceptual representations involving to the task at hand.

A study conducted by (Ritu, 2015) found that the hypothesis that there is no significant difference between the achievement scores in English of undergraduate students using Collaborative learning and individual learning is rejected. The findings also reveal that is there is a significant difference between the means of achievement in English by using Collaborative learning approach and Individual learning approach. The achievement is higher for collaborative learning methods as compared to individual learning methods.

Lyons, Lobczowski, Greene, Whitley, and McLaughlin (2021) found a positive result on Using a design-based research approach to develop and study a web-based tool to support collaborative learning. A study conducted by (Laal & Laal, 2012) found that Collaborative Learning encourages critical thinking skills to students much better than individualistic learning environments.

A study conducted by Al-kaabi, (2016)The clue of collaborative learning dates back to between 1950 and 1960 to that used by doctors to deal and communicate with medical students, where it was well-known that the students who were working in groups had medical assessment and results better than those who were working alone which reflected the great success of this idea.

Further investigation should be conducted with a larger sample of students from diverse courses in order to demonstrate the transferability to other disciplines and to obtain a consistent application pattern in collaborative learning,further research should explore new modes to enhance group commitment and communication within teams(Noguera, Guerrero-Roldán, & Masó, 2018).

Research Hypotheses

The following hypotheses were formulated in line with specific objective to be tested at 0.05 level of significance.

HO_1 There is no significant difference among the pre-test mean academic achievement of secondary school students taught financial accounting using Collaborative and Conventional learning approach in Bauchi state, Nigeria.

HO_2 There is no significant difference between pre-test and post-test mean academic achievement of secondary school students taught financial accounting using Collaborative learning approach in Bauchi state, Nigeria.-

Methodology

The study employed quasi-experimental pre-test-post-test design. Quasi-experimental design was defined by (Creswell, 2012) as type of experimental design in which individuals are not randomly assigned to groups. This is because the researcher cannot artificially create groups for the experiment. The researcher used intact classes of both experimental and control groups. Pre-test and post-test was administered to both experimental and control groups. This is in order not to

interrupt the normal classes of the students and the school time-table. This design, according to Sambo (2005), can be symbolically presented as follows:

G_1	**X_1**		**X_2**
G_2	**X_1**	**O_2**	**X_2**

Where: G1 is the control group and G2 is the Collaborative group
O_2 indicate the treatment to Collaborative group
X_1 and X_2 are pre-test and post-test respectively.

The Area of the study is Bauchi state. The State occupies a total land area of 49,119km representing about 5.3% of Nigeria's total land mass and is located between latitudes 90 3 and 120 3 north and longitudes 80 5 and 110 east. The state is bordered by seven states, Kano and Jigawa to the north, Taraba and plateau to the south, Gombe and Yobe to the East and Kaduna to the West.

A Population is a group of individuals who have the same characteristic (Creswell,2012). The population for the study made up of all public senior secondary school (SSSII) students offering Financial Accounting in the three (3) zones namely: Bauchi, Katagum and Darazo The population comprised of 725 students from 17 senior secondary schools in Bauchi State.

The researcher used simple random sampling is type of sampling where researcher selects participants (or units, such as schools) for the sample so that any individual has an equal probability of being carefully chosen from the population (Creswell, 2012).

The researcher adopted two tests for the purpose of collecting data for the study. The first one is Financial Accounting Achievement Test I (FAAT- 1) which was used as pre-test and Financial Accounting Achievement Test 2 (FAAT – 2) which was used as post –test. The questions of the two tests was adopted based on the SS II Financial Accounting syllabus with reference to West African Examination Council past question papers. Financial Accounting Achievement Test I (FAAT- 1) consists of 25 objectives and Financial Accounting Achievement Test 2 (FAAT – 2) consists of 20 objectives questions. Both FAAT- 1 and FAAT – 2 are drawn up from WAEC past questions of 2005 – 2012 without modifications based on the topic "trading, profit and loss accounts of a sole proprietor" the researcher was used to teach the respondent.

The researcher had verbal interactions with all the students concerned after which the Financial Accounting Achievement Test (FAAT – I pre-test)(appendix IV) was adapted by the researcher and was administered on student of financial accounting. The topic taught was final accounts of a sole proprietor. Independent sample T-test was used to address hypothesis one and Paired sample T-test was used to analyse hypothesis two. The Second phase has to do with the pass mark. Financial Accounting Achievement Test – I (FAAT-I) and Financial Accounting Achievement Test – 2 (FAAT-2) were adopted based on WAEC and NECO Financial Accounting Syllabus and past questions papers to ensure standard.

Result

HO_1--There is no significant difference between the pre-test of mean academic achievement of secondary school students in financial accounting using Collaborative learning approach and Conventional approach in Bauchi state, Nigeria.

Table 1 below shows the Independent samples t-test that was conducted to compare pre-testmean achievement of student taught financial accounting using Collaborative learning approach and Conventional learning approach in Bauchi state. The result from the table shows that there was significance difference between the mean scores of the Collaborative (mean = 1.31 and S.D. = 5.46) and the Conventional (mean = 2.72 and S.D. = 10.42) and P= 0.80. The P value is greater than the alpha value of 0.05, that is P > 0.05. The null hypothesis which states that There is no significant difference between the pre-test of mean academic achievement of secondary school students in financial accounting using Collaborative learning approach and Conventional approach in Bauchi state, Nigeria was accepted.

Table 1: Independent Sample t-test Result of secondary school students' academic achievement in financial accounting between Collaborative group

Groups	N	Mean	Std. Deviation	t	df	P-Value	Decision
Collaborative	38	1.31	5.46	9.85	37	0.80	H_{O1}Accepted
Conventional	38	2.72	10.42				

Source: Field Study (2019)

Where:

N –Number of Students (76 Students) df – Degree of Freedom
S.D. –Standard Deviation α – Alpha
t – T-test p - P- value

HO_2 There is no significant difference between the pre-test and the post-test mean academic achievement of secondary school students in financial accounting using Collaborative learning approach in Bauchi state, Nigeria.

Table 2 below shows the paired samples t-test that was conducted to compare pre-test and post-test mean achievement of student taught financial accounting using Collaborative learning approach in Bauchi state. The result from the table shows that there was significance difference between the mean scores of the Post-test (mean = 24.72 and S.D. = 10.42) and the Pre-test (mean = 12.31 and S.D. = 5.46) and P= .000. The P value is less than the alpha value of 0.05, that is P < 0.05. The null hypothesis which states that There is no significant difference between the pre-test and post-test mean achievement of student taught financial accounting using Collaborative learning approach and those using conventional teaching method in Bauchi state was rejected.

Table 2: Paired Sample t-test Result of secondary school students' academic achievement in financial accounting between Collaborative group

Collaborative Group	N	Mean	Std. Deviation	t	df	P-Value	Decision
Pre-test	38	12.31	5.46	9.85	37	.000	H_{O3} Rejected
Post-test	38	24.72	10.42				

Source: Field Study (2019).

Discussion

Based on the data analyzed and in line with formulated hypotheses, the following major findings emerged:

The findings of Research Hypothesis one revealed that there was no significant difference between the pre-test mean scores of students taught Financial Accounting using Collaborative learning approach and those taught using conventional teaching method in Senior Secondary School in Bauchi state. This signifies that both the experimental and the control groups were at the same entry behaviour before the treatment was applied. This finding is in line with that of Ritu(2015) and Tumba, Chinda, & Andeyarka (2014). All found no difference between the achievement of students in the experimental and control group in the pre-test which implies that both the experimental and the control groups were at the same entry behaviour before the treatment was applied.

The findings of Research Hypothesis two revealed that there was a significant difference between the pretest and post-test mean scores of students taught Financial Accounting using Collaborative learning approach and those taught using Conventional teaching method in senior secondary school in Bauchi state. This implies that the post-test mean score of students taught Financial Accounting using Collaborative learning approach was significantly higher than the mean score of students taught Financial Accounting using Conventional teaching method. This finding is in line with that of Laal and Laal (2012) and (Al-kaabi, 2016)

Conclusion

Having reviewed the performance of students in Financial Accounting in the selected senior secondary schools in Bauchi state. Collaborative learning approaches for teaching Financial Accounting the researcher hereby concluded that Collaborative learning approaches of teaching have positive effect on the performance of students in Financial Accounting. However, Collaborative learning approaches has more positive effect on students" academic performance than Conventional learning approaches. Since this is the case, adoption of Collaborative learning approaches of teaching financial accounting will reduce failure rate in O'level WASSCE and NECO examinations. This will ensure that many of the candidates can secure admission into higher institutions and make accounting their career.

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Analyzing the Impact of Covid-19 Pandemic on Science Education Professionals In Nigeria Toward A Paradigm Shift: Science Education and ICT as Antidote.

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Abstract
This paper analysed the current situation of Science Education Professionals in Nigeria amidst covid-19 pandemic. The global health threat and rapid structural changes caused by the pandemic has caused confinement of people in various work of life, ranging from closure in workplace, markets, event centres, and schools. This confinement has brought about changes in different aspects of human endeavour such as in the educational sector, leading to transfer of knowledge from face-to-face process to online interface. Due to this new interface of learning process, science education have had to adopt to the ever increasing challenges, ranging from new methodological approaches, safety as well as usage of ICT in the teaching and learning activities. The purpose of this study is to offer ways that optimizes the functionality of science education professionals in Nigeria in the current context of the covid-19 pandemic through the use of Information and Communication Technologies (ICT) as an antidote in integrating the new interface or methodology towards contributing to meaningful learning in students. The use of ICT by science education professionals can make a great impact and contribution towards paradigm shift that is happening globally.

Keywords: COVID-19 pandemic, Science education professional, ICT

Introduction

The current trends in human life worldwide as caused by the threat of covid-19 pandemic is leading to transformation in virtually all sectors of human endevours, thereby leading to unprecedented challenges to different spheres of social, economic, political and work pattern of human. The outbreak of this novel coronavirus disease (Covid-19) began in the city of Wuhan in China in December 2019, and by February 2020, it has spread to every continent of the world, thereby making every country government to put a closure to its borders, schools and universities, as well as cancellations of conferences ro avoid social contact (Vlachopoulos& Luis et al 2020). Universally, government of each nation are bringing out modalities to serve as emergency responses to the suspension of face-to-face interface of learning activities and closure of educational centres in order to curtail the spread of the disease.

With the emergence of covid-19 disease and its impact on reshaping STEM education in Nigeria through online interface is keenly of interest to all stakeholders in the Nigerian educational sectors. This covid-19 impact has led to two major shifts in the teaching and learning of Science education in Nigeria. First, the introduction of online interface and secondly, the reintroduction of physical school space to aid in class-teaching, thereby creating an enabling environment for teaching and learning process during a time of great social upheaval and instability (Triona 2020).

With the announcement of the closure of all schools to limit the spread of the pandemic in March 2020 by Nigeria ministry of education, the negative impact of such school closure as highlighted from the transfer of lesson from face-to-face (F2F) to distance learning or online interface, many students have been denied access and engagement with educational activities due to socioeconomic difference or social class of their background as well as student with special educational needs (SEN) (Ruth and Eilish 2020).

Preventive measures and efforts in curtaining the spread of the coronavirus through the non-medical ways such as social distancing, suspension of unified examinations and self-isolation have led to total school closures across over 100 hundred countries with Nigeria among them globally. This paper aimed to reflect the consequences of the covid-19 pandemic in the area of science education, with emphasise in the paradigm shift of transferring learning activities from face-to-face process to online teaching and how science education professionals in Nigeria must equip themselves for easy adaptation to the new normal of education through modality, which is occurring in a frantic and abrupt manner. Though, this new normal of online modalities is causing science education professional new circumstances, coupled with new difficulties and high level of stress. According to Luis (2020) in a survey conducted using more than 10,000 teachers, the result revealed that 92.8% of the respondents suffered emotional, exhaustion, anguish, stress as a result of confinement, unclear instruction, absent of support in teleworking and technical means in the discharge of their duties during the pandemic. Poor online teaching aids, lack of teacher training on the use of teleworking facilities, lack of information on the usage of teleworking facilities as well as complex home surrounding were some of the reasons highlighted as the possible causes of the emotional trauma these set of teachers undergoes during the period of the pandemic confinement.

To curtail these problems facing teachers and science education professional as a whole in Nigeria, teacher training through series of guidelines on the use and usage of teleworking facilities to aids in shifting the paradigm of science education professionals in Nigeria from the traditional method of face-to-face interface to the new normal or convectional method of online pedagogy and learning.

Impact of COVID-19 Pandemic on Nigerian Educational System

The impact of covid-19 pandemic on the Nigerian educational system has helped to clearly revealed the digital divide among nations with an indices of neglect between an average Nigerian child and his counterparts in most developing and developed worlds, owning to the effective measures adopted in these countries to curb the effect of disruption of regular schooling activities during the outbreak of the pandemic, countries such as China where computers were provided for low income households as well as offering of mobile data and telecom subsidies to these households to enable their children to participate in virtual and online learning. Likewise in France, computer devices were lent to students who do not have access to computer to be used for virtual learning activities. Also, in Portugal, the government partnered postal services to deliver working sheet to student who do not have access to internet at home (Vincent, 2020).

The Nigerian education system before the pandemic have purely adopted the face-to-face approaches to teaching and learning in primary and secondary schools, as these sets of students in both primary and secondary schools are not technologically inclined to the extent that the students

are not allowed to own or use any electronic or digital devices and gadgets in the process of learning, or even to be seen in the school vicinity with such a gadget, this thereby limiting their technological scope in handling online interface devices for easy and smooth learning outcome in case of eventuality such as the covid-19 pandemic outbreak.

At the peak of the pandemic outbreak and due to closures of educational sector, countries like Nigeria and other less affluent nations had no plan to keep their students engaged in academic activities, as such, with no clear cut policy to mitigate the disruption of academic activities, student were kept at home without any form of academic engagement. Even though the ministry of education casually announced that students should be engaged in learning activities through the public media channels such as, television and radio, this had little effect in stimulating the desire learning outcomes in the learners, as there is no feedback mechanism in this process. This public media platform employed by the government has no clear cut mechanism and policy to immediately tackle the disruption of academic activities of over 45 million school children affected by the closure of school activities as a result of this covid-19 pandemic (Vincent et al 2021).

The impact of the covid-19 pandemic outbreak on the Nigerian educational system in general can be attributed to some of the country policy and framework patterns, such as the Nigerian political leadership pattern, which has failed in giving the educational sector its rightful position, such as in budgetary allocation to the education sector, their short sighted political goals rather than long term gains for effective and efficient system of education. In term of educational policy and framework, the Nigerian education needs a total reform that would align its system with global realities such as changes in technological advancement, functional policy align with resourceful and strategies that would propel the sector in the direction and pace of global societies. This impact is mostly felt by the children in both primary and secondary level as indicated by the figure according to UNESCO, that almost 40 million learners have been affected and denied access to education and learning activities as a result of nationwide school closure in Nigeria, with over 91 percentage of such figure coming from primary and secondary school children in Nigeria (Thelma and Adedeji 2020). Due to all these failure in policy, direction and framework, covid-19 pandemic outbreak impacted negatively as a result of:

i. Lack of capacity to migrate schools activities in the face of the pandemic to virtual learning platforms.
ii. Lack of unified data to easily link schools to central information system or portal for collective learning activities.
iii. Lack of access to internet facilities and resources in many households.
iv. Rural settlers with limited internet access and unreliable electric power supply.

A Cursory Glance At Science Education In Nigeria Before COVID-19 Pandemic

Science education as seen as the application of educational theories in an attempt for endless search of knowledge, resulting in the development of learner's cognitive, affective and psychomotor domains, through systematic processes involving careful observation, deduction and testing by empirical means (Abubakar, Yusuf, Igba, Olarongbe and Usman 2021).

Science education can be seen as an approaches and ways which integrate and combines the content of science, technology and mathematics in the teaching and learning processes with the main aims and objectives of breeding students that are capable of facing challenges and utilizing

the prospects in the 21st century workforce. These approaches are geared towards inspiring generations of learners in curbing challenges through decisive decision making, innovations, collaborations and creative problem solving techniques in the global society (Abubakar et al 2021). Globally, science education has been recognized as a prerequisite for scientific and technological development which provides opportunities for students to acquire relevant and useful knowledge, scientific skills, values and answers to problems in a bid to provide and interpret natural occurrence. It helps students to inculcate right values, self-discipline, scientific literacy and general commitment to natural phenomenon's (Abubakar et al, 2021).

Science teacher education or science education professional plays an important role in the growth and development of any nation, as such; its importance sprang across technical, scientific, vocational circle as well as institutions of learning. The achievement recorded in many developed nations is as a result of government commitment and attention given to science educators welfares and favourable condition of service. A good outcome of science education teacher programme is expected to achieve an appreciable development in Nigeria according to its National Policy on Education, but contrary to the proposed policy, the country is yet to develop due to successive government lip service to the programme. The growth and development of any nation is measured upon its success and depended on its science teacher education. The major positive strives recorded in all area of human endeavour worldwide is attributed to science teacher education (Helen, 2020). The importance of science education professional in Nigeria cannot be over-emphasized, as it has helped in reducing illiteracy and poverty which are seen as an impediment to the development of the country. Globally, it is believed that the adoption of scientific frame of mind is a prerequisite for sustainable development and economy prosperity. It helps in improving the quality of life of an individual in the society in areas such as, health, nutrition, agriculture, transportation, energy production and industrial development (Akpan, 2008).

Though, the importance of science education professional towards sustainable development in Nigeria cannot be over-emphasized, it has some impending situations and circumstance that has continue to hindered it from fulfilling its aspiration and desired outcomes in Nigeria. These problems include:

i. Security: The security situation in Nigeria has affected virtually all areas of human endeavours. From the educational perspective, it has led to loss of capital and human resources. Evidence of human resources lost can be seen from recent attacks on Bayero University Kano, where a professor of chemistry was murdered, as well as bomb blast at Federal College of Education Kontagora, where a female student lost her life as a result of the blast. All these form of attack have led to insomnia in the heart of many academic staff and student alike, thereby limiting people to engage in scientific and knowledge-based activities, this in the long run, affect the scientific society and the country at large.
ii. Corruption has becomedeeply ingrained in theNigerian system and manifests itself in allsectors, including education. In Nigeria today you don'tknow what you know, but who you know. That is why the job search is linked to certain criteria such as political favoritism, the geographical area or the quota system. Many teacher training institutions and universities cannot boast of the best academic staff because the best are unlikelyto have a sponsorto help them. Appointment is no longer based on merit, but on who you know and how much you can offer for that position. Admission to higher

education is not based onmerit, but also on who you know. The purchase of scientificmaterial in schools is no longer transparent, since the school director orone of his relatives takes care of the delivery. In this case, they donot provide the required specification or quantity; in most cases they don't even deliver anything. Most science labs are empty buildings or buildings full of counterfeit or outdatedscientific equipment that isonly useful for demonstrations.Fundsearmarked for staff training will be diverted to personal accounts, while a selection of those who will benefitfrom staff training will go toyour-know-syndrome. All thishas hadan impact on the quality of science teacher training that the country produces.

iii. Economy: Nigeria is blessed with many natural resources on which its economy isbased;however,overdependence on oil has seriously affected the economy. Thisaffects science education becausescientific equipment and apparatus in educational institutions are inadequate and the cost of importing these materials is high duetothe exchange rate. All efforts to shift the focus of economics from the oil industry to other economic activities have not produced positive results dueto corruption. In somestatessalaries and other subsidies for science teachers are not paid and scientific equipment is not provided due to decreased production and slow economic growth dueto labour distortions, layoffs, brain drain, among others.

iv. Teachers Science teachers are the key factor to consider when discussing the evolution of science education in any country. There is a shortage of qualified science teachers in Nigerian schools. The so-called science teachers are not professionally qualified. They may have the knowledge of the subject, but they lack the method. Findingsonthe challenges and prospects of science education in primary schools confirmed that there are unqualified science teachers in our schools. The attitude of many teachers towards teaching is discouraging. They have been teaching for many years without updating their certificate throughin-service training. This affects their performance and is a problem for the development of science education. Science teachers must employ different strategies because there is no one-size-fits-allapproach,one-size-fits-all model fora particular class. Many science teachers still adhere to the chalk and talk method, which is not suitable for teaching science at this age. Lack of good science teaching strategies affects student performance and has along-termimpact on student (Helen, 2020).

Analysis of The Current Nigeria Educational Context During the Outbreak Of COVID-19 Pandemic

The outbreak of the covid-19 pandemic necessitated the Nigerian government to close all schools on March 27th 2020 as a measure to limit the spread of the virus across the 36 states in the country. As of 31st March 2020, according to data from the Nigeria Centre for Disease Control (NCDC), there are 139 confirmed cases, 66% are males, 34% are females within the age group mostly affected is 51-60 (27%) . The essence of the school closure was intended to curtail the spread of the virus within its populace, prevent carriage to other vulnerable people and maintain public health, these measures comes with its own high economic, social, health and thwart implication on the educational sector (www.ncdc.gov.ng, Uchena, Maximus, Charity &Chiedu 2021).

For low and medium income countries like Nigeria, the impact of the covid-19 pandemic is a great threat to the educational system, given that the sector was working and relying on substandard

policy, framework and platforms. The challenges imposed by this pandemic as a result of overcrowded resources which are constrained in mostly public schools. The most challenging impact of this pandemic resulted in decreased in the level of education, widening the existing divide in accessibility of learning outcomes as well as increased in school dropouts which are culminated by poor health system, poverty and inequity, hunger, high population densities, urban-rural divide and highly internally displaced people. Though the covid-19 pandemic further revealed the broadened existing quarmire in the educational system of Nigeria, as prior to covid-19 outbreak, Nigeria globally accounts for one in every five of the global out-of-school children, with about 10.5 million children within the age of 5-14 were out of school (Uchena et al 2021). Though according to UNESCO data as of May 2020, almost 1.2 billion student including children and youth globally were affected by the closure of school, with Nigeria students not an exception which represent 70% of the total world population. The consequences of this school closure on the student children and youth sprang from social, economic, physical, health as well as denial to nutrition and physical exercise (Luis et al 2020).

Consequences of School Closure as a Result of COVID-19 Pandemic In Nigeria

The far-reaching consequences of school closure are evident in low-income countries like Nigeria. These consequences posed a great threat to the entire population in most of disadvantaged countries like Nigeria, owing to its peculiar vulnerabilities in health sector, urban-rural divide and high out-of-school population. School closure bring high social and economic burden for people across communities and the impact of school closure is mostly felt by low-income countries like Nigeria, where this school closure are resulting in disruption and widening the already existing disparities within the education system among people in the society. School closures are likely to have a much negative impact on student learning and their well-being, most especially students from low-income countries and disadvantaged background (Vlachos 2021). According to UNESCO (2020), the adverse consequences of school closure can be itemized as follows:

i. Disruption of learning activities: With the school closure, students are deprived access and right to education, which affect their personal development. Limited access to education as a result of school closure due to pandemic causes more damage to the educational sector in general.
ii. School closure affect labour supply as evidence in health care workers, hence reducing healthcare capacity.
iii. School feeding: with Nigeria having one of the highest malnutrition disorder, affecting more than 42% of its total school children, and which is responsible for 49% absenteeism of its primary school children, the Nigerian National Home Grown School Feeding Programme (NHGSFP), which is a social investment programme designed by the Nigerian government to tackle poverty, improve health and education of school and vulnerable children. With the scheme, school enrolment and reduction in absenteeism are some of the gains recorded as a result of school feeding program (www.guardian.ng).
iv. Loss of jobs: The Nigeria National home grown school feeding programme has brought and created a lot of opportunities and jobs, as well as brought peace in some homes when hitherto some women were jobless, some Nigerian farmers and business people who engages in the sell and supplies of farm produces to the scheme could not supply their products as a result of school closure during the pandemic, as children do not have access to school and thereby denying them food at school during the pre-

pandemic period. This has leads to economic consequences through increased unemployment.

v. Increased in school drop-out: The possibility of increased in school dropout after a prolonged school closure is eminent, owing to the fact that some children will have taken up interest in other life sustaining endeavour.

vi. Reduction in school hours: Due to school closure as a result of covid-19 pandemic and the subsequent reopening, the effect of such closure is evidence in the number of hours school children spent at school these days, there is reduction in the duration of educational instruction and other school activities, as schools are trying in minimizing the number of days in a term to a lesser days, in order to regain back the former school calendar, this thereby reduces the time for educational attainment and other extra-curriculum activities.

Working During COVID-19: Training Needs of Science Education Professionals in the Face of a Paradigm Shift

The exceptional circumstances caused as a result of the covid-19 pandemic in the context in which schools are closed in about 185 countries is causing an impeding situation capable of threatening the deep of global educational crises. This has therefore forcing government of every nation to adapt a new paradigm shift, from the face-to-face process of learning to transition of academic activities through the digital interface. This paradigm changes have necessitated the need to train science education professionals in the use of technological gadgets and devices for ease learning outcomes and curriculum implementation in the present state of the pandemic. These changes in educational paradigm as a result of the negative impact of the covid-19 pandemic has made tele-training of educators and students in the use of Information and Communication Technology (ICT) gadgets, devices and knowledge as a necessity platforms for the continuity of teaching methodology and learning in these time of the covid-19 pandemic (Luis et al, 2020).

The paradigm shifts from the face-to-face modalities to online interface in Nigeria have its own area of concern for science education professionals. The competence of the teachers and how prepared are schools in readiness in facing these changes towards virtual teaching. In line with this argument, 2018 PISA reports indicated a survey result showing 30% and 80% in terms of teacher competence in the use of ICT for virtual teaching and school resources for usage in integrating digital devices and gadgets into virtual teaching (Hodges et al 2020, & Fernandez et al, 2017).

These changes from face-to-face interface to online process has caused by the covid-19 pandemic has revealed the existence of three (3) gap. The first gap is the access gap, which reveals the accessibility or not to internet connectivity and technological devices and gadgets, secondly, the gap of usage, that is, time of use and its quality, and lastly, the gap in teachers' skills, availability of resources and adaptation of online platforms to aids teaching.

The effects of these digital gaps are evidence during the period of the covid-19 pandemic confinement between the affluent families and the less resources families. ICT and technologies in recent years have influenced the way of learning, working and socializing through the modification in accessibility of information in terms of distance and time.

The training needs of science education professionals amidst the pandemic and subsequent reopening of schools amidst limited resources in low-income countries like Nigeria, critical decision must be taken about how they can best support teachers working during the pandemic. The following have been highlighted as areas to be considered:

i. Teachers' access to timely information and guidance about covid-19 and how to provide support to their students which can be achieve through communication methods.
ii. Strategies and methodology needed to help students from low-income home, girls, students with special needs, and low-performing students to catch up on learning lost during school closures as a result of the covid-19 pandemic.
iii. Strategies are needed by teachers on how to encourage students to return to school, this can be done with extra support from teachers to the less disadvantaged students.
iv. Psychological, emotional, materials, physical support can also be given to students by the teachers as additional support to students during the school closures.
v. Training on the use of practical infrastructure support to help prevent the spread of the virus through hand washing facilities, adherence to social distancing and strict compliance on the use of face masks.

The Paradigm Shift: the Role of ICT and Science Education Professionals in Optimizing Learning Amidst COVID-19 Pandemic Outbreak in Nigeria.

Information and communication technology (ICT) can be defined as an infrastructure and artefact which is used in acquiring, integrating, processing and analysing information through a mediating tool in communication which is the computer. The computer which is seen as a automated technology use for information procession in terms of gathering, storing, processing and sending data or results (Ulf, Gajek&Gunilla, 2009).

The use of ICT in science education programme is classified either as a tool application or learning through ICT. The learning through ICT is further divided into three (3) different categories for direct support learning, these include:

i. Computer-Assisted Learning (CAL): This is for any interaction between the students and a computer system designed to help students in learning.
ii. Computer-Assisted Inquiry (CAI): is the application of ICT for the collection of information and data from different sources to support scientific reasoning.
iii. Distance-Learning Approaches: is the use of ICT for educational purposes such as electronic mail, news group, chat-room, blogs, Wiki and videoconferencing.

The ICT as an infrastructure used by the science education professionals for the quest for effective and efficient learning outcomes. The science educators are seen as the user of the ICT infrastructure. The use and role of ICT and science education professional towards contributing, supporting and ensuring learning continues in the face of the pandemic is quite commendable.
The inculcation of ICT in science education will affects the outcomes of teaching and learning activities, so science education professional should be up and doing in mastering of the use of ICT, this will lead to active and collaborative activities among the students. According to Osborne and Hennessy (2003), itemizes the role of science education professional in the selection, usage, design and evaluating appropriate ICT tools for effective teaching and learning during the pandemic, these include:

i. In planning activities to engage students in active participation during the pandemic through the use of ICT.
ii. Ensuring that the use of ICT by the students will add value to learning and activates new goals in them.
iii. Prompts students to thinks and links theories and concepts in science.
iv. Create time for discussion, reasoning, analysis and reflection of tasks given to them.
v. Developer of students' skills for finding and analysing information through the use of the internet.
vi. Autonomy-supporting activities of the students by the teachers through student-centered learning methods or collaborative learning activities which support feeling of autonomy.
vii. Support to student 'feeling of competency' through choice and use of constructive evaluation methods.
viii. Supports to students' social relatedness through co-planning and ICT use which help students to feel close to their peers.
ix. Support to interest and enjoyment through waking up of curiosity by choice of surprising evoking inquiring or simulations.

Though, the pandemic has led to school closures globally, students need to be engaged in their academic activities by the teachers, the teacher is to serve and offer optimal resources for motivating, stimulating through the process of choosing the learning activities for the students. The teachers does all these as a result of school closure caused by the pandemic, which led teachers to change their classroom into online platform spaces, as such led the teachers changing their concepts, strategies and feeling, through virtual consequence as some teachers are not familiar with digital technologies.

Teachers'usage of ICT to engage the students during the period of school closure as a result of the pandemic caused by the covid-19 virus is made possible through the use of ICT in the following approaches:

i. PowerPoint supported lecture or teaching as a result of social distancing among the students to reduce contact and spread of the disease.
ii. The use of animation to make learning more concrete and lasting in the minds of the learners.
iii. The use of multi-media resources which enables visualization and manipulation of images for better enhancement of scientific ideas.
iv. ICT allows both the teacher and the student alike to carry out repetitive tasks quickly and accurately, thereby reducing time spent on scientific data generation.
v. Using internet and email for communication dissemination among teachers, school head and students.
vi. Using websites to make information available to the students and general public through ICT.
vii. Enabling making contact with other schools in other places and countries for useful and relevant information during the period of the pandemic.
viii. Using ICT as a means of keeping in touch with peers through social media platforms such as Facebook, Whatsapp, and Telegram, as a result of social distancing as caused by the pandemic.

Conclusion

In this time of global unrest has caused by the covid-19 pandemic, which is leaving a devastating consequences in the society from different aspects of human endeavour such as health, economic, education, political and social point of view. In the area of education, a paradigm shift as necessitated by this pandemic which goes beyond mere change in the methodology of teaching from the face-to-face interface to online process, the urgency and speed at which this transformation is happening is a thing of concern to educational stakeholders globally. In low-income countries like Nigeria, the divide is eminent during the pandemic due to lack of capacity to migrate school activities during the pandemic to virtual platform, lack of unified data to easily link schools to central information system, as well as absence of internet facilities and resources in many resources. As a result of the aforementioned problems, its adverse consequences include; disruption of learning, affects labour supply as evidence in health care workers, school feeding children been at home as a result of school closure, loss of jobs as well as increased in school drop-out children.

For this reason, a paradigm shift was necessitated in the teaching profession, the educational sector must geared itself to adapt to the new situation. This is through the use of ICT tools in the teaching and learning process after the covid-19 crises.

Before the use of ICT in the teaching and learning process as a result of the pandemic, some training needs of the teachers working during the pandemic are access to timely information, new strategies and methodology on how to encourage students to return back to school, as well as giving psychological, physical and emotional support to the students in this great time of adversities.

ICT usage and applications in overcoming these adversities for effective and efficient teaching and learning cannot be over-emphasized at these periods of greater upheaval in our society. The use of ICT by the science education professionals in planning activities to engage students in active participation through the use of ICT, thereby prompting students to think and links relationships between concepts and theories.

ICT can be applied in optimizing teaching and learning of science through different approaches such as usage of PowerPoint and slide to decongest the classroom for effective learning outcome, and reduces the spread of the disease. The use of multimedia to aids in visualization and manipulation of images for better enhancement of scientific ideas.

Recommendations

It might be too common for issues and challenges of ICT to be completely analyse amidst the COVID-19 pandemic outbreak in Nigeria, its impact and implications on educational sector is too eminent to be discard, as such, the consequences and negative impact of this outbreak of the pandemic which led to disruption of schooling activities, loss of jobs, malnutrition of school children and challenges in the health care sector, has prompted the following recommendations:

i. School principals should become knowledgeable about effective ICT integration in teaching and learning process.

ii. Central data unit should be provided by the government to links school for ease information dissemination among its populace especially during an outbreak of pandemic.
iii. Access to internet facilities to its entire citizen at an affordable rate and subsidies provided.
iv. Reliable electric power supply to rural dwellers to enable them access to internet and ICT.
v. Science education professionals should be empowered on method and strategies needed for effective ICT usage.
vi. Science education professionals should prioritise ICT integration and initiate intensive techniques for effective ICT integration into current teaching and learning practices due to pandemic outbreak.
vii. School Principals should not assume that teachers who are computer literate are also knowledgeable and skilled in ICT integration in the teaching and learning process.

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Perception of Undergraduate Students on the Influence of COVID-19 Pandemic on their Learning in Federal University of Technology Minna, Niger State.

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Abstract
The study is a descriptive survey research that assessed the perception of undergraduate students on the influence of the COVID-19 pandemic on their learning using mean and standard deviation. The population of the study comprised 21,6172019/2020 undergraduate students of the University. A purposive sampling technique was used to select three schools from the population with 8,397 students. Simple random sampling technique was used to determine 200 respondents from the target population. –items questionnaire with a 5-points Likert scale was developed and administered to the respondents. 198 questionnaires were completed and returned, giving the rate of 99% respondents. In this study, it was found out that the pandemic has affected the learning system of the students. The students adhered to the COVID-19 Protocols, which also involved their learning mode in the University. In this context, it was recommended that Alternative measures in the educational sector should be adopted where the universities would minimize the physical gathering of teachers and students, thereby considering online teaching and learning.

Keywords: Learning Activities, COVID-19 Pandemic, Perception.

Introduction

Dealing with undeterminable challenges caused by the COVID-19 pandemic has raised a dreadful alarm, resulting in many setbacks and confusion in the world, therebyleaving many people with uncertainties and questions on how the next moment will be because of the tension caused by the pandemic. Aylie and Mekonin (2020) described the COVID-19 pandemic as a public emergency of international concern that affects several nations.

In addition, World Health Organization (WHO)has describedcoronaviruses as a deadly virus that belong to a family of viruses that cause illness such as the common cold to more severe diseases like the SevereAcuteRespiratorySyndrome (SARS) and the Middle East Respiratory Syndrome (MERS). These viruses were formally transferred from animals to humans. SARS, For example, was transmitted from civet cats to humans while MERS moved to humans from a particular camel. However, the COVID-19 pandemic was first discovered in Wuhan, China, in December 2019 and rapidly spread worldwide. The coronavirus was officially known as Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) by the International Committee on Taxonomy of Viruses (ICTV). SARS-CoV-2 is seen to be a spillover of an animal coronavirus and later adapted the ability of human-to-human transmission (World Health Organization, 2020).

This disease spreads fast and quickly among humans. In this context, the World Health Organization(WHO)on March 12, 2020, declared it as a pandemic. The symptoms of the infection include fever, cough, shortness of breath, and breathing difficulties. In more severe cases, it can lead to pneumonia, multiple organ failure, and even death. COVID-19 pandemic has caused governments authorities worldwide to take drastic measures to control the spread of the

infections.Many countries declared nationwide lockdown,banned local and international flights, postponed school attendance, halted universities activities, business operations, restricted large gatherings, and asked people to stay back at home(WHO, 2020).

In Nigeria, the first case of COVID-19 was discovered on February 17, 2020, in Ogun state, and since then, manysuspected cases where found in different states.During this study, Nigeria has recorded 196,000 victims with 2,573 deaths, while Niger state was recorded 966 victims with 20 deaths(Nigeria Center for Disease Control [NCDC], 2021).However, there is no doubt that the COVID-19 pandemic has not disrupted the educational process across the entire world. Billions of students and educators were affected by school closures and other measures. On the other hand, many governments had responded immediately to the pressing need by providing school children with learning possibilities via online education and distance learning (Romer, 2020).

Learning activities have been disrupted by the COVID-19 pandemic, with over 1.53 billion learners out of school across the entire world by school closures measures which have impacted over 87.6% of the world's total enrolled learners (Education Cannot Wait [ECW], 2020). In curtailing the spread of the COVID-19 pandemic, governments and educational administrators want students to be accessible through online education and distance learning which has contributed to the problem. Because an online education requires an excellent infrastructure where every student needs access to the internet (Akat&Karates, 2020), this new learning method opened an easier way to stop direct contact among students or lecturers. Unfortunately, many students had no access to online teaching due to financial limitations, poor infrastructure, and unreliable power supply. AS such, it has increased the rate of depression, anxiety, and distress.

As a result,before the reopening of schools in Nigeria, Ben Goong spokesman for the Federal Ministry of Education, out-listed COVID-19 protocols parents and respective institutions must ensure compliance to COVID-19 protocols,which included the compulsory wearing of face masks by all students, teachers, and workers in all schools, temperature checks, and handwashing facilities at strategic locations in all schools, constant supply of water, hand sanitizers, and enforcing maintenance of social distance and suspension of sizeable social gathering such as assembly (Ben Goong, 2021).

However, In the Federal University of Technology Minna Niger State, the protocols were implemented to have a COVID-19 free environment and ensure practical learning activities or outcomes. But unfortunately, the protocols such as; temperature check has made some students got to the lecture hall late because of the long queue,use of nose mask has made students uncomfortable during lecture time, thereby losing concentration,teachers don't move in the classroom to check students who might not be engaged in class activities due to the of fear of getting infected by the COVID-19,students are not allowed to go into school premises without nose-mask,this has made many students miss their lectures or go into the lectures hall with high tensions and nervousness. Therefore, this study tends to assess students' perception of the influence of the COVID-19 pandemic on their learning in Federal University of Technology Minna, Niger State.

Statement of the Problem

COVID-19 Pandemic unexpectedly attacked the entire world and forced every nation to be on stay safe precautions -nationwide lockdown, banned the local and international flights, postponed school attendance, maintained social distance, halted universities and business operations, restricted large gatherings, and asked people to stay back at home.As a result, all over the world, every aspect of national development was put on hold, including the education system, which drawn a strong line of a challenge to the system.Nigeria recorded 196,000 victims with 2,573 deaths in this study, while Niger state recorded 966 victims with 20 deaths. These hadraised a high tension on the academic institutions and halted all the learning activities to maintain students' safety. On the hand, teachers also had to adjust their teaching practices to meet the new health regulations.

However, Jegede (2020) researched the impact of the COVID-19 pandemic on higher institution development and found out that the COVID-19 Pandemic has affected the students' academic calendar. Also, Akat and Karatas (2020) researched the psychological effects of the COVID-19 Pandemic on society and its reflections on education and found out that the pandemic hurts everybody.Therefore, this study investigates undergraduate students' perception of the influence of the COVID-19 pandemic on their learning in Federal University of Technology Minna, Niger state.

Aims and Objectives

This study investigates undergraduate students' perception on the influence of the COVID-19 Pandemic on their learning in Federal University of Technology Minna, Niger state.
Specifically, the study was designed to achieve the following objectives:

1. To determine the perception of students on the influence of the COVID-19 pandemic on their learning at the University
2. To examine the extent to which the students' adhered to the COVID-19 Protocolsin the University
3. To examine the perception at which the adherence to COVID-19 Protocols influence the undergraduate students' mode of learning in the University

Research Question

The following research questions were raised to guide the study;

1. What is undergraduate students' perception of the influence of the COVID 19 pandemic on their learning in the University?
2. To which extent do the students adhere to the COVID-19 protocols in the University?
3. Does adherence to COVID-19 protocols influence the mode of your learning at the University?

Research Design

The study adopted a descriptive survey research design to assess undergraduate students' perception of the influence of the COVID-19 pandemic on their learning in the Federal University of Technology Minna, Niger state. The population of the study comprised21,617 2019/2020 undergraduate students of the University. A purposive sampling technique was used to select three schools from the population with 8,397total numbers of students. A Sample of 200 respondents was selected using simple random sampling techniques.A 30-items questionnaire with a 5-

pointsLikert scale was developed and administered to the respondents. 198 questionnaires were completed and returned, giving the rate of 99% respondents. The demography of the respondents was elicited in part A of the questionnaire, part B of the instrument consist of items on the perception of students on the influence of the COVID-19 pandemicon their learning in the University.

Mean and standard deviation was used to answer the research questions.

Results

Research Question One:

What is undergraduate students' perception of the influence of the COVID 19 pandemic on their learning in the University?

Table1: the perception of undergraduate students on the influence of COVID 19 pandemic on their learning in the University

S/N	Items Analysis	**N**	Mean (**X**)	Standard deviation S.D	Remarks
1	The lockdown period of stay at home affected my studies at the University	198	4.31	1.12	Moderately agree
2	The lockdown period made me forget much of what I learned in school	198	3.89	1.15	Moderately agree
3	Because of COVID-19, course contents were not adequately covered	198	3.98	1.18	Moderately agree
4	Most of the topics were poorly taught after the post-COVID 19 pandemic	198	3.60	1.29	Moderately agree
5	Environmental post-COVID 19 protocols have affected my learning activities at the University	198	2.97	1.36	Agree
6	I find it challenging to adapt to the new teaching/learning environment	198	2.80	1.34	Agree
7	It is difficult for me to concentrate during classes while trying to adhere to COVID 19 protocols	198	2.84	1.43	Agree
8	I get nervous about meeting up my lecture time due to the long queue at the gate for a temperature check	198	3.03	1.44	Agree
9	My interest in studies is meagre due to the extended stay at home	198	3.38	1.28	Agree
10	Planned events of physical presence which could not be carried out remotely in school were not observed	198	3.26	1.22	Agree
	Grand mean		3.40	1.28	Agree

Table 1 reports the perception of students on the influence of the COVID -19 pandemic on their learning.From the result,the grand mean was 3.40, with a standard deviation of 1.28,more significant than the criterion score of 2.50. Hence, it is evident that undergraduate students perceived that COVID-19 had influenced their learning in the University.

Research Question Two:
To what extent do the students adhere to the COVID-19 protocols in the University?

Table 2: Students Adherence to COVID 19 Protocols in the University.

S/N	Items	N	Mean (X)	Standard Deviation (S.D)	Remarks
1	I make use of a mask every time I am in school	198	3.81	1.24	Moderately agree
2	I avoid crowds as much as I can	198	3.62	1.32	Moderately agree
3	I utilize the handwashing equipment provided by the school for regular hand washing	198	3.18	1.48	Agree
4	I avail myself for temperature check before entering the school every morning	198	3.19	1.51	Agree
5	I avoid touching surfaces, especially within the school	198	3.29	1.40	Agree
6	I protected my school reputation by following the COVID 19 protocols	198	3.85	1.18	Moderately agree
7	I adhered to COVID 19 protocols and advice my friends to do likewise	198	3.67	1.31	Moderately agree
8	I was afraid of been punished, so I adhered to the COVID 19 protocols	198	3.68	1.36	Moderately agree
9	COVID 19 protocols have helped me to be more conscious of my health status	198	3.91	1.18	Moderately agree
10	Observance of social distancing has reduced interactions with my coursemates.	198	3.08	1.50	Agree
	Grand Mean		3.52	1.34	Agree

Table 2 shows students' adherence to COVID-19 protocols in the University, from the grand mean score of 3.52, the standard deviation of 1.34,which is greater than the criterion of 2.50. Hence, it is evident that students adhere to a great extent of 3.52 to COVID-19 protocols in the University at different levels.

Research Question Three: Does adherence to COVID-19 protocols influence the mode of your learning at the University?

Table 3: Influence of COVID 19 Pandemic on Students Modes of Learning in the University

S/N	Items	N	Mean (X)	Standard Deviation (S.D)	Remark
1	the pandemic helped me to learn how to explore materials online since contents are sometimes not covered in class	198	3.77	1.41	Moderately agree
2	my use of tutorial videos has increased because of the pandemic	198	4.00	3.79	Moderately agree

3	Individual learning became more interesting by exploring other means of education due to the pandemic	198	3.75	1.26	Moderately agree
4	my use of social media for academic purposes increased as a result of the pandemic	198	3.70	1.20	Moderately agree
5	The frequent use of ICT facilities during the lockdown has improved my ICT skills tremendously	198	3.45	1.33	Agree
6	The pandemic has forced me to prefer smaller classes to larger classes for my tutorial	198	3.42	1.33	Agree
7	I prefer the use of audio records to be present in the class because of COVID 19	198	2.79	1.48	Agree
8	I prefer individualized practical work to group work	198	2.81	1.48	Agree
9	I find audio records more beneficial because I can replay them as often as I can	198	3.27	1.43	Agree
10	I understand my course content when I use tutorial videos	198	3.52	1.32	Moderately agree
	Grand Mean		**3.44**	**1.72**	

From table 3, all the items had a mean of 2.5 and above, which is the minimum for an item to be categorized as agreed. This implies that COVID-19 has influenced students' modes of learning in the University. In items 1,2,3,4, and 10, the respondents moderately agreed, while items 5,6,7,8 and 9 decided that COVID-19 has influenced students' modes of learning in the University.

Discussion

Research question one shows thatthe respondents'perceived that the COVID-19 pandemic has influenced their learning in the University. Furthermore, The respondents agreed that the lockdown period of stay at home affected their study at the University. The lockdown period made them forgot much of what they learned in school. Coverage of contents has not been satisfactory because of the COVID-19 lockdown. They find it challenging to adapt to the new learning environment, and it was difficult for them to concentrate in class while trying to adhere to COVID-19 protocols. Also, getting to the lecture halls on time became a challenge because of the long queue at the entrance gate for temperature check. Their interest in studies was affected by their extended stay at home. Practical and field works could not be well attended to due to COVID-19 restriction. In a bid to adhere to the COVID-19 protocols, course contents were delivered poorly. This finding corroborated with Mohammed (2020), who pointed out that the COVID-19 pandemic lockdown affected students' learning activities in the Faculty of Veterinary Medicine South Valley University, Qena, Egypt.

The findings from Table 2 showed a high level of adherence to the COVID-19 protocol by the respondents. The respondentsagreed that adherence to COVID-19 protocols such as; use of face mask, avoidance of large crowd, utilization of handwashing equipment provided by the school management for hand washing, compliance for temperature check at the school gate, avoiding touching of surfaces within the school, among others had affected their learning in the University. This finding is in line with Varol et al.(2021) on the University Students' Adherence to the COVID-

19 guidelines: A Qualitative Study on Facilitators and Barriers. In addition, their findings revealed that the respondents were willing to adhere to the guidelines within the university building.

The result from Table three also agreed that the pandemic significantly affects their learning mode in different ways. They resorted to sourcing materials online since course contents were sometimes not covered in class adequately. Their use of tutorial videos increased because of the pandemic. Individual learning became more attractive as a result of the pandemic, their usage of social media for academic purposes increased, their frequent use of ICT facilities helped to improve their ICT skills, the pandemic made them prefer smaller discussion groups to large ones, their usage of audio records for learning also increased. They now like individual practical work to group work. This is in line with the findings of Ghada R.(2021) examined the effects of the sudden shift from face-face to online distance learning due to the COVID-19 pandemic lockdown at one of the university in Egypt. The findings revealed that this unplanned and rapid shift at the pandemic did not result in a poor learning experience as was expected.

Conclusion

COVID-19 is a withering Pandemic that has deeply affected education. The pandemic has influenced thelearning activities of the students. Most of the students adhered to COVID-19 protocols and perceived that the pandemic also influenced their learning mode. In this context, the following recommendations were made.

Recommendations

Based on the findings of this study, the following recommendations were presented.

20. Adequate infrastructure for an online or distance education system should be strengthened so that every studentwill have access to education. While, Lecturers should be provided with in-service training to improve their online teaching competencies.
21. Parents should add more efforts to make up their children's learning and educational activities should be emphasized in an online environment with the support and cooperation of teachers and all the concerned experts to prepare ahead for any pandemic.
22. Students should be given emotional support through motivation, education on how to handle and manage stress, anxiety, and depressions. While, the Government should increase funding of tertiary institutions to allow them to manage all the damages caused by the COVID-19 pandemic. Also, the researchers recommended an alternative measures in the educational sector should be adopted where Universities minimize the physical gathering of teachers and students, thereby considering online teaching and learning.

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SUB-THEME: STEM and TVET for Innovation Technology and Engineering Education

Innovative Skills Required by Technology Education Students of Tertiary Institution in Niger State for Self Reliance

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Abstract

The study identified the acquisition of innovative and entrepreneurship skills required by technology education students of Tertiary Institution in Niger State for self reliance. The design of the study was descriptive survey. Three research questions and three hypotheses were formulated to guide the study. The population for the study was 172 final year technology education students from FUT Minna Niger State and COE Minna Niger Statecensus Sample techniques. A structured questionnaire titled "Acquisition of Innovative and Entrepreneurial Skills Required Questionnaire" (AIESRQ). In a four point rating scale duly validated by experts in the field was used as instrument for data collection. The reliability coefficient of the instrument was determined using the Cronbach Alpha method which yielded a mean value of 0.71. Mean was used to answer the research questions while t-test was used in testing the formulated hypotheses at 0.05 level of significance. The study revealed that entrepre neurship skills such as ability to determine the needs of customers, ability to capture, maintain and retain the attention of customers, ability to determine demand and supply situation, ability to develop good negotiation skills and others were identified as entrepreneurial marketing skill needs required for self-reliance by business technology students. Based on these findings, Conferences, seminars and workshops should be periodically arranged for teachers and students as this will assist them to update their knowledge and skills in technology education programmes. Government and other stakeholders in education should expose the students to other skill acquisition programmes and opportunities that will ensure skill development and promote economic self-reliance.

Keywords: Education Technology, Students, Skills, Innovative, Entrepreneurship Skills, Self-Reliance

Introduction

Education is the process of receiving systematic instruction, especially at a school or university. Oboreh and Nnebe (2019) explained education as a veritable tool for enhancing economic growth and national development. It is seen as the cornerstone of development because it forms the basis of literacy, skill acquisition, technological advancement, knowledge acquisition and ability to harness the natural resources of the environment. Education in the context of this study is skills needed for students to acquire inorder to function effectively in world of work. A major objective of education as defined by the National policy on Education is the acquisition of appropriate skills, abilities and competence that will enable individuals contribute to national development (NPE, 2013). Vocational and Technology Education (VTE)programme strives to achieve this aim by

preparing students for the world of work either as employed or self-employed by instilling them with relevant skills, abilities knowledge and competencies.Raymond, *et al.*, (2019) explained the aim of establishing VTE programme is to train individuals to equip them with teaching skills and technical skills in specific occupational area of specialization to enable them function effectively as Vocational and Technical teachers or lecturers at TVET institutions (technical colleges, vocational schools, training centers among others) as well as skilled technical personnel in industries. VTE in the context of this the study is a form of education the equips skills needed to function in the world of work to students.

Students are person who is studying at a university or other place of higher institution. Aliyu (2014) postulated that students are someone who is studying in order to enter a particular profession. Students in the context of the study are those students of technology education who exposed to different vocational skills in institutions such as electrical electronics technology, building technology, woodwork technology, metalwork technology and Automobile technology. The exposures of the students to these different fields make them to be skillful.

Skills is process by which individual is expertise. Mautin*et al* (2019) postulated that skill is the ability and capacity that is acquired through deliberate, systematic, and sustained effort to smoothly and adaptively carryout complex activities or job functions involving ideals (cognitive skills), things (technical skills) and / or people (interpersonal skills).Skills in the context of this study are the process by which technology education students acquired knowledge and skills needed to be self reliance to enter a particular profession. As technology is dynamic the students of technology education have to innovative.

Innovative is the ability of introducing new ideas or ways of doing things. Faiza, *et'al.,*(2018) explained innovative as the process of developing, generating, applying or promoting new ideas by employees to increase job performance.Innovative in the context of the study is the process at which the students of technology education is being creative, Using imagination to manipulateinstruments, to discover possibilities, and to construct objects and images that never existed before. Entrepreneurial skills acquisition are said to be the necessary set of skills required to be an entrepreneur. In other words, entrepreneurial skills acquisition are those necessary skills an entrepreneur needs to successfully run a business or add value to work. Agu*et al.,*(2013) argued that acquisition of innovative skills must be nurtured through proper education so that it can be directed to responsible and enriching small business endeavours that will benefit the individuals and the communities in which the entrepreneurs live.

Entrepreneurship skills acquisition are those skills that an individual need to possess in order to enable him/her succeed in a virtual learning environment. Umunadi, (2014) defined entrepreneurial skills are business skills, which an individual acquires personally to function effectively in business as an entrepreneur and be self-reliant. Entrepreneurship skills in the context of this study is the business skills that students of technology education needs to gains and profits on their fields of profession to become self-reliant.

Self-reliance is the process at which individual depends on his own. Umoru and Nnagi, (2015) explained Self-reliance is the ability of an individual to establish a business of his own without depending on someone else. A person who is independent and self-employed is self-reliant. To

achieve self-reliance, one must be able to develop the spirit of self-employment; take calculated risk; translate his/her dream into reality through creating, organizing, and producing ideas; spot opportunity and utilize every difficult situation; and develop a school to work strategy, that is, have a practical work experience before graduation from school (Medeyase, 2013). Similarly, Daluba and Odiba (2013) observed that Nigerian graduates could only be self-reliant if they acquire relevant skills through entrepreneurship programmes which will translate into self-employment, wealth creation, job creation, and satisfaction. Despite the clamor for self-reliance and job creation in Nigeria, the planning of technology education in the country has not given enough attention to quality, relevance, and functionality of education. This is evident in students that have graduated from the tertiary institutions that are not yet self-reliant and cannot even do anything for themselves. Hence, this study is design to determine theinnovative skills required by technology education students in tertiary institution in Niger State for self reliance.

Acquisition of innovative and entrepreneurship skills helps in development of a country. It reduces poverty and creates jobs for the youths. This skills helps the technology education students to functions effectively after their graduations. Wey and Wolugbom (2018) explained that every technology education student needs to acquire entrepreneurial marketing skills to achieve self-reliance as its importance cannot be over-emphasized. The possession of these skill needs will facilitate students' self-employment after graduation thereby reducing graduate unemployment in Nigeria. Marketing as a facet of technology education provide a lot of business opportunities for students after graduation. Thus technology education students must get themselves acquainted with these skill needs while in school so they can achieve self-reliance after graduation and also contribute their quota to national development.

However, Nigeria has been confronted with the challenge of high unemployment among her youths. Today, the present state of the Nigerian economy requires every individual to think of the very best alternative means of meeting his/her immediate needs through self-employment which acquisition of innovative skills and entrepreneurial marketing skills offers to graduates especially those of technology education. According to Ezenwafor and Olaniyi (2016), the skill needs required by graduates of Nigerian tertiary institutions in this contemporary time, are more than mere preparation for white collar jobs but for self-reliance geared towards national development. The field of marketing in technology education provides abundant self-reliant employment opportunities for graduates, which they are unable to identify and explore because of they are deficient in relevant entrepreneurial skill needs required to market a business. It is very certain that unemployment will continue to increase at an alarming rate owing to ill-acquisition of entrepreneurial skills amongst Nigeria graduates (Adebisi, 2015), especially those of technology education. Thus the technology education student is also faced with the challenge of unemployment and striving to survive in the midst of the dwindling Nigerian economy.

Propose of the Study

The main purpose of this study was to determine the innovative skills required by technology education students in tertiary institution in Niger State for self reliance. Specifically, the study sought to:

1. Identify the acquisition of innovative and entrepreneurship skills required by technology education students for self-reliance.

2. Identify constraints that hinder the effective innovative and entrepreneurial skill acquisition by technology education students.
3. Proffer possible strategies for enhancing acquisition of skills by technology education students.

Research Questions

Based on the purpose of the study, the following research questions were answered:

1. What are the innovative and entrepreneurship skills needs required by technology education students for self- reliance?
2. What are the constraints that hinder effectiveinnovative and entrepreneurship skills acquisition by technology education students?
3. What strategies will enhance acquisition of innovative andentrepreneurial skills by technology education students?

Hypotheses

The following null hypotheses were tested at 0.05 level of significance.

3. There is no significant difference in the mean responses of technology education students of federal university of technology (FUT) and College of Education (COE) Minna on innovative entrepreneurial marketing skills required for self-reliance.
4. There is no significant difference in the mean responses of technology education students of federal university of technology (FUT) and College of Education (COE) Minna on constraints that hinder effectiveinnovative and entrepreneurship skill acquisition by technology education students.

Methodology

The descriptive survey design was used for the study. The study was guided by 4 research questions and 4 hypotheses. The study was carried out in Niger State. The state has two tertiary institutions offering technology education programme, namely Federal University of Technology (FUT) and College of Education (COE) Minna. The choice of the state for this study was necessitated by the adequate number of technology education graduates who constituted the respondents for the study and also the growing number of unemployed technology education graduates who will benefit immensely from the findings of the study. Population of the study comprised all 172 final year students in the department of industrial and technology education and vocational and education from the two tertiary institutions for 2019/2021 academic session. The choice of this category of respondents was because they have vast potential for entrepreneurial development. Census techniques were used due to manageable size of the students. The instrument used for data collection was a 30 item structured questionnaire titled "Acquisition of Innovative and Entrepreneurial Skills Required Questionnaire" (AIESRQ), drafted using four (4) point rating scale ranging of strongly agree (SD) 4 points, agree (A) 3 points, disagree (D) 3 points and strongly disagree (SD) 1 point. The questionnaire items were subjected to face and content validation by two experts from technology education and measurement and evaluation. A reliability coefficient of 0.71 was obtained using SPSS Cronbach Alpha method thus making the instrument suitable for use. Data collected relative to research questions were analyzed using the meanwhile null hypotheses were tested at0.05 level of significance using f-test. Mean scores of 2.50 and above were considered as accepted while mean scores below 2.5 were considered as rejected.

Results

Research Question 1

What are the innovative and entrepreneurship skills needs required by technology education students for self- reliance?

Table 1: Respondents Mean Responses of Technology Education Students of Federal University of Technology (FUT) andCollege of Education (COE) Minna on Innovative Entrepreneurial Marketing Skills Required for Self-Reliance.

S/N	Items	FUT N-69	COE N-103	MEAN	Decision
1	There is no policy framework for banks to set aside funds to support small and medium enterprises.	3.62	3.45	3.54	Accepted
2	Most parent and lecturers do not encourage entrepreneurial spirit and aspiration among children	2.10	3.01	2.56	Accepted
3	There are inadequate facilities and equipment for innovative and entrepreneurial acquisition	2.82	3.70	3.26	Accepted
4	Incompetency of lecturers	3.42	3.08	3.25	Accepted
5	Curriculum does not contain much room for creative freedom and enough entrepreneurial learning experiences	2.19	3.43	2.81	Accepted
6	Most lecturers are not trained to lead students through the path of productivity, self reliance and job creation	3.42	3.11	3.27	Accepted
7	Lack of awareness of benefits of entrepreneurial skill acquisition	3.93	3.72	3.83	Accepted
8	Lack of students interest in practically oriented courses	3.45	3.51	3.48	Accepted
9	Poor societal attitudes to self employment	3.53	2.88	3.21	Accepted
10	Inability of utilize resources more effectively and efficiently	3.20	3.19	3.19	Accepted
	Grand Total	**3.17**	**3.31**	**3.24**	**Accepted**

Table 1 above revealed that respondents agreed on all questionnaire items on innovative and entrepreneurship skills needs required by technology education students for self- reliance (mean scores > 2.5). The grand mean of 3.17 and 3.31 from Federal University of Technology and College of Education (COE Minna) respectively and an overall grand mean of 3.24 are indications that these institutions agreed that innovative and entrepreneurship skills needs required by technology education students for self- reliance in Niger State.

Research Question 2:

What are the constraints that hinder effective innovative and entrepreneurship skills acquisition by technology education students?

Table 2: Respondents Mean Responses of Technology Education Students of Federal University of Technology (FUT) and College of Education (COE) Minna on Strategies That will Enhance Acquisition of Innovative and Entrepreneurship Skills by Technology Education Graduates.

S/N	Items	FUT N-69	COE N-103	MEAN	Decision
1	Ensure teachers are well motivated	2.70	2.10	2.40	Rejected
2	Government should provide adequate facilities and equipments for innovative and entrepreneurial skills acquisition	3.42	3.01	3.22	Accepted
3	Developing positive attitude towards self-employment	2.90	3.41	3.16	Accepted
4	Provision of conducive teaching and learning environment	3.00	2.82	2.91	Accepted
5	Ensure practical instructional delivery	3.56	2.97	3.27	Accepted
6	Students should exposed to practical	3.56	3.06	3.14	Accepted
7	Students should be motivated	3.73	2.93	3.33	Accepted
8	Aims and objectives of the technology education programme should be well defined to the students	2.85	3.10	2.98	Accepted
9	Attending skills oriented trainings, seminars and conferences	3.51	3.11	3.31	Accepted
10	Banks should sets up policy frameworks to support small scale and medium enterprises	2.99	3.40	3.19	Accepted
	Grand Total	**3.22**	**3.06**	**3.14**	**Accepted**

Table 2 above revealed that respondents agreed on nine out of ten questionnaire items on hinder effective innovative and entrepreneurship skills acquisition by technology education students (mean scores> 2.5). The grand mean of 3.22 and 3.06 from FUT and COE respectively and an overall grand mean of 3.14 are indications that these institutions agreed that outlined are hinder effective innovative and entrepreneurship skills acquisition by technology education students in Niger State.

Research Question 3:
What strategies will enhance acquisition of innovative and entrepreneurial skills by technology education students?

Table 3: Respondents Mean Responses of Technology Education Students of Federal University of Technology (FUT) and College of Education (COE) Minna on Strategies that will Enhance Acquisition of Innovative and Entrepreneurship Skills by Technology Education Graduates.

S/N	Items	FUT N-69	COE N-103	MEAN	Decision
1	Ability for identify new trends in the marketing environment.	3.21	3.10	3.16	Accepted
2	Entrepreneurial skills for recognizing and using tools and materials for production	3.52	3.02	3.27	Accepted
3	Skills for accessing funds and accounting	2.87	2.92	2.89	Accepted
4	Ability to capture the attention of customers	3.41	3.00	3.21	Accepted
5	Ability to acquire effective sale techniques	2.90	2.71	2.81	Accepted
6	Business managerial skills establishment, managing and sustaining business	3.56	3.21	3.39	Accepted
7	Ability to organize and build network	3.42	3.41	3.42	Accepted
8	Ability to determine the needs of customers	3.60	2.56	3.08	Accepted
9	Skills for introducing or using new ideas/ways of doing things	3.62	3.10	3.36	accepted
10	Innovative skills of being independents imaginative and constructive thinkers	2.89	3.14	3.02	Accepted
	Grand total	**3.30**	**3.02**	**3.16**	**accepted**

Table 3 above revealed that respondents agreed on all the outlined strategies will enhance acquisition of innovative and entrepreneurial skills by technology education students (mean scores> 2.5). The grand mean of 3.30 and 3.02 from FUT and COE respectively and an overall grand mean of 3.16 are indications that these institutions agreed that the outlined strategies will enhance acquisition of innovative and entrepreneurial skills by technology education students in Niger State.

Hypothesis One:
There is no significant difference in the mean responses of technology education students of Federal University of Technology (FUT) and College of Education (COE) Minna on innovative entrepreneurial marketing skills required for self-reliance.

Table 4: Summary of f-test on innovative entrepreneurial marketing skills required for self-reliance.

Respondents	N	Mean	Df	Sig	f-value	Decision
FUT Students	69	3.17				
			170	0.09	0.05	Upheld
COE Students	103	3.31				

Table 4 shows the finding of the analysis of variance on readiness of FUT and COEas shown on innovative entrepreneurial skills required for self-reliance. (Table 4) revealed that 3.17 and 3.31, the f-test value 0.09 is greater than 0.05. This suggests that there is no significant difference in the mean responses of technology education students of Federal University of Technology (FUT) and College of Education (COE) Minna on innovative entrepreneurial marketing skills required for self-reliance. As a result, the null hypotheses was upheld

Hypothesis Two:
There is no significant difference in the mean responses of technology education students of federal university of technology (FUT) and College of Education (COE) Minna on constraints that hinder effective innovative and entrepreneurship skill acquisition by technology education students.

Table 5: Summary of f-test on constraints that hinder effective innovative and entrepreneurship skill acquisition by technology education students.

Respondents	N	Mean	Df	Sig	f-value	Decision
FUT Students	69	3.22				
			170	0.07	0.05	Upheld
COE Students	103	3.06				

Table 5 shows the finding of the analysis of variance on readiness of FUT and COE as shown on innovative entrepreneurial skills required for self-reliance. (Table 5) revealed that 3.22 and 3.06, the f-test value 0.07 is greater than 0.05. This suggests that there is no significant difference in the mean responses of technology education students of federal university of technology (FUT) and College of Education (COE) Minna on constraints that hinder effective innovative and entrepreneurshipskill acquisition by technology education students. As a result, the null hypotheses was upheld.

Discussion of Findings
The Findings of the study presented in table 1 revealed that all the identified innovative and entrepreneurship skills needs' required by technology education students for self- reliance. This is because it will help students achieve self-reliance and self-employment after graduation. This finding aligns with the opinions of Ezeh (2012) viewed that acquisition of entrepreneurial skills help students develop potentials for the attainment of self-reliance thereby contributing to sustainable development. This finding also collaborates with the view of Oyerinde and Falana (2016) that students who acquire marketing skills will be able to cross the bars of unemployment and become self-reliant.

The findings as presented in table 2 revealed that constraints such as lack of funds, incompetent manpower, lack of students' interest in practically oriented courses, poor societal attitude to self-employment, inadequate teaching/learning facilities, among others hinder the effective innovative and entrepreneurial skill acquisition by technology education students. This agrees with Kayode

(2010) that most teachers are yet to acquire some practical entrepreneurial skills they are to instill in students as well as develop and adopt new teaching methods that will enhance skill delivery. It also confirms the observation by Gbenidio (2012) teaching and learning facilities are still inadequate in Nigerian tertiary institutions because education in Nigerian still remains poorly funded.

Findings from table 3 above, revealed that measures such as provision of adequate teaching/learning facilities and conducive environment, developing positive attitude towards self-employment, attending trainings, conferences, seminars and workshops that are skill oriented, competent manpower, and ensuring practical instructional delivery among others will promote the acquisition of entrepreneurial skills for self-reliance by technology education students after graduation. This is in line with Ugwu and Ezeani (2012) which indicated that tertiary institutions should have a strategy of action plan for teaching and research in entrepreneurship. This also aligns with the view of Nwakeaku (2013) that students are bound to develop skills which need to be improved through well planned strategies.

The findings of the study as revealed in tables 4, 5, and 6 also shows that disparity does not exist in the opinions of final year technology education students from the two tertiary institutions as it relate to the acquisition of innovative and entrepreneurship skill needs required by students, constraints hindering entrepreneurial skill acquisition and the strategies that will promote effective skill acquisition by technology education students in Niger State.

Conclusion

This study identified the acquisition of innovative skills and entrepreneurial skill needs required for self-reliance by technology education students, the constraints that hinder effective innovative and entrepreneurship skills acquisition as well as the strategy that will promote the acquisition of these innovative and entrepreneurial skill needs. Innovative and entrepreneurial skill needs are veritable tools that will prepare students for the contemporary world of work, helping them to become self-reliant and creators of jobs thereby reducing unemployment in the nation and sustenance of the economy. The ability of individuals to survive in the present state of the Nigerian economy is dependent on the type and quality of his or her innovative and entrepreneurial skills acquired.

Every technology education student needs to have innovative and acquire entrepreneurial skills to achieve self-reliance as its importance cannot be over-emphasized. The possession of these skill needs will facilitate students' self-employment after graduation thereby reducing graduate unemployment in Nigeria. Entrepreneurships as a facet of technology education provide a lot of business opportunities for students after graduation. Thus technology education students must get themselves acquainted with these skill needs while in school so they can achieve self-reliance after graduation and also contribute their quota to national development.

Recommendations

Based on the findings, the following recommendations were made:

1. Conferences, seminars and workshops should be periodically arranged for teachers and students as this will assist them to update their knowledge and skills in technology education programmes.

2. Government and other stakeholders in education should expose the students to other skill acquisition programmes and opportunities that will ensure skill development and promote economic self-reliance.
3. Technology education students should endeavour to acquire themselves with all the relevant skill needs necessary for them to create, and maintain their customers' needs
4. The teaching of technology education courses should be practical oriented as this will help to improve students creativity

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Determination of Optimal Number of Servers in Banking System to Reduce Waiting Time of Customers

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Abstract
It is a common knowledge that most customers in Nigeria spent lot of their useful times in commercial banks queuing systems before being served. First City Monument Bank (FCMB) Minna branch is not left out from these times wasting. These times wasting are mostly as a result of improper allocation of banking personnel (Servers) at the different units (nodes) of the banks or redundancies in some of the units of the banks. Hence, the need to use scientific techniques to determine optimal number of banking personnel (Servers) to different units in First City Monument Bank (FCMB) Minna branch arose, in other to reduce waiting time of the customers, increase efficiency of the bank and improve its productivity. In this thesis, a network queuing model that determines optimal numbers of servers at the nodes of the Bank network queuing system to reduce waiting time of the customers is presented. The relevant data were collected for a period of four (4) weeks, through direct observations and personal interview. The number of arrivals and departures were also obtained. The total expected waiting time of customers in the current system before modification was 65 minutes with total number of 11 servers in the system while the total new expected waiting time of the customers in the system after modification was reduced to 28 minutes with optimal number of 16 servers (personnel) in all the nodes. The study has determined optimal number of servers (personnel) at the nodes of bank network system. Result from this study is an important information to the management of the First City Monument Bank, Minna branch for efficient and better service delivery.

Keywords: FCMB, Nodes, Servers, Customers, Waiting time, Network of Queue.

Introduction
A Common situation that occurs in everyday life is that of queuing or waiting in line, when the demand for a service exceeds the capacity of the service, waiting is unsurprising and inevitable (Kembe., 2012). Queues or waiting lines are usually seen at hotels, hospitals, bus stops, supermarkets, traffic, airports, gas stations, bank counters and so on. Service delay is unavoidable as a system gets blocked (Kandenmir and Cavas., 2007). When too much service is provided it's involves excessive cost and not providing enough service capacity causes the waiting line to become excessively long. The ultimate goal is to achieve an economic balance between the cost of service and the cost associated with the waiting for that service. Queuing systems theories have been used to study waiting time and predict the efficiency of services to be provided (Nityangini and Pravin., 2016). In queuing theory, there are three basic components of a queuing process which are:- Arrivals patterns, the actual waiting line and service facilities. Customers arrive to the facility from an infinite calling population, with a random arrival pattern following poison process. Once customers arrive, they are served immediately if the server(s) is empty, or otherwise the customers wait in the queue for the next empty server. Mostly, the service is on a first come first serve (FCFS) basis although other methods like service at random order (SARO) can be used. Preference service depending on the level of risk, urgency or the social, economic or political standing of the

customers and Hold on line (HL) discipline, where important arriving customer takes the lead of the queue is rampant in many facilities. Customers who may feel to have waited for long in queue can balk or renege and seek alternative equivalent services elsewhere, however, the queue length and waiting time depends on the traffic intensity, which is the ratio of arrival and service rates. The service discipline follows an exponential pattern, with individual service time variation due to different nature of the problems to be handled (Rotich., 2016).

In an open queuing network, jobs enter and depart from the network. In a closed queuing network, jobs neither enter nor depart from the network. Open queuing networks can be further divided into two categories; open feed forward queuing networks and open feedback queuing networks. In an open feed forward queuing network, a job cannot appear in the same queue for more than one time. In an open feedback queuing network, after a job is served by a queue, it may reenter the same queue (Tin yan and Veeraraghavan., 2004). In a Mixed Networks, Network has multiple job classes and is open with respect to some classes but closed with repeat to the others (Shanmugasundaram and Umarani., 2015).

Problem Formulation

The First City Monument Bank Minna branch is located adjacent to Central Bank Minna, Niger state, Nigeria. The Bank consists of five main Units, which are the Meter Greeter Unit, Customers Service Unit, Marketing Unit, Tellers Unit, and Customers Service Manager Unit. In this study, each department is regarded as node of the network system. The data used in this research were collected from the five different departments of the Bank and they were collected based on the arrival and departure rate as well as time spent at each node. The method adopted for the data collection was direct observation and personal interview. It was done for a complete one month, started from Monday to Friday. The collection of the data was for a total of six (6) hours at different time of the day, for each node. In a day, the number of arrivals and departures together with service time were taken at intervals of 5 minutes arrivals of customers into a node (□), while the departure rate was obtained also by the average number of five (5) minutes departures of customers at that particular node. However, each of the nodes was observed for a period of one (1) hour daily.

Model Assumptions

The following are the model assumptions made for Network Queuing System of the First City Monument Bank (FCMB), Minna.

1. The First City Monument Bank in the network queuing system is considered as an independent queuing system.
2. Queuing discipline is usually first come first served in the bank.
3. The external arrival of the customers in the bank followed by a Poisson arrival process.
4. Each node in the bank has one or more servers with exponential services time
5. The service rate depends on the number of customers at each node.
6. The way customers enter the bank is not restricted, but the departing rate out of the system is considered to be faster.
7. Servers represent all the banking personnel.
8. All the service providers are working in full capacity

We consider a banking network queuing system based on Jackson open network queuing model, the First City Monument Bank, Minna constitute of five units. In this study, we assumed that

customers who come in to bank for services will start by going first to the meter greeter unit and then move to the customer's service unit, then some customers proceed to tellers unit or customers service manager until all customers depart from the bank.

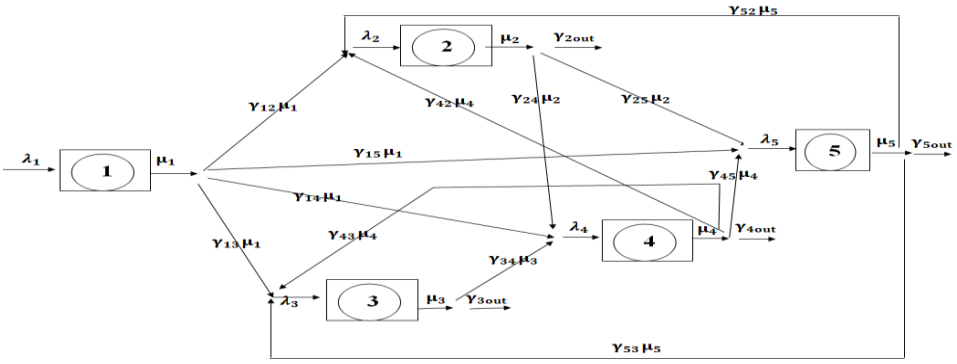

Figure 1:0 A Schematic Diagram of FCMB Queuing Network

Where: λ_i Is the arrival rate of the customer, for i = 1, 2,...5

μ_i Is the departure rate out of the system, for i = 1, 2,…5

γ_{ij} Are the weights of moving from server i to server j.

The following are the nodes in the network queuing system of the bankand Node1, Node2, Node3, Node4, Node5 are defined as follow: Meter Greeter Unit denoted by node1; Customer Service Unit denoted by node2; Marketing Unit denoted by node3; Tellers Unit denoted by node4; Customer Service Manager Unit denoted by node5.

Methodology

The following are model equations, obtained from fig 1

$$\lambda_2 = \gamma_{12}\mu_1 + \gamma_{42}\mu_4 + \gamma_{52}\mu_5 \quad (3.1)$$

$$\lambda_3 = \gamma_{13}\mu_1 + \gamma_{43}\mu_4 + \gamma_{53}\mu_5 \quad (3.2)$$

$$\lambda_4 = \gamma_{14}\mu_1 + \gamma_{24}\mu_2 + \gamma_{34}\mu_3 \quad (3.3)$$

$$\lambda_5 = \gamma_{15}\mu_1 + \gamma_{25}\mu_2 + \gamma_{45}\mu_4 \quad (3.4)$$

Also;

$$\mu_1 = \gamma_{12}\mu_1 + \gamma_{13}\mu_1 + \gamma_{14}\mu_1 + \gamma_{15}\mu_1 \quad (3.5)$$

$$\mu_2 = \gamma_{24}\mu_2 + \gamma_{25}\mu_2 + \gamma_{2out}\mu_2 \quad (3.6)$$

$$\mu_3 = \gamma_{34}\mu_3 + \gamma_{3out}\mu_3 \quad (3.7)$$

$$\mu_4 = \gamma_{42}\mu_4 + \gamma_{43}\mu_4 + \gamma_{45}\mu_4 + \gamma_{4out}\mu_4 \quad (3.8)$$

$$\mu_5 = \gamma_{52}\mu_5 + \gamma_{53}\mu_5 + \gamma_{5out}\mu_5 \quad (3.9)$$

Where:

$\gamma_{12}, \gamma_{13}, \gamma_{14}, \gamma_{15}, \gamma_{24}, \gamma_{25}, \gamma_{2out}, \gamma_{34}, \gamma_{3out}, \gamma_{42}, \gamma_{43}, \gamma_{45}, \gamma_{4out}, \gamma_{52}, \gamma_{53}, \gamma_{5out}$
Are to be determined

Equation (3.1 – 3.9) can also be represented in the following forms, thus:

$$\lambda_2 = \mu_1\gamma_{12} + 0\gamma_{13} + 0\gamma_{14} + 0\gamma_{15} + 0\gamma_{24} + 0\gamma_{25} + 0\gamma_{2out} + 0\gamma_{34} + 0\gamma_{3out} + \mu_4\gamma_{42} + 0\gamma_{43} + 0\gamma_{45} + 0\gamma_{4out} + \mu_5\gamma_{52} + 0\gamma_{53} + 0\gamma_{5out} \quad (3.10)$$

$$\lambda_3 = 0\gamma_{12} + \mu_1\gamma_{13} + 0\gamma_{14} + 0\gamma_{15} + 0\gamma_{24} + 0\gamma_{25} + 0\gamma_{2out} + 0\gamma_{34} + 0\gamma_{3out} + 0\gamma_{42} + \mu_4\gamma_{43} + 0\gamma_{45} + 0\gamma_{4out} + 0\gamma_{52} + \mu_5\gamma_{53} + 0\gamma_{5out} \quad (3.11)$$

$$\lambda_4 = 0\gamma_{12} + 0\gamma_{13} + \mu_1\gamma_{14} + 0\gamma_{15} + \mu_2\gamma_{24} + 0\gamma_{25} + 0\gamma_{2out} + \mu_3\gamma_{34} + 0\gamma_{3out} + 0\gamma_{42} + 0\gamma_{43} + 0\gamma_{45} + 0\gamma_{4out} + 0\gamma_{52} + 0\gamma_{53} + 0\gamma_{5out} \quad (3.12)$$

$$\lambda_5 = 0\gamma_{12} + 0\gamma_{13} + 0\gamma_{14} + \mu_1\gamma_{15} + 0\gamma_{24} + \mu_2\gamma_{25} + 0\gamma_{2out} + 0\gamma_{34} + 0\gamma_{3out} + 0\gamma_{42} + 0\gamma_{43} + \mu_4\gamma_{45} + 0\gamma_{4out} + 0\gamma_{52} + 0\gamma_{53} + 0\gamma_{5out} \quad (3.13)$$

$$\mu_1 = \mu_1\gamma_{12} + \mu_1\gamma_{13} + \mu_1\gamma_{14} + \mu_1\gamma_{15} + 0\gamma_{24} + 0\gamma_{25} + 0\gamma_{2out} + 0\gamma_{34} + 0\gamma_{3out} + 0\gamma_{42} + 0\gamma_{43} + 0\gamma_{45} + 0\gamma_{4out} + 0\gamma_{52} + 0\gamma_{53} + 0\gamma_{5out} \quad (3.14)$$

$$\mu_2 = 0\gamma_{12} + 0\gamma_{13} + 0\gamma_{14} + 0\gamma_{15} + \mu_2\gamma_{24} + \mu_2\gamma_{25} + \mu_2\gamma_{2out} + 0\gamma_{34} + 0\gamma_{3out} + 0\gamma_{42} + 0\gamma_{43} + 0\gamma_{45} + 0\gamma_{4out} + 0\gamma_{52} + 0\gamma_{53} + 0\gamma_{5out} \quad (3.15)$$

$$\mu_3 = 0\gamma_{12} + 0\gamma_{13} + 0\gamma_{14} + 0\gamma_{15} + 0\gamma_{24} + 0\gamma_{25} + 0\gamma_{2out} + \mu_3\gamma_{34} + \mu_3\gamma_{3out} + 0\gamma_{42} + 0\gamma_{43} + 0\gamma_{45} + 0\gamma_{4out} + 0\gamma_{52} + 0\gamma_{53} + 0\gamma_{5out} \quad (3.16)$$

$$\mu_4 = 0\gamma_{12} + 0\gamma_{13} + 0\gamma_{14} + 0\gamma_{15} + 0\gamma_{24} + 0\gamma_{25} + 0\gamma_{2out} + 0\gamma_{34} + 0\gamma_{3out} + \mu_4\gamma_{42} + \mu_4\gamma_{43} + \mu_4\gamma_{45} + \mu_4\gamma_{4out} + 0\gamma_{52} + 0\gamma_{53} + 0\gamma_{5out} \quad (3.17)$$

$$\mu_5 = 0\gamma_{12} + 0\gamma_{13} + 0\gamma_{14} + 0\gamma_{15} + 0\gamma_{24} + 0\gamma_{25} + 0\gamma_{2out} + 0\gamma_{34} + 0\gamma_{3out} + 0\gamma_{42} + 0\gamma_{43} + 0\gamma_{45} + 0\gamma_{4out} + \mu_5\gamma_{52} + \mu_5\gamma_{53} + \mu_5\gamma_{5out} \quad (3.18)$$

From model equation (3.10 - 3.18) can be represented in the matrix form as:

$$\begin{bmatrix} \mu_1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & \mu_4 & 0 & 0 & 0 & \mu_5 & 0 & 0 \\ 0 & \mu_1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & \mu_4 & 0 & 0 & 0 & \mu_5 & 0 \\ 0 & 0 & \mu_1 & 0 & \mu_2 & 0 & 0 & \mu_3 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & \mu_1 & 0 & \mu_2 & 0 & 0 & 0 & 0 & 0 & \mu_4 & 0 & 0 & 0 & 0 \\ \mu_1 & \mu_1 & \mu_1 & \mu_1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & \mu_2 & \mu_2 & \mu_2 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & \mu_3 & \mu_3 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & \mu_4 & \mu_4 & \mu_4 & \mu_4 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & \mu_5 & \mu_5 & \mu_5 \end{bmatrix} \begin{bmatrix} \gamma_{12} \\ \gamma_{13} \\ \gamma_{14} \\ \gamma_{15} \\ \gamma_{24} \\ \gamma_{25} \\ \gamma_{2out} \\ \gamma_{34} \\ \gamma_{3out} \\ \gamma_{42} \\ \gamma_{43} \\ \gamma_{45} \\ \gamma_{4out} \\ \gamma_{52} \\ \gamma_{53} \\ \gamma_{5out} \end{bmatrix} = \begin{bmatrix} \lambda_2 \\ \lambda_3 \\ \lambda_4 \\ \lambda_5 \\ \mu_1 \\ \mu_2 \\ \mu_3 \\ \mu_4 \\ \mu_5 \end{bmatrix} \quad (3.19)$$

Equation (3.19) can be represented in the form

$$\begin{bmatrix} \gamma_{12} \\ \gamma_{13} \\ \gamma_{14} \\ \gamma_{15} \\ \gamma_{24} \\ \gamma_{25} \\ \gamma_{2out} \\ \gamma_{34} \\ \gamma_{3out} \\ \gamma_{42} \\ \gamma_{43} \\ \gamma_{45} \\ \gamma_{4out} \\ \gamma_{52} \\ \gamma_{53} \\ \gamma_{5out} \end{bmatrix} = \begin{bmatrix} \mu_1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & \mu_4 & 0 & 0 & 0 & \mu_5 & 0 & 0 \\ 0 & \mu_1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & \mu_4 & 0 & 0 & 0 & \mu_5 & 0 \\ 0 & 0 & \mu_1 & 0 & \mu_2 & 0 & 0 & \mu_3 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & \mu_1 & 0 & \mu_2 & 0 & 0 & 0 & 0 & 0 & \mu_4 & 0 & 0 & 0 & 0 \\ \mu_1 & \mu_1 & \mu_1 & \mu_1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & \mu_2 & \mu_2 & \mu_2 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & \mu_3 & \mu_3 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & \mu_4 & \mu_4 & \mu_4 & \mu_4 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & \mu_5 & \mu_5 & \mu_5 \end{bmatrix}^{+} \begin{bmatrix} \lambda_2 \\ \lambda_3 \\ \lambda_4 \\ \lambda_5 \\ \mu_1 \\ \mu_2 \\ \mu_3 \\ \mu_4 \\ \mu_5 \end{bmatrix} \quad (3.20)$$

Mathematical Formulation for new Departure Rate

Reducing waiting time of the customers in the banking hall and increasing the efficiency of the bank is thrust of this research, hence we formulate new departure rate of each of the nodes in our network system. This is done using equation (3.1 – 3.4), thus, we have the following equations.

$$\lambda_2 = \gamma_{12}\mu_1 + 0\mu_2 + 0\mu_3 + \gamma_{42}\mu_4 + \gamma_{52}\mu_5 \quad (3.21)$$

$$\lambda_3 = \gamma_{13}\mu_1 + 0\mu_2 + 0\mu_3 + \gamma_{43}\mu_4 + \gamma_{53}\mu_5 \quad (3.22)$$

$$\lambda_4 = \gamma_{14}\mu_1 + \gamma_{24}\mu_2 + \gamma_{34}\mu_3 + 0\mu_4 + 0\mu_5 \quad (3.23)$$

$$\lambda_5 = \gamma_{15}\mu_1 + \gamma_{25}\mu_2 + 0\mu_3 + \gamma_{45}\mu_4 + 0\mu_5 \quad (3.24)$$

Model equation (3.21-3.24) can be transform to matrix as in equation (3.25)

$$\begin{bmatrix} \gamma_{12} & 0 & 0 & \gamma_{42} & \gamma_{52} \\ \gamma_{13} & 0 & 0 & \gamma_{43} & \gamma_{53} \\ \gamma_{14} & \gamma_{24} & \gamma_{34} & 0 & 0 \\ \gamma_{15} & \gamma_{25} & 0 & \gamma_{45} & 0 \end{bmatrix} \begin{bmatrix} \mu_1 \\ \mu_2 \\ \mu_3 \\ \mu_4 \\ \mu_5 \end{bmatrix} = \begin{bmatrix} \lambda_2 \\ \lambda_3 \\ \lambda_4 \\ \lambda_5 \end{bmatrix} \quad (3.25)$$

Where:

The arrival rate $\lambda_i = \frac{1}{mean\ number\ of\ arrival}$, for i = 1,2,...5 (3.26)

The departure rate $\mu_i = \frac{1}{mean\ number\ of\ departure}$, for i= 1,2,…5 (3.27)

$\rho = \frac{\lambda_i}{\mu_i}$, *for* $i = 1, 2, \cdots 5.$ (3.28)

The expected number in the queue is given as

$l_q = \frac{\rho}{m-\rho}$, (3.29)

Where m stands for the number of servers at the node

The expected waiting time in the queue is given as:

$w_{qi} = \frac{l_q}{\lambda_i}$, (3.30)

The expected number of customers in the system is given as

$l_s = l_q + \rho$ (3.31)

Finally, the expected waiting time in the system for node 1-5 is given as

$w_i = \frac{l_s}{\lambda_i}$, For i = 1,2,…5.

Results and Discussion

The summary of the computed performance measure for determination of optimal number of servers at network queuing nodes to reduce waiting time at the First City Monument Bank, Minna (**(FCMB)**, is given in the table below:

Table 1: Showing all the results obtained before modification.

Nodes i	Number of Servers (m_i)	Probabilities (α_{ij})	ρ_i	Lq	Ls	W_q	W_S
1	1	0.490525394. 0.285121877 0.02012705 0.204225679	0.90	9.0	9.9	16.7	18.5
2	2	0.204005077. 0.490675285. 0.305319638	1.00	1.0	2.0	1.00	2.0
3	3	0.460132145. 0.539867855	0.70	0.3	1.0	0.54	1.8
4	4	0.525454436. 0.275816098. 0.177498442 0.021231023	0.86	0.3	1.2	0.52	2.1
5	1	0.579712044. 0.334950037. 0.08533792	0.96	34.6	9.9	38.7	40.2
Total	**11**		**4.42**	**31.4**	**24.0**	**57.46**	**64.6**

Table 2: Showing all the results obtained after modification

Nodes i	Number of Servers (m_i)	ρ_i	Lq	Ls	W_q	W_S
1	2	1.4	2.3	3.7	4.30	6.9
2	3	1.7	1.3	3.0	1.30	3.0
3	4	0.7	0.2	0.9	0.36	1.6

4	5	0.9	0.2	1.1	0.34	11.9
5	2	1.2	1.5	2.7	2.41	4.4
Total	**16**	**5.9**	**5.5**	**11.4**	**8.71**	**27.8**

Table 3: Showing the comparison between current number of servers and optimal number of servers obtained

Nodes1	Current number of servers	Optimal number of servers obtained
1	1	2
2	2	3
3	3	4
4	4	5
5	1	2
Total	**11**	**16**

Conclusion

The FCMB network queuing system has been investigated and studied effectively. The study has determined optimal number of servers at the nodes of the FCMB network queuing system to reduce waiting time of the Customers. The result from the study is important information to the management of FCMB for proper planning and efficient service delivery. The analysis has shown that the arrival rate, departure rate as well as probabilities at each node (department) were obtained. The total expected waiting time of the customers in the system before modification is about 65 minutes. While, the total expected waiting time of the customers in the system after modification is about 28 minutes. This demonstrated that the optimal number of servers at the nodes of FCMB network queuing system is achieved.

Recommendation

To empower the FCMB consistently in order to meet up with its high standard of giving satisfactory services to her customers, the management of FCMB is advised to implement the following recommendations.

23. The number of servers at the node1 (Meter Greeter Unit) ought to be at least Two (2) servers.
24. The number of servers at the node2 (Customers Service Unit) ought to be at least Three (3) servers.

25. The number of servers at the node3 (Marketing Unit) ought to be at least Four (4) servers at each time for legitimate Proficiency.
26. The number of servers at the node4 (Tellers Unit) also, ought to be at least five (5) servers for legitimate Service delivery.
27. The number of servers at the node5 (Customers Service Manager Unit) similarly, ought to be at least Two (2) server.

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Effect of Iron Ore Tailings on the Compressive Strength of Concrete

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Abstract
The study investigated the effects of partial replacement of fine aggregate with Iron Ore Tailings (IOT). Physical and mechanical properties of varying percentage of IOTconcrete and 100% river sand cement concrete, DOE method of mixed design was adopted using 0.53 water-cement ratio, and was examined and compared. Ninety (90) cubes of size 150 × 150 × 150 mm³ with different percentages by volume ofIron Ore Tailings to river sand (RS) in the order of 0% which is the control, 10%, 20%, 39% and 40% Iron Ore Tailingswere casted and crushed. The specific gravity of theIron Ore Tailingswas 2.84, while the twenty-eight days (28days) compressive strength of 49.7N/mm^2 showed that 32.8% of the IOT replacement with river sand was the optimum value of replacement. The 40% IOT showed a decrement in compressive strength, but still greater than the control. Finally, the workability decreases as the IOT percentage increases which entails the needs for super-plasticizers in order to attain a uniformly mixed paste of concrete with a workable consistency.

Keywords: Iron Ore Tailings (IOT), River Sand (RS)

Introduction
The challenge for the civil engineering community with the concept of sustainable development involves the use of waste materials and by-products at reasonable cost with the lowest possible environmental impact. Rapid increase in consumption of river sand due to the increased in construction activity means that sand mining exploration increased in which the river bed is over exploited (Nath and Sarker, 2014)

Environmental issues of Sand mining are depletion of virgin deposits, collapsing of river banks, water table lowering and water pollution. Rapid increase in consumption of river sand due to the increased in construction activity means that sand mining exploration increased in which the river bed is over exploited. The challenge for the civil engineering community with the concept of sustainable development involves the use of waste materials and by-products at reasonable cost with the lowest possible environmental impact (Shettima*et al.*, 2018).

Nan Su *et al*. (2001) examined the feasibility of reusing spent zeolite catalyst, after fluidized catalytic cracking, as a substitute for fine aggregate (sand) in cement mortars. The tested result shows that spent catalyst can replace up to 10% of fine aggregate without decreasing the mortar strength. In fact, the substituted mortars show higher compressive strength than the control samples. The workability of the fresh mortars decreases with increasing substitution level and the mortars incorporated with spent catalyst show less bleeding. Ghourchian*et al*. (2013). In the hardened state, the water absorption of the resulting mortar increases with longer curing age, higher substitution level and smaller water-to-cement (W/C) ratio. Toxicity characteristic leaching procedure (TCLP) analysis confirmed that the spent catalyst meets the standard, and thus should be classified as general non-hazardous industrial waste (Khare, 1993).

This research is interested in the use of iron ore tailing as sand in concrete and mortar. The global demand to reduce the increasingly high cost of waste disposal and conserve raw material has led to intense global research towards economic utilization of waste for engineering purposes. The successful utilization of iron ore tailing (IOT) as fine aggregate would turn this waste material into valuable resources, reduction in the strain on the supply of natural sand, and economy in concrete production (Ugama*et al.*, 2014).

Material and Methods

Materials

Water

The water used for producing and curing the concrete was obtained directly from the tap in the laboratory.

Cement

Ordinary Portland cement conforming to ASTM 150 specification was used. Table 1 shows the physical properties of cement used compared with code specification.

Sand

River sand having bulk density 1352 kg/m3 and fineness modulus 2.78 was used. The specific gravity was found to be 2.80. The particle size distribution is plotted as shown in fig 1. The gradation of sand used, is within limits specified in ASTM C 31. And it's suitable for concrete works. Figure 1. Particle size curve (RS)

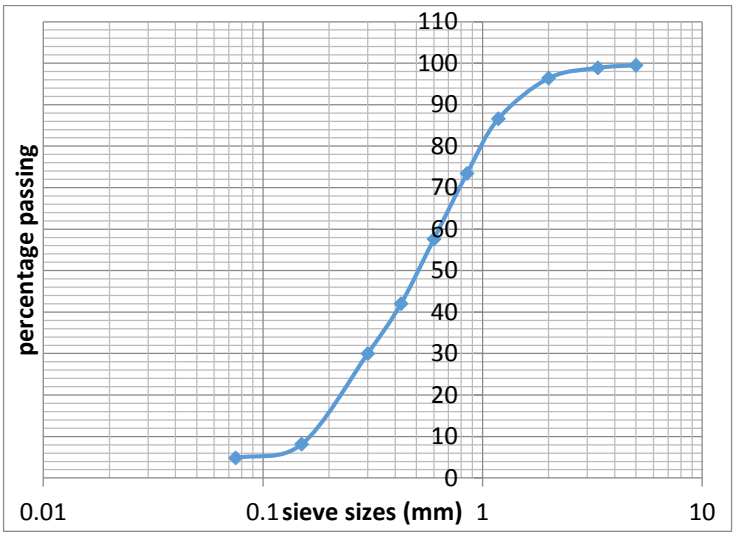


Fig 1: Particle Size Curve of Sand

Iron ore tailing

Iron ore tailing having bulk density 1580 kg/m3 and fineness modulus 2.51. The specific gravity was found to be 2.84. The particle size distribution is plotted as shown in fig 2. The gradation of tailing used, is partly within limits specified in ASTM C 31. Hence suitability analysis has to be carried out to determine its possible use as fine aggregate (Ugama*et al.*, 2014).

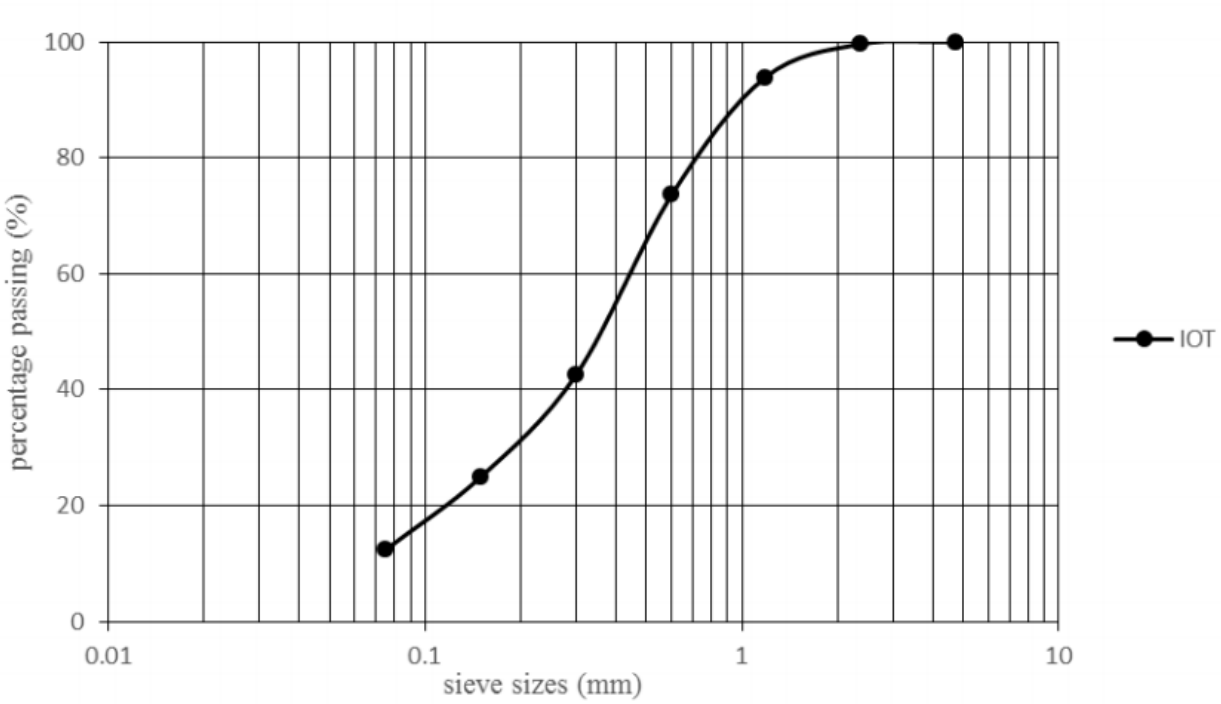


Figure 2. Particle size curve (IOT)

Methods

Ordinary Portland cement and natural river sand along with crushed gravel of 10 mm coarse aggregates were locally obtained and used in this study. The IOT was obtained from one iron ore mill in Itakpe, Kogi State. The results of particle size distribution of the river sand and IOT are shown in Fig. 1 and Fig. 2 respectively. The first mix was control, which is a conventional concrete designated as K0 (i.e. without iron ore tailings), and the other four mixes contained IOT. The river sand was replaced with IOT at replacements levels of 10%, 20%, 30% and 40% and designated as K10, K20, K30 and K40 respectively. Finally, BOE method of mix design was adopted ad the mix proportioning obtained for the constituents is shown in table 2

Table 1. Chemical Composition of Itakpe Iron Ore Mine Tailings

S/n	Component	Value (%)
i	SiO2	71
ii	Al2O3	2.62
iii	Fe(total)	15
iv	TiO2	0.2
v	CaO	1.2
vi	MgO	0.3
vii	P	0.08
viii	S	0.06
ix	Total Alkali ($Na_2O + K_20$)	1.2

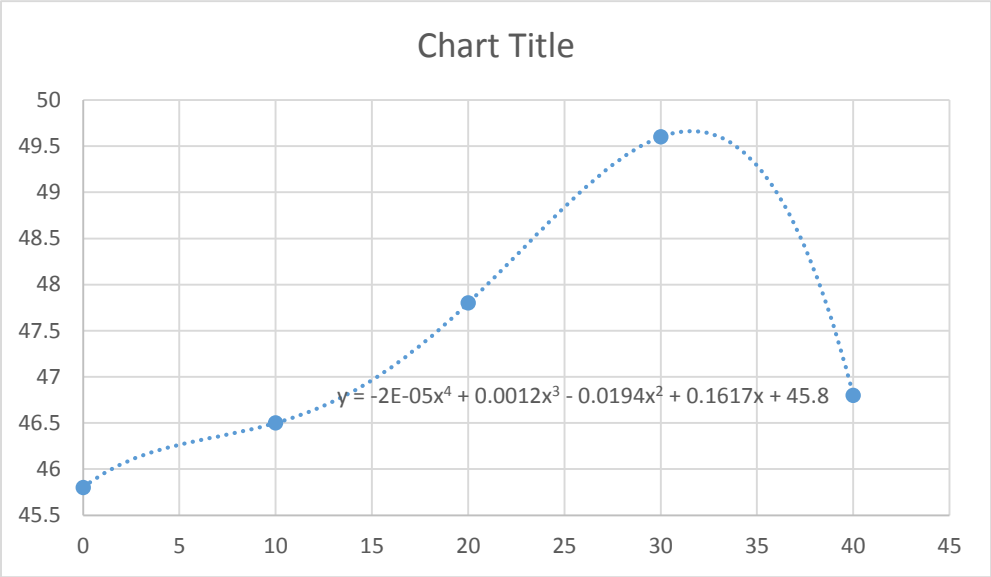
Table 3. Mix proportion of concrete mixes incorporating iron ore tailings.

	Proportion of IOT's				
Description	**M0**	**K10**	**K20**	**K30**	**K40**
OPC (kg/m^3)	396.2	396.2	396.2	396.2	396.2
Coarse aggregate (kg/m^3)	1009	1009	1009	1009	1009
Natural sand (kg/m^3)	645.3	580.8	516.2	451.7	387.2
Iron ore tailings (kg/m^3)	-	64.5	129.1	193.6	258.1
Water (kg/m^3)	210	210	210	210	210
Slump (mm)	60	52	48	42	40
Compacting factor	0.83	0.85	0.87	0.90	0.91
Fresh concrete densities(kg/m^3)	23500	23650	23890	24000	24500

Results and Discussion

Table 4. Compressive strength of concrete specimens.

Compressive strength of concrete mixes (MPa)	
Type of specimen	**28 days**
K0	45.8
K10	46.5
K20	47.8
K30	49.6
K40	46.8



Fresh concrete properties

The results of slump values in Table 3 showed that all the IOT concrete samples reduced the slump value with increase in IOT content due to the high water affinity of the IOT. Although there was decrease in the slump of the IOT concrete samples, Fresh control concretes (k0) is more cohesive and workable than concrete containing IOT. This might be attributed to the higher specific surface area of IOT, which absorbed more water compared to the river sand. The fineness modulus of 2.07 for IOT; which is less than the minimum value of 2.3 specified for sand by ASTM C33 (Tang *et al.*, 2020) standard also increased water demand, thus resulting in a decreased in slump workability. The compacting factor test results for all the concrete samples tested, ranges between 0.83-0.91 as shown in Table 3. The British standard BS 1881-103 (Anifowose, *et al.*, 2021) prescribes for normal weight concrete, compacting factor value range of 0.82 to 0.92. The study of the fresh density of concrete demonstrated in Table 3 shows that fresh density values increase as the IOT content increased in concrete. It can be seen that, although the fresh density was lower in control specimens as compared to those of IOT concrete, all of them are above the minimum limits of 2300 kg/m^3 specified by the BS EN 12350-6 (BS EN 12350-6, 2009). The higher density values of IOT concrete could be due to the high concentration of iron content in the material, which was heavier than river sand in terms of weight. Another factor could be due to finer particles and angularity which has a better filling effect than the sand, which lead to a higher packing density in the fresh concrete.

Compressive Strength

The compressive strength tests for the control and IOT concrete mixes are shown in Table 4. The results shows that all the IOT concrete samples gave better performance in compressive strength than the control specimen. The incorporation of IOT improves concrete strength up to 32.7% optimum level and then decreased when the percentage of IOT was more than 40% replacement to sand but still higher than reference concrete (k0).

The reasons for this decrease in strength could be attributed to the high water demand for hydration process, which might result to lower compressive strength. The presences of 4 heavy metals in the IOT such as Zn, Cu, Pb and Cd also retard hydration, and lower the strength development. The percentage increase of compressive strength relative to k0 at 28 days were 1.5%, 4.4%, 8.3% and 2.2% for k10, k20, k30 and 40, respectively. This observed increase in the compressive strength could be partly attributed to the finer particles of IOT, which filled the pore and optimized the pore structure. It is also attributed to the internal curing effect whereby water from the IOT is gradually released into the concrete to further hydrate the matrix. This may be related to chemistry of IOT as observed in the chemical composition. It is equally suspected that the presence of iron in higher concentrations might have positive effect on strength attainment (Anifowose*et al*., 2021). It was ranged between 10-50% optimum mixtures replacement of natural sand with IOT (Tang *et al.*, 2020).

Conclusion

Due to the high affinity of IOT for water demand, there was significant decrease in the slump of the IOT concrete, which was believed, influenced by the surface area and rough surface of the tailings, the concrete sample k30 produced the highest value of compressive strength, 49.6 MPa, which gave higher strength than k0 concrete sample, which serves as reference. They all attained the designed strength of grade 30 at 28 days curing.

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Integrating Engineering into Teaching and Learning Science: Phases, Challenges and the Way Forward

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Abstract
This paper is prompted by the current educational reform efforts that call for the integration of engineering into science education. Therefore, it examines the integration of engineering into the teaching and learning of science. It also pointed out how it is possible and beneficial to integrate engineering into teaching and learning of science. Emphasis is made on how engineering helps to make abstract science concepts concrete and develop better skills in students to fit into the current demands of the workforce. Factors militating against the integration of engineering into formal teaching and learning of science were clearly explained with how they can be quickly and rightly overcome. Due to the current educational reforms going on worldwide, there is an urgent need to integrate engineering into biology instruction for better development of creative skills among students, which are mostly and currently needed in the workforce. It was recommended that engineering be integrated into the science curriculum and that science teachers should be trained, supported, encouraged, and motivated to implement it to teach science.

Keywords: Engineering, STEM, Science, Education

Introduction
As technology keeps advancing in our nation, so does our dependency on it as a people. For a country to grow for human benefit, it needs to embrace technology in all ramifications. Teaching and learning science require appropriate methodologies or strategies for effective and positive outcomes. The teaching and learning of science in the past has depended almost entirely on traditional teaching methods such as lecture, demonstration, questioning, field-trip, discussion, etc.

This has made the learning of science and science-related subjects difficult and has encouraged cramming among science students. It is so sad that most science students taught with the methods mentioned above can not compete in skills application. For example, there are shortages of professional workers in the workforce market with proficient Science, Technology, Engineering and Mathematics (STEM) knowledge and skills required in the 21st century (Sazman, 2019). The growing concerns that there are insufficient numbers of professionals majoring in STEM disciplines have prompted nations like the United States of America, United Kingdom, etc. to launch the American Society for Engineering Education (ASEE) in 2006 as an initiative with the overall intent of transforming educational engineering through an academic scholarship to better prepare graduates for the 21st-century workforce. Engineering education helps integrate engineering research into teaching and learning of science which in turn accelerates technological and educational innovations and improve the quality and diversity of graduates who would enter the labour market ceremoniously. Advancing STEM education requires going beyond an extracurricular science and mathematics outreach initiative. It requires that engineering and

technology applications be incorporated into the science curriculum for better teaching and learning of science. According to Ghalia, *et al*. (2016), implementing engineering curriculum into science education will increase the educational outcomes of the students. It will go a long way in helping to motivate students to learn science content and increase students level of understanding of science. It will also boost students interest in pursuing a STEM or STEM-related careers. The advancement accompanies the increased emphasis on integrating engineering into science teaching and learning in developing and introducing initiatives to expose students to engineering applications like STEM. Despite the influential role of these initiatives in exposing students to engineering, they cannot bypass teachers as the cardinal source of influence for students achievement (Ghalia, 2016).

Engineering is a significant focus in STEM education because it has encompassed applications that advance students learning in an open-ended problem within real-world contexts. It is found to help develop students' problem-solving skills and communication and teamwork skills, mainly since collaboration is often used as an instructional strategy for engaging students in solving open-ended problems (Park, 2012). The introduction of NGSS (NGSS Lead States, 2013) has made engineering a core part of the science curriculum, emphasizing that science curricula that "stimulate and build interest" in STEM can increase the numbers of students pursuing STEM fields.

Need to Integrate Engineering into Science Teaching and Learning.

The integration of engineering into the teaching and learning of science is crucial for the following reasons:

To promotes creativity: - integrating engineering into science teaching and learning helps to promote new ideas and innovations. For example, there will be no meaningful development in artificial intelligence or digital learning if there is no ingenuity and creativity. These are products of science, technology and engineering.

To encourage tech use: Integrating engineering into science teaching and learning empowers students with good knowledge of technology and innovation. When they encounter new technologies, they should be prepared to embrace them instead of being hesitant or fearful. It will also guarantee the upper hand in the global landscape as the world becomes technologically based every day.

To encourage Teamwork: Integrating engineering into teaching and learning science helps teach students of all ability levels. Students of varying ability levels can work together to find solutions to problems, record data, write reports, give presentations, etc. The result is students will understand how to collaborate and thrive in a team-oriented environment.

To encourage knowledge application: - using engineering as a strategy for teaching and learning science will teach students skills that they can use in the practical world. This motivates the students to learn as they know that the skills they acquire can be utilized immediately and in such a way that can positively impact them and their loved ones. In addition, the ability to apply their knowledge to new and novel tasks will bode well for them when they enter the workforce.

To teach problem-solving skills: - STEM education teaches students how to solve problems using critical thinking skills. By engaging in STEM learning experiences, students learn to examine the issues and create a workable plan to solve them.

To build resilience: - When engineering is used to teach or learn science, students can fail and try again. It stresses the value of failure as a learning process, enabling students to embrace mistakes as part of the learning process. This allows students to build confidence and resilience, allowing them to keep going even when the going gets rough. After all, failure is part of the process that ultimately leads to success.

To encourage experimentation: - without engineering, many technological advancements that have occurred in a couple of decades would not be possible. Unfortunately, many of these innovations were created by people who were told that their ideas wouldn't work and their response was, "Let's try and see". This type of attitude can be encouraged with STEM learning.

To increase the number of students pursuing STEM fields, the number of those with STEM knowledge and skills will undoubtedly increase by integrating engineering into science teaching and learning.

It enables students to realize the importance of science and engineering: integrating engineering into science teaching and learning will help foster the understanding of how science and engineering are mutually related and the critical role they play in innovation and problem-solving.

Integrating Engineering into the Teaching and Learning of Science

To integrate engineering into science teaching and learning, an engineering design process must be strictly followed. The use of Bio-inspired design, Biometrics and Biomimicry can encourage the process through which innovative, responsible and impactful solutions to mankind problems can be achieved. (Bilici, 2021). According to Householder and Hailey (2012), the following phases are used to integrate engineering into the teaching and learning of science:

Phase 1: Problem identification
Phase 2: Background research investigation
Phase 3: Idea generation through brainstorming
Phase 4: Selection of the best solution.
Phase 5: Prototype construction.
Phase 6: Prototype testing and assessment.
Phase 7: Communication and reflection
Phase 8: Redesigning and finalizing the design.

According to Park (2012), the following engineering design process can be used to integrate engineering into teaching and learning of science:

Phase 1: Identify the problem/need
Phase 2: Research and Rank Objectives and constraints
Phase 3: Develop possible solutions
Phase 4: Select the best solution within constraints
Phase 5: Model solution
Phase 6 : Test/Evaluate the solution

Phase 7: Present/communicate the results
Phase 8: Redesign and Revise

English and King (2015) implemented Engineering as engineering design process in alimentary school. The pases include:
1. Problem solving
2. Idea generation
3. Design construct
4. Evaluation and
5. Redesign

The phases of; Ask, Imagine, Plan, Create and improve (Shahali *et al* 2017).
Given the proceeding, the implementation of Engineering as a teaching approach will depend on the instructional content and the final outcome.

From the above engineering design processes, it's clear that engineering can be integrated into teaching and learning of science.

Factors Militating the Integration of Engineering into Sscience Teaching and Learning.
Teaching and learning science using engineering has not come without challenges. These challenges are:
Inadequately trained teachers in engineering: - integration of engineering into teaching and learning of science is always problematic. This is because most teachers of science have little or no knowledge of engineering.

Therefore, when asked to implement the curriculum that incorporates the use of engineering to teach science, they always find it not only difficult but somehow impossible: because of the following factors

Lack of conceptual understanding of how to integrate engineering into their curriculum: - According to Ziaeefard, *et al*. (2017), science teachers lack the conceptual understanding on how to integrate engineering into school curriculum from which they can implement. This is because only few of them might have been exposed to instruction that integrates curriculum design, engineering, and technology, so it is not surprising that they lack the knowledge on how to use engineering effectively to teach.

Lack of practical knowledge: - most science teachers are not practically oriented and this stands as a serious barrier in the integration of engineering into science teaching and learning. Engineering as a field of study requires more of practical applications than theoretical presentations. For science teachers who base in teaching theory for example, may find it extremely difficult to bring in engineering into the curriculum of science.

Poor funding of education: - one of the major problems that hinders the the integration of engineering into science curriculum is the fact that education as a sector is usually being poorly funded. Using engineering to teach science will demand a lot of funds for the purchase of materials and also for training and retraining of teachers.

Lack of administrative support for the programme: - Ross, *et al*. (2018) states that professional development opportunities, as well as curriculum integrating engineering applications are not prevalent, which means that the support that teachers need for transforming their practices is quite limited.

Education policy makers: - education policies made by policy makers do not usually provide room for the integration of engineering into science teaching and learning. This is one of the reasons why the integration of engineering into science curriculum may be difficult.

Corruption: - this is a cancer that eats deep into the education sector. Some of those who are entrusted to manage education sectors are highly corrupt. Apart from looting the money allocated for education upkeep, they make bad policies that do not provide conducive learning environment for the students. This is already a problem to the implementation of engineering as a strategy of teaching and learning of science particularly in secondary schools.

Teachers attitudes: if teachers consider the integration of engineering into the science curriculum as an additional workload for them, they may have negative attitudes towards its implementation.

Time constraint: Time is one of the significant challenges in implementing engineering into the teaching and learning of science. This is because students need a lot of time to perform the activities that are enshrined in the design procedures

Way Forward

Despite the problems stated above, as a nation, we must work sleeplessly towards addressing them. The following ways will go a long way in addressing those problems:

Establishment of engineering training centres for science teachers: - to teach in science teachers the skills of engineering to enable them to acquire and apply same in the integration of engineering into science teaching and learning, training centres must be established to give them training inform of seminars, workshops, conferences, etc. This will provide the enabling environment for them to develop the needed skills.

The school administrators should support teachers to develop engineering skills: - For science teachers to be motivated to take the bull by the horn in ensuring that they acquire the needed skills for the teaching of science using engineering, such teachers must be encouraged and supported by the school proprietors/proprietress both in kind and in the form of incentives.

Identification of curriculum that is infused appropriately with engineering: - Ross et al. (2018) recognized that while it is valuable to learn how to identify a curriculum that is appropriately infused with engineering, there is much to learn about transforming already developed classroom lessons into "engaging and educationally appropriate design challenges with open-ended solutions "

Proper funding of the education sector: When the education sector is properly funded, the environment for better teaching and learning of science shall stay. This will also create avenues

for proper sponsorship of science teachers to acquire more knowledge and skills to implement engineering as a method of teaching and learning science. It will also make it possible for teachers and school administrators to acquire the materials needed for this purpose.

Better education policies should be made: - when good policies are made regarding education, particularly science education, it becomes easier for contemporary ideas to be incorporated into the system. For example, for a contemporary method such as engineering to teach science to be integrated into science education, policies favouring its inclusion must be made first. Without such guidelines, it becomes difficult for the new method of teaching and learning to see the light of the day.

Tackling corruption in the education sector with corrupt managers will always remain without any technological progress. This is because, when funds are released to the education sector for research, infrastructure, and staff training, such money may end up in the broader pockets of the looters. But when the corrupt persons are arrested, prosecuted and sanctioned, the system will pave the way for the right people who may eventually come in with better ideas or opinions for the growth of education.

Conclusion

This paper illustrates several considerations that may inform the future to integrate engineering into teaching and learning science meaningfully. The need for the integration of engineering into the teaching and learning of science is also stressed. Challenges facing the implementation of engineering as a method of teaching science were also highlighted, and ways to overcome them were clearly stated.

Recommendations:

Based on the above research study, the following recommendations were made:

1. Curriculum planners should ensure that they make provision for the integration of engineering into science curricular.
2. Government and other non-governmental organizations whose interest is in science education should support the program by providing the enabling environment (fund) to schools to establish the program.
3. School administrators should ensure that science teacher receive suitable training on using engineering to teach science. This could be through organizing seminars, workshops, conferences, etc.
4. Science related engineering courses should be introduced in the departments of science and technology education across the universities in the country for the upcoming teachers to learn.
5. Science teachers should be prepared and willing to implement any policy regarding engineering to teach science.
6. Durations for teaching science should be increased in the school timetables to enable science teachers to accommodate engineering to teach science.

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Strength Characteristics of Reclaimed Asphalt Pavement-Stone Dust Composite Blended with Fresh Bitumen

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Abstract
The recycling of asphalt has become a common practice in the transportation industry. Motivation for recycling typically includes the environmental, economic and social benefits. The use of RAP in the roadway construction fits with the global objectives of sustainable development by the prudent use of natural resources. This and other factor has attracted the attention of this research. Sieve analysis, specific gravity, bulk density were determined on both RAP and stone dust. The strength characteristics such as compaction and CBR were also carried out on the five different mixes A to E at varying percentage of bitumen content. The result shows that RAP has a uniform gradation while stone dust is medium coarse sand, the specific gravity of RAP and stone dust were found to 2.2 and 2.67 and their corresponding bulk densities were 1.19 and 1.78g/cm^3. The highest MDD for 0% bitumen was 2.56g/cm3 with OMC of 8.2% and the least was 1.874g/cm3 MDD with 10.4% OMC. The highest MDD after the control was 2.53g/cm3 at 2% bitumen with 9% OMC. The minimum MDD recorded after apart from that of control was 1.876g/cm3 at 10.8% OMC also at 2% bitumen content. The maximum CBR value apart from that of control (0%) was at 1% bitumen for all different types of mixes.

Keywords: Bitumen, CBR, Compaction, Mixes, RAP, Stone dust

Introduction

Road networks worldwide cost billions of dollars. Structural design of roads consists of asphalt layer, base layer; sub base layer on top of the sub grade layer. The constructions of roads have been increasing recently (Abdelzaher, 2016).

A pavement is said to be relatively stable layer or crust constructed over a natural soil. It can also be defined as layers of process and unprocessed materials placed on the natural soil, configured to carry traffic of any kind. The main function of pavement is to support and distribute the heavy wheel loads of vehicles over a wide area of the underlying natural soil called sub grade and permitting the deformation within elastic or allowable range and to provide adequate surface (Ahmed, 2001).

Depending on the types of pavement, some materials differ. Virgin aggregate which can be substituted with Recycle asphalt pavement (RAP), stone dust and fresh bitumen make up a part of flexible pavement compositions. RAP is the most widely used recycle material. It is produced by removing and reprocessing existing asphalt pavement.

Reclaimed Asphalt Pavement (RAP) is a latest technology in the field of construction of bituminous pavements. RAP is being widely adopted all over the world as it has several benefits. By using RAP the cost of project is marginally reduced and it also has a favorable effect on

environmental impact. RAP also leads to optimization of resources. Over a period of time the technological improvements have resulted in reclaiming the bituminous pavement in usable condition. Earlier the old pavements were excavated using excavators which resulted in availability of bituminous mix in form of chunks. In modern times, the scarifying process using diamond cutters result in removal of pavement in sizes nearly aggregate size. The results given by RAP mixes are either similar or better than virgin mixes. Hence the use of RAP is justified. (Jashanjot and Duggal, 2015)

Bitumen can be defined as a mixture of organic liquid that are highly viscous, black, sticky, entirely soluble in carbon disulfide and composed primarily of highly condensed chemical compound or can be defined as an amorphous, black or dark color (solid, semi-solid, or viscous) cementations substance, composed principally of high molecular weight hydrocarbons, and soluble in carbon disulfide. Bitumen is the residual or by product obtained by fractional distillation of crude oil. It is the heaviest fraction and the one with highest boiling point. (Herbert, 2007). Stone dust is another material to be used.

The recycling of asphalt has become a common practice in the transportation industry. Motivation for recycling typically includes the environmental, economic and social benefits. The use of RAP in the roadway construction fits with the global objectives of sustainable development by the prudent use of natural resources (Edward *et al.*, 2015).

The recycling of asphalt has become a common practice in the transportation industry. Motivation for recycling typically includes the environmental, economic and social benefits. The use of RAP in the roadway construction fits with the global objectives of sustainable development by the prudent use of natural resources (Edward et al., 2015). The use of Reclaimed Asphalt Pavement, stone dust mix will assist in the reduction of the cost of construction and protect the environment. Evaluating the strength characteristics of each components; RAP, stone dust and fresh bitumen will greatly assist in reducing the cost of construction. This will also reduce the waste from the RAP which causes environmental imbalances by modifying these RAP either increasing or decreasing the proportion of other components which make up a pavement

Literature Review

A pavement is said to be relatively stable layer or crust constructed over a natural soil. It can also be defined as layers of process and unprocessed materials placed on the natural soil, configured to carry traffic of any kind. The main function of pavement is to support and distribute the heavy wheel loads of vehicles over a wide area of the underlying natural soil called sub grade and permitting the deformation within elastic or allowable range and to provide adequate surface (Ahmed, 2001).

Reclaimed Asphalt Pavement (RAP) is a latest technology in the field of construction of bituminous pavements. RAP is being widely adopted all over the world as it has several benefits. By using RAP the cost of project is marginally reduced and it also has a favorable effect on environmental impact. Reclaimed asphalt pavement (RAP) is produced by milling, ripping, breaking, crushing, or pulverizing types of equipment and is mostly generated during pavement rehabilitation and reconstruction, and contains high-quality, well-graded aggregates coated with asphalt cement when properly crushed and screened (FHWA 2008,Osinubi and Edeh 2011,Osinubi

etal. 2012a). Majority of RAP is used in road construction and maintenance applications (FHWA, 2008).

Bitumen is the residual or by product obtained by fractional distillation of crude oil. It is the heaviest fraction and the one with highest boiling point. (Herbert, 2007). The aged bitumen present in a RAP has physical properties that make it undesirable for reuse without modification (Chen *etal*.2007). This has caused the recycling of pavement materials to become aviable alternative to be considered in road maintenance and rehabilitation with the conservation of resources, preservation of the environment, and retention of existing highway geometrics (Taha *etal.* 2002). The use of Reclaimed Asphalt Pavement, stone dust mix will assist in the reduction of the cost of construction and protect the environment. Evaluating the strength characteristics of each components; RAP, stone dust and fresh bitumen will greatly assist in reducing the cost of construction. This will also reduce the waste from the RAP which causes environmental imbalances by modifying these RAP either increasing or decreasing the proportion of other components which make up a pavement. The recycling of asphalt pavement is a valuable technical approach to the friendly economical and environmental atmosphere (Salman, 1998).

The use of RAP is not only a beneficial alternative Accepted for Publication, Presently and in future, but will also become a necessity to ensure economic competitiveness (Salman, 1998). The performance of bituminous mix generally depends on the amount of filler in the mix. The workability of a mix depends, to some extent, on the amount and type of the filler present in the mix. The mixture performance also affected by the interactions between asphalt and filler because of the larger surface area, filler may absorb more asphalt and its interaction with asphalt may lead to different performance of asphalt-concrete mixture. The size distribution, particle shape, surface area, surface texture, voids content, mineral composition, and other physiochemical properties vary for several fillers.

Therefore, their effect on the properties of asphalt-concrete mixture also varies. Conventionally in Bangladesh, fine sand with stone dust is used as filler material in bituminous mix. In this study an attempt is made to find the effect of types of cheap & non-conventional filler on the behavior of bituminous mixes. For this purpose, stone dust fillers will be used. Sutradhar, MintuMiah, Chowdhury, Sobhan (2015).

The use of RAP fully or partially, without and with the addition of industrial waste or fresh material as filler have been studied by researchers: NagaRajesh, Kumar, Jagadeesh, and Srinivasa (2018), Jashanjot and Duggal (2015), but most of the studies were aimed at comparing the strength, marshall stability, flow value and density of the bituminous mixes against the conventional mixes.

Sample Preparations

Stone dust was collected from a quary along Abuja – Kaduna express way behind Zuma Rock Niger State and transported down to the Civil Engineering Laboratory and then sieved through 2mm sieve. The RAP was also collected from the same site, breaks into smaller units and sieved through 5mm sieve in the laboratory. Bitumen was also purchased and transported to the laboratory. Five mixed were considered which are 0-90% (A), 25-75% (B), 50-50% (C), 75-25% (D) and 90-10% (E) representing (RAP-Stone dust) with varying percentage of bitumen contents (from 0, 1, 2 and 3%).

Preliminary Test

The following preliminary test were conducted on the materials; RAP, stone dust and bitumen. These test include the specific gravity, sieve analysis and bulk density.

Plate I: Materials Used

Compaction characteristics procedure

The procedure adopted was as outlined in BS1377 (1990). The mass of an empty mould was weighed, noted and recorded as M_1. Then, a 3kg of air dried mix sample was thoroughly mixed with small amount of water. The mixed samples (RAP-Stone dust-Bitumen) was compacted into a 940cm^3 cylindrical mould in three layers of approximately equal mass, with each layer receiving 25 blows of a 2.5kg rammer falling freely through a height of 300mm. After compacting the last (fifth layer), the collar was removed and the surface of the mix was trimmed to level with the mould and then weighed as M_2. Specimen from top and bottom of the mould were taken for moisture content determination. The mix weredemoulded and mixed together with the remaining sample on the tray. The above procedure was repeated at varying moisture content, until the mass decreased. The dry density, in each case was calculated and plotted against its corresponding moisture content. The same procedures were repeated for all other mixes B, C, D and E with varying percentage of bitumen content.

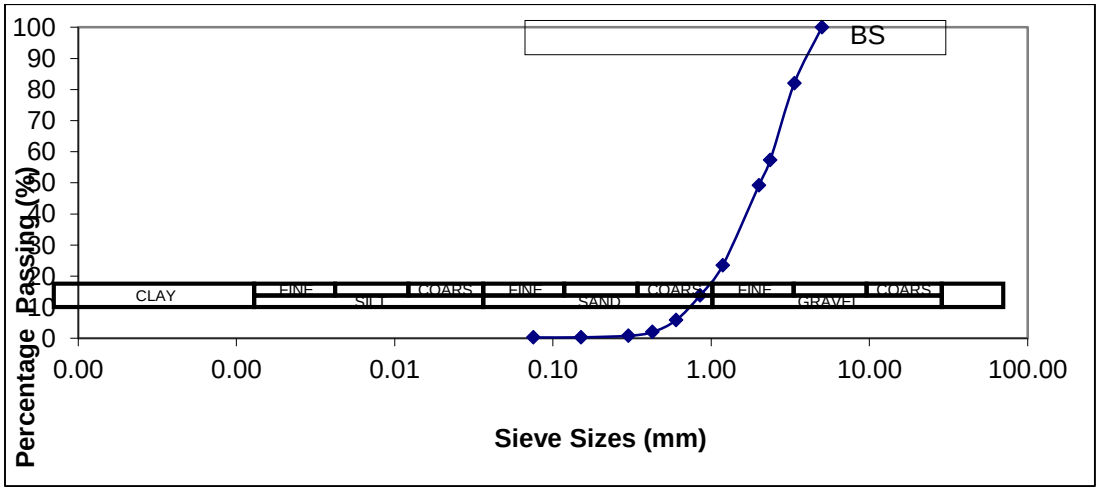
CBRcharacteristics procedure

An empty compaction mould with base plate, with extension collar removed was weighed. The soil sample was thoroughly mixed at OMC. A spacer disk was inserted over the base plate and a coarse filter paper was placed on top of the spacer disc. The mould was placed on a solid base (concrete floor) and the wet mixture with varying bitumen content of 0, 1, 2 and 3% into the mould was compacted in five layers of approximately equal mass, each layer was given 62 blows with 4.90kg hammer equally distributed and dropped from a height of 450mm above the soil. The extension was removed and carefully the compacted mixture was leveled.

Sieve analysis Results

Figure 4.1 presents the result for the sieve analysis of stone dust. The result shows that a large portion of the sample was retained on sieve 3.35mm and almost all the sample passes 95.77% with 4.23% retained on 5mm. The result also shows a uniform graded curve ranging from fine to coarse sand.

Figure 4.2 presents the sieve analysis result for RAP; it was observed that 100% of the material passes through the maximum sieve aperture. The distribution was well graded ranging from fine to coarse sand material.



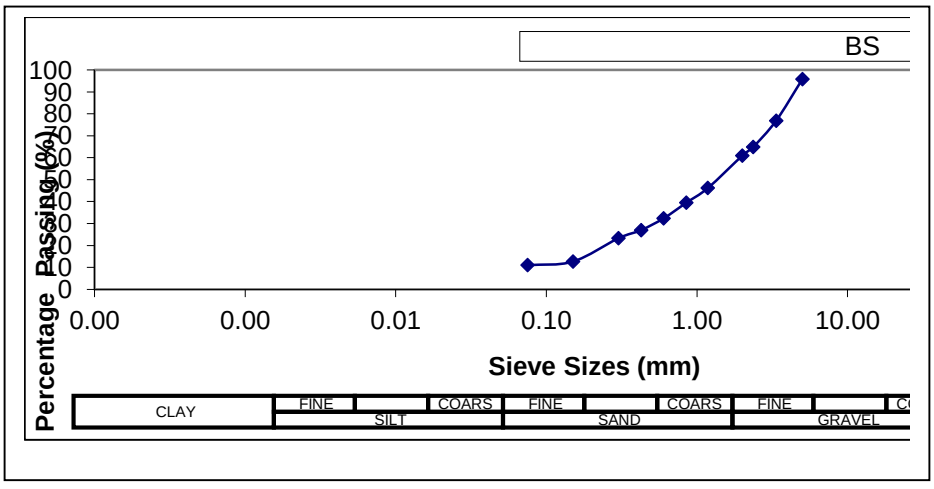


Figure 1: Sieve analysis curves of RAP and stone dust

Specific Gravity and Bulk Density

Materials	Specific Gravity	Bulk Density
RAP	2.2	1.19 g/cm^3
Stone dust	2.67	1.78 g/cm^3

The average specific gravity of Stone dust was found to be 2.67 as presented in Table 4.3, this shows that the material is 2.67 times heavier than it equal volume of water. While Table 4.4 shows the average specific gravity of RAP with 2.20 less than that of the stone dust. The specific gravity for stone dust falls within the standard range of 2.6 to 2.7 for conventional aggregate. While, that of RAP fall outside and below the standard range. Hence it is not a conventional aggregate.

The bulk density of stone dust and RAP are presented in Table 4.5 and 4.6. The density depends on how densely the aggregate particles are parked and it is influenced by the nature of compaction. The density of stoned dust was 1.78g/cm^3 which fall out above the range of 1.52-1.68g/cm^3 for normal weight aggregate; hence it is not a normal weight aggregate but heavy weight. In the same vein, the bulk density for RAP was 1.15g/cm^3 which also fall out and below the range of standard normal weight. Hence it is a light weight aggregate and can only be used for light weight concrete production. However, it can be used for road construction material when modify and its other properties such aggregate impact value (AIV) and aggregate crushing values (ACV) were checked.

Compaction Results

Table 4.8 presents summarily the compaction result for all mixes with varying bitumen content. It was observed that, Mix A with 10% to 90% representing RAP – Stone dust shows the maximum values of MDD with the highest of them being at 2% bitumen less than the control value of 2.56. At no bitumen content, Mix A has the maximum MDD value of 2.56g/cm^3 with a corresponding OMC of 8.2%, while mix C has the least MDD 1.872g/cm^3 and OMC of 10.4%. Hence a mixture of RAP/Stone dust with a proportion of 0%-90% gives the highest MDD.

When bitumen was added by 1%, Mix A was still found to have the maximum MDD of 2.19 less than the maximum value for no bitumen content (2.56) and corresponding OMC of 7.6%, while Mix D has the minimum MDD of 1.895 slightly greater that of case with 0% bitumen content and corresponding OMC of 10.4%

As the bitumen content increases to 2%, Mix A still have the highest MDD value of 2.53g/cm^3 greater that of 2% and less than that of 0%, it has a corresponding OMC of 8.6%. While Mix B has the lowest MDD value of 1.876g/cm^3 slightly greater than that of 0% but less than that of 1%, it also has the corresponding OMC of 10.8%.

At 3% bitumen content, Mix A still shows the highest MDD value of 2.21 which is greater than that of 1% but less than that of 0 and 2% bitumen, it has the corresponding OMC of 8.6%. While Mix E has the minimum MDD value of 1.985 which is greater than the minimum value for all othermixes

Table 4.8: Summary of Compaction Result

Bitumen Content	Mixes	A	B	C	D	E
	OMC	8.2	8.8	10.4	11.2	7.6
0%	MDD	2.56	1.912	1.872	2.01	2.018
	OMC	7.6	8.4	9.6	10.4	8.4
1%	MDD	2.19	2.68	2.04	1.895	2.025
	OMC	9	10.8	11.6	10	9.6
2%	MDD	2.53	1.876	1.884	2.025	2.015
	OMC	8.6	10.8	10.4	9.6	8
3%	MDD	2.21	2.6	1.998	2.04	1.985

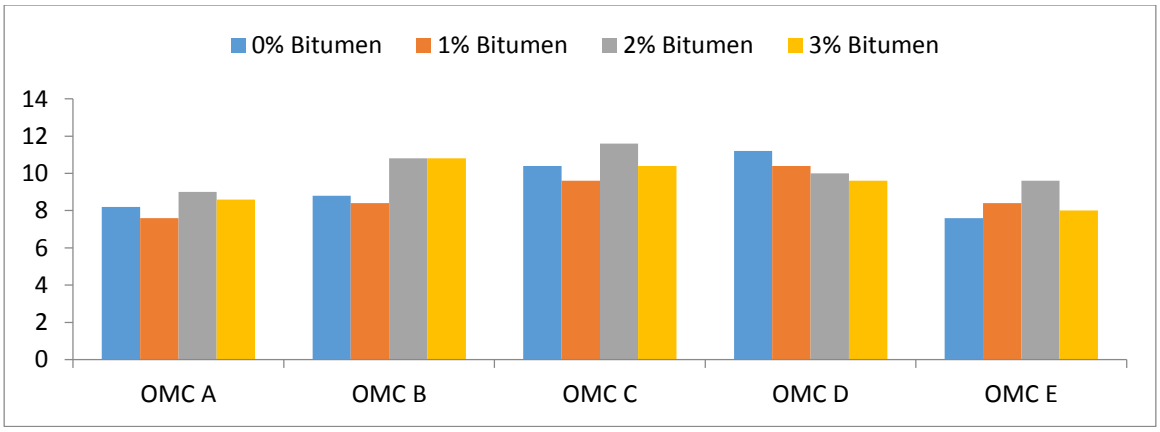


Figure 2: Summary of OMC Variation with Mixes

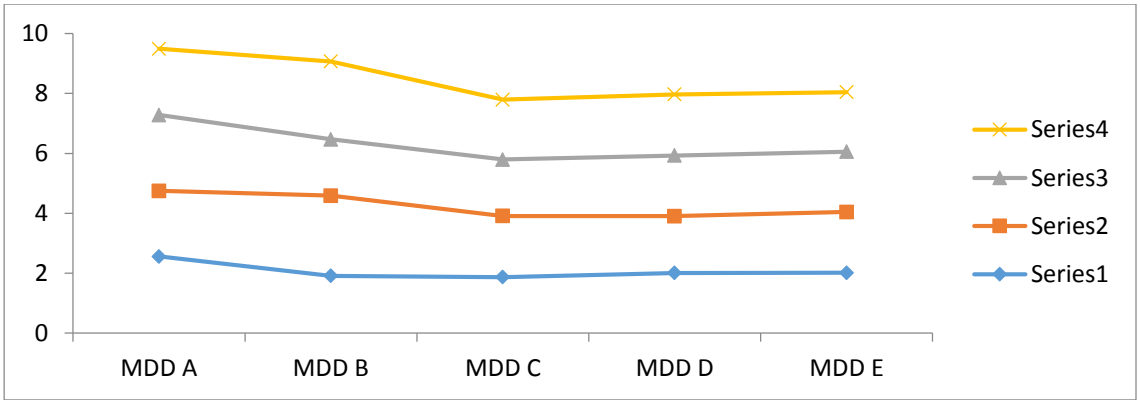


Figure 3: Summary of MDD Variations with Mixes

CBR Result

At 0% bitumen content, the CBR results for different mixes were presented in Figure 4.23. It was observed that the trend follows a parabolic curve as the strength increases from mix A through B with maximum value of 65.67% down to mix E with least CBR value of 14.29%

As bitumen was added by 1%, the trend behavior changes from parabola to sinusoidal as in the case of 0%. The maximum CBR was still at mix B which is less than that of 0% bitumen content and the minimum was at mix C but less than that of 0% bitumen.

As more bitumen was added in 2%, mix A has the highest CBR but less than that of 0% bitumen content, while mix B have the least CBR which is also below that of 0 and 1% bitumen content.

When the percentage of bitumen content was increased to 3%, the CBR values for all mixes slightly vary from one another. However, mix B shows the highest CBR while mix A and E are the lowest as presented in Figure 4.26.

Apart from the 0% bitumen content, 1% bitumen addition averagely yields better result in-terms of the maximum CBR value in comparison to other bitumen content. In fact, adding more bitumen to the mixes reduces the CBR strength characteristics as shown in Figure 4.

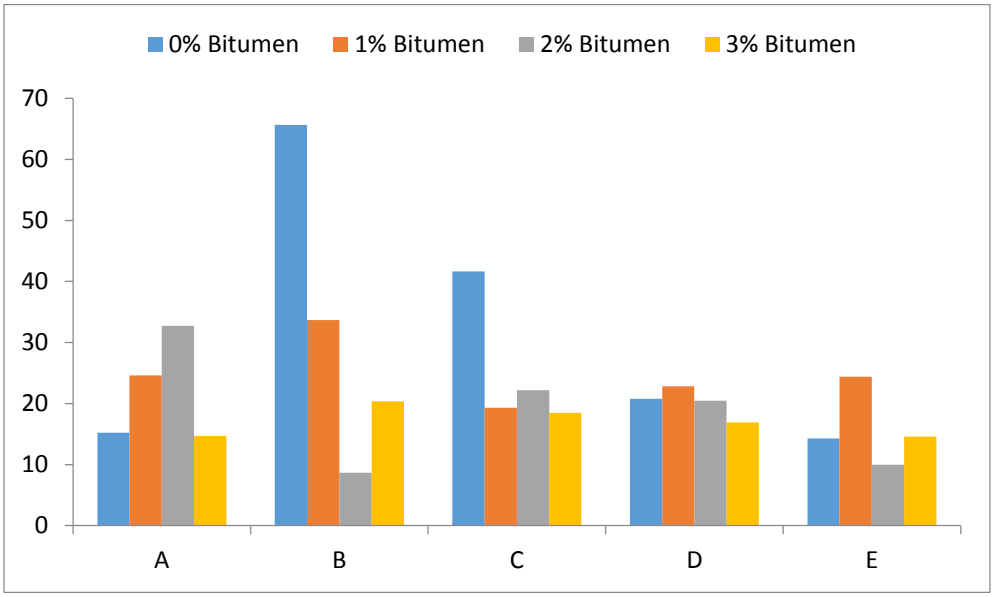


Figure 4: Combined CBR for all Bitumen Content

Conclusion

At the end of the research and result analysis, the following conclusions were drawn:

The specific gravity were conducted o n both the RAP and stone dust.

The Specific gravity for both RAP and stone dust were respectively 2.20 and 2.67.

The bulk density of RAP and stone dust are respectively 1.19g/cm^3 and 1.78g/cm^3.

The highest MDD for 0% bitumen was 2.56g/cm^3 with OMC of 8.2% and the least was 1.874g/cm^3 MDD with 10.4% OMC. The highest MDD after the control was 2.53g/cm^3 at 2% bitumen with 9% OMC. The minimum MDD recorded after apart from that of control was 1.876g/cm^3 at 10.8% OMC also at 2% bitumen content.

The maximum CBR value apart from that of control (0%) was at 1% bitumen for all different types of mixes.

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Experimental study on physical properties of Cement - Bentonite Slurries made from selected cement types

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Abstract:
Cement-Bentonite (CB) slurry cut-off walls are low permeability barriers whose basic function is to limit the flow of groundwater and contaminants in several engineering structures such as landfill, cores of earth dams, reservoirs as well as buffer and backfill of radioactive nuclear waste containments. In this study, some physical parameters that characterize CB slurries made from selected cement types namely CEM I, CEM II and CEM III were determined. Laboratory tests including the density, Marsh funnel viscosity and bleeding tests were conducted on cement–bentonite mixtures of 40%, 45%, 50%, 52% and 55% cement with 10, 13, 15, 20 and 25% bentonite at w/c ratio of 0.65. Results indicate that the density and bleeding values of CB slurries decreased with higher bentonite content while the viscosity was found to increase with increase in bentonite content across the cement types. In terms of the effect of different cement types on these parameters, CEM III specimens initially yielded higher densities compared to CEM I and CEM II, however from 20% bentonite content, their densities tended to converge and the difference in density values based on the cement types is minimal. Similarly, at 25% bentonite for CEM I, CEM II and CEM III, the viscosity of mixtures reached values as high as 44, 45 an 50 respectively while bleeding rates were 3.4, 3.5 and 4 for CEM I, II and III respectively. With regards to recommended threshold values specified in most codes guiding the use of CB slurries, all physical parameters of mixtures measured in this study produced favourable results although CEM III seem to have an edge over the others.

Keywords: bentonite, bleeding, cement, density, viscosity

Introduction

Cement–bentonite mixtures are commonly used to build cutoff walls. The main application of this barrier is to limit the flow of groundwater and transport of contaminants. The major advantages of CB slurry barriers technology include its technological efficiency, the self-supporting nature of the barrier; the relative uniformity of the mixture; the cost effectiveness of the technique and the low hydraulic conductivity.

Typical CB mixture would comprise water, bentonite, cement, and cement replacement materials such as Pulverised Fuel Ash, PFA, or Ground Granulated Blast furnace Slag, GGBS, at replacement levels up to 30 % and 80 % respectively in order to achieve the low hydraulic conductivities required viz. $k \leq 1x10^{-9}$ m/s (ICE, 1999), although mixtures outside these stated proportions can still result in the desired physical properties.

The use of bentonite is not only effective in reducing the hydraulic conductivity but also in enhancing the workability as well as the self-healing properties of the mixture (Antonio and Madelyn 2017).It is an aluminum phyllosilicate formed mainly from volcanic ash alteration which is very rich in montmorillonite (>80%) from the smectite group (Abdullahi & Audu, 2017; Amadi

and Odedede, 2019). Classified into two groups, namely sodium (Na) (swelling bentonite) or calcium (Ca) non-swelling bentonite(Abdullahi and Audu, 2017). Ca-bentonite with Ca^{++} as a dominant exchangeable cation possesses a low swelling and water absorptions capacity, while the Na-bentonite carrying Na^{++} as a predominant exchangeable cation, exhibits more swelling and also absorb a large quantity of water leading to formation of a more viscous fluid (Christidis and Huff, 2009). The effectiveness of bentonite in this type of applications is attributes to its vital physical properties such as small particle size, high surface area, high viscosity, absorption and swelling properties, cation exchange capacity, high bond strength, plasticity and impermeability(Apugo et al, 2011).In the mixture, bentonite controls the permeability, better workability (Amadi and Eberemu, 2012).

On the other hand, cement is employed for its contribution to the shear strength and stiffness of the mixture. Portland cement comes in various forms: CEM I is a Portland cement with 95-100% clinker and only 0-5% minor additives, CEM II is Portland cement whose constituents are 80-94% clinker, 6-20 additives in the form of slag, fly ash, silica or lime and 0-5% minor additives and CEM III also known as metallurgical cement (symbol: CEM III/A or CEM III/B or CEM III/C) contains Portland cement clinker blended with blast furnace slag. The clinker replacement rate in CEM III ranged from 66 to 80%(Rummane*t al*., 2016).On the other hand, CEM IV is a Pozzolanic cement; comprising of Portland cement clinker and higher proportions of pozzolana than in a CEM II cement while CEM V is a composite cement; comprising Portland cement clinker and combinations of blast furnace slag and pozzolana or fly ash ().

Notwithstanding the general acceptance and availability cement is CEM II type of cement in the Nigeria, it is always important to determine the most appropriate and effective cement type to be used for various engineering applications.

To characterize CB slurry system some fundamental physical parameters used in codes and standards for determining whether a CB mixture is appropriate for engineering applications are usually determined. These parameters/indicators strongly influence the ease with which they can be constructed and in addition reflect their ability to perform as effective hydraulic containment barriers ().

Initial or fresh slurry density which gives an indication of the quantity and type of hydrated solids in the slurry mixture is one of such indicators. Density of slurry should be sufficient to provide the necessary hydrostatic force required for the structural stability. The slurry density required to achieve this will depend on the nature of the surrounding ground. Past studies reported that the initial density of CB slurry varies from 1040kg/m^3 to 1150kg/m^3, but would rises to almost 1250kg/m^3 post construction (Opukumo et al., 2021;). In-trench density of 1300kg/m^3 is generally thought to be the threshold level for self-hardening slurries, above which workability is impaired ().Similarly, in-trench densities that are relatively similar from top of trench to the bottom indicate good suspension characteristics. A dramatic density increase with depth on the contrary may indicate slurry with poor suspension characteristics causing excess sand and other solids to settle to the trench bottom with a resultant increased seepage.

In addition to the density, another important indicator is the viscosity of the slurry which relates to the workability of the slurry and settling rate of suspended solids in the trench. The CB slurry must have the appropriate Marsh viscosity. Benyounes, (2019) investigated the effect of bentonite on

the rheological behavior of cement grout and reported that bentonite leads to increase in apparent viscosity, yield stress, and consistency of cement grout. Typically, CB slurry viscosities in the range of 40 to 50 seconds are considered normal (); although, higher slurry viscosity can be achieved by increasing the cement and/or bentonite proportions. On the other hand, slurry viscosity can be reduced by set retarders ().

Equally important in the characterization of CB slurries is the bleeding properties. Bleeding can lead to some consequences such as reduction in the mobility and pumpability of the slurry (Azadi*et al*., 2017). Low bleed characteristics are usually desirable in CB slurry since excessive loss of water constitutes a loss of useful slurry volume and indicates that the slurry mix is unstable. Maximum bleed levels of 2% are often specified, although Jefferis (1981) stated that bleed of less than 1% can be achieved by a well-designed CB slurry mix. In contrast, **s**lurries with bleed levels of 5% and above have been branded as unstable. Partial replacement of cement with GGBS has been recommended to reduce bleed level to zero.

In a study by Suckling *et al.* (2011), the causes of bleeding of free water from a bentonite slurry was investigated and the result revealed that the amount of bleed strongly depends on both the degree of contamination and the hydration time. The study concluded that bentonite fluids should be allowed to sit in the storage tank for at least 24 hours after mixing.While it is recognized that permeability remains the most important criterion, it can be impacted by the physical properties of the CB slurry. Therefore, this study determined some critical physical parameters of CB slurries and highlighted the differences in these physical parameters due to different cement types.

Materials and Methods

Materials

The cement samples used in the study labeled CEM I, CEM II and CEM III, adopting the terminology used in European standard FN 196-1 (AFNOR, 2006; ASTM, 2012) was obtained from cement store while CEM I and III were blended in the laboratory with constituents obtained from Dangote cement factory obajana Kogi state. Similarly, the bentonite, a product of Verokebi Ent. Co. Ltd. from India was obtained from a chemical store in Lagos.

Sample preparation

Bentonite was first hydrated with 10% water for 24hours for a rheological reaction that produces a highly colloidal suspension with excellent holding, sealing, and lubricating performances. CEMI and CEM III Cements used were blended in the laboratory using the standard constituent materials i.e, for CEM I and III in a ball mixer. However CEMII used for this research was obtained from Dangote Cement factory, Obagana Kogi state, Nigeria. The cement–bentonite slurry investigated comprised of five different mix ratio of cement (40%, 45% 50%,52%and 55%)with bentonite 10%, 13%, 15%,20% and 25% at w/c ratio of 0.65. The slurry was prepared in laboratory using high speed mortar mixers for 5-6 minutes, to ensure thorough mix following the procedure adopted by Royal *et al.*(2013)and Mesboua *et al.*(2018).

Testing Procedures

Slurry density test was conducted using Barroid's mud balance. On filling the mud cup with slurry specimen, the apparatus was set to balance on the knife edge by adjusting the lever to meet the corresponding density values.

For the slurry viscosity, the test was carried outin a temperature-controlled roomusing viscometer marsh funnel. The 1000ml cylindrical cup was filled with slurry and transferred to the funnel with close orifice. The orifice was opened to release the slurry into the cup. The time taken for the slurry to fill the 100ml cup multiply by the constant 1.8 in second is the slurry viscosity.

Bleeding was tested for 120mins by putting freshly mixed slurry sample in a glass graduated cylinderundisturbed for this period following the procedure in ASTM C 940 (ASTM, 2016). The suspended water level in percentage is the corresponding bleeding of the CB mix.A CB mix is considered stable when the final bleeding is less than 5% after 120mins (Tan*et al*., 2005;Mesboua *et al*., 2018).

Results and Discussion

Characterization of Mixture Constituents

The bentonite consisted of 81.47% montmorillonite with other components such assilica, feldspar and carbonates with the dominating oxides being silicon oxide (48.15%). aluminum oxide (19.42%) and ferric oxide (12.16%).Other oxides present in the bentonite were<1.5% (Table 1 as given by the manufacturer).The values of the specific gravity, liquid limit, and plastic limit of bentonite are 2.92, 430%, and 32%, respectively (Table 2).

The bentonite sample conformed to specification that the reactive SiO_2 content should not be less than 25% by weight (EN 197-1, 2011).

The cements were compliant with standards outlined in the reference guide with minimum strength class requirements of 42.5 MPa.

The chemical compositions determined by X-ray diffraction for the different cements used in the study are presented in Table 3 as given by the manufacturer as well as from laboratory tests. The results in Table 3 show that the predominant constituent in all cement samples is calcium oxide, ranging from 58.13 %for CEM II to 64.09% for CEM I. The specific gravity of the cements are 3.68, 3.12 and 2.92 respectively for CEM I, CEM II and CEM III. On the other hand, the initial setting times of the cements ranged from 72-110mins and final setting times were 190mins, 230mins and 300min respectively. The Blaine specific surface area is 3545cm^2/g.

Table 1: Chemical Composition of Bentonite sample

Chemical Composition (%)	SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	Na_2O	K_2O	SO_3
Value	48.15	19.42	12.16	0.86	1.24	0.63	0.86	0.95

Table 2: Physical properties of Bentonite sample

Properties	**Result**
specific gravity	2.92
liquid limit	430

plastic limit	34
Plasticity index	396
Montmorillonite	81.47

Table 3: Chemical Composition of Cement sample

Chemical Composition (%)	SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	Na_2O	K_2O
CEM 1	19.63	4.71	3.25	64.09	1.17	0.27	0.73
CEM II	16.90	4.96	2.87	58.13	1.96	0.12	0.54
CEM III	34.6	14.3	0.6	43.4	5.1	0.2	0.5

Effect of cement types on Density mixtures

The variation of fresh slurry density of the different mixtures with bentonite content is shown in Figure. Generally, the density of mixtures decreased with higher bentonite content. At 10% of bentonite content, the densities varied from for CEM I, CEMII and CEM III respectively had similar density of about 1.6 g/cm^3 while CEM III had higher density at 1.7 g/cm^3. The density of cement grout depends on the specific gravity of solids (bentonite and cement). Since the specific gravity of cement is greater as compared to bentonite

Remarkably, from 20 - 25% bentonite content, it was apparent that the density values for the different cement types converged, displaying densities that are about 5– 6 times lower than the density at 10% bentonite. Thus, density values for mixtures with the three cement types reduced to 1.5 g/cm^3.

At 15% to 20% bentonite content in the CEM types slurries, density for CEM I and CEM III was gradually reducing, although CEM II maintained almost uniform density from 15% to 25% bentonite content. However it could be observed that at 20% to 25% bentonite content, there is uniformity and sustained density across the three cement types. Generally it was observed that the density was decreasing across the cement types (CEM I, CEMII, and CEMIII) as the bentonite was increased, this observation is in conformity with (Mesboua et al., 2018; Gustin, Karim, & Brouwers, 2007; Sonebi et al., 2012)

Typical cement-bentonite slurry densities can range from 1.09 to over 1.44 gm/cm3 depending on the quantity of cement specified in the mix design ().

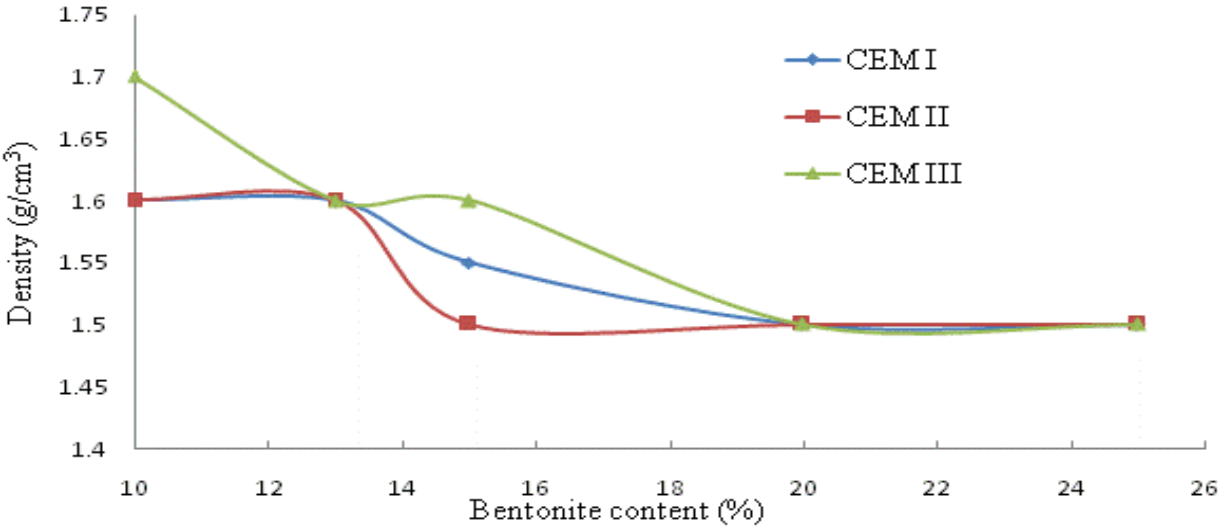

Figure 1: Relationship of Density with Bentonite content for different cement types

Effect of cement types on Viscosity

The result of CEM I slurry indicate that: as the percentage of bentonite was increased (10%-25%) in the cement slurry the viscosity was also increasing (from 34s-44s). Similarly bleeding also increased from (2%-4%). However density decreased (from 1.6-1.5 g/cm^3). Similarly for CEM II slurry when admixed with bentonite, the behaviour indicates that as the percentage of bentonite was increased (10%-25%) in the cement slurry the viscosity was also increasing (from 40s-45s). In the same way bleeding also increased from (2%-4%). However density was almost uniform throughout (1.5 g/cm^3). The CEM III slurry when admixed with bentonite, the behaviour indicates that as the percentage of bentonite was increased (10%-25%) in the cement slurry the viscosity was decreasing (from 50s-445s). Similarly bleeding decreased too (from 4%-3%). Nevertheless the density was not uniformly distributed but averaged at (from 1.4g/cm^3).

It can be observed that the Viscosity of the slurries across CEM I, CEMII and CEM III at various percentage content of the bentonite shows that at 10% bentonite content CEMI had the lowest viscosity at less than 35 s while CEMII viscosity was higher with 40 s viscosity and CEM III had the highest viscosity of about 48 s. At 15% bentonite content in the slurry across the CEM types, CEM I Viscosity steadily increased as the bentonite content was increasing from 15 to 25% peaking at 25% CB with viscosity at about 43 s. While CEM II and CEM III was decreasing from 45s and 50s respectively to 45s as CB was increased from 15% to 25% respectively. The plot also shows that CEM III had the highest viscosity followed by CEM II and CEM I had the lowest viscosity. From the plot the viscosity of CEM II which is the most commonly used cement shows that viscosity increased as the bentonite increases from 10% replacement to 25% replacement, this result is in conformity with Benyounes, (2019) who observed that the rise of bentonite content leads to the increase of infinite viscosity, he further asserted that this behaviour is an indication of a high degree of interaction between bentonite and cement particles for high bentonite content in which for this study is 25% bentonite content. and also Çelİk and Canakci, (2015) who found that the plastic viscosity of grouts increases with increasing of RHA content regardless of the w/b ratio.

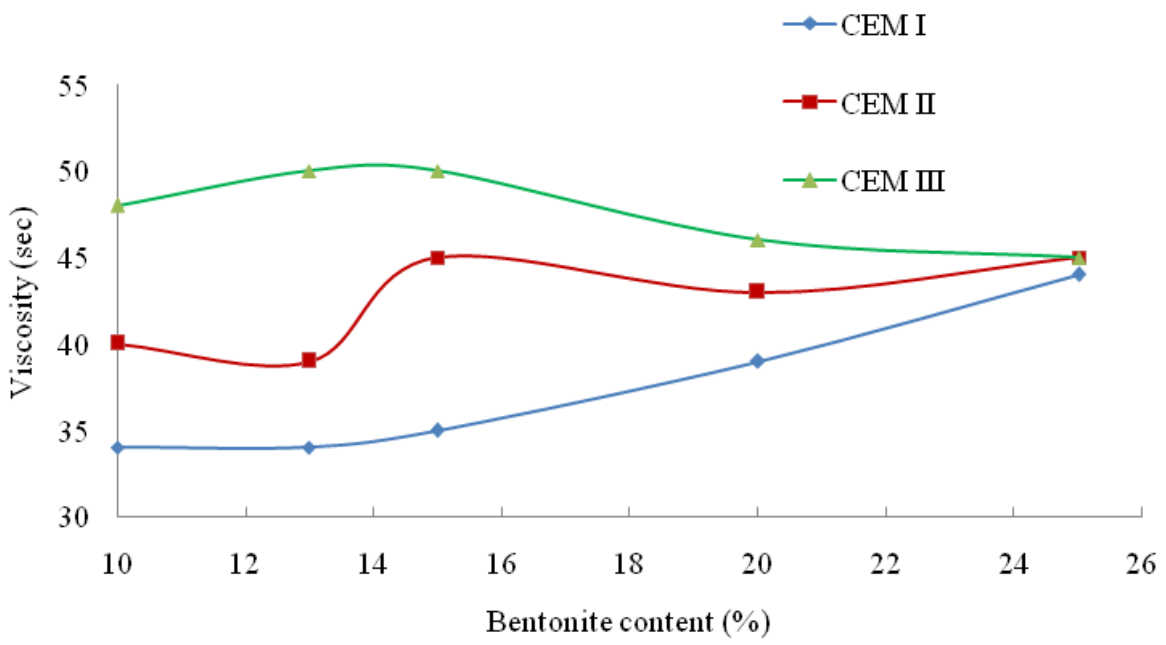

Figure 2:Variation of Viscosity with Bentonite content for different cement types

Effect of cement types on Bleeding

The variation of bleeding of mixtures with bentonite content is illustrated in Figure 4. The results indicate that bleeding was found to reduce as bentonite content increased across CEMI, CEMII and CEM III. The results also show that at each bentonite content, CEM III produced the highest bleeding whereas CEM I had the lowest value. For example, at 10% bentonite content, the bleeding of CEM I was 2.7% while CEM II and III had 2.8% and 3% bleeding rates respectively. This results are in agreement with values reported by past researchers (Suckling *et al*., 2011;).

Bleeding rate for the various mixtures decreased up to 20% bentonite content when bleeding rates maintained constant values up to the highest bentonite content (25%) adopted in the study.This suggests that the optimum mixture in terms of bleeding for CEM I, II and III was achieved at 20% bentonite content.

In general, it can be observed that the bleeding of the CB slurries for the various cement types did not exceed 5% at which slurries/grouts are considered unstable (Mesboua *et al*., 2018).

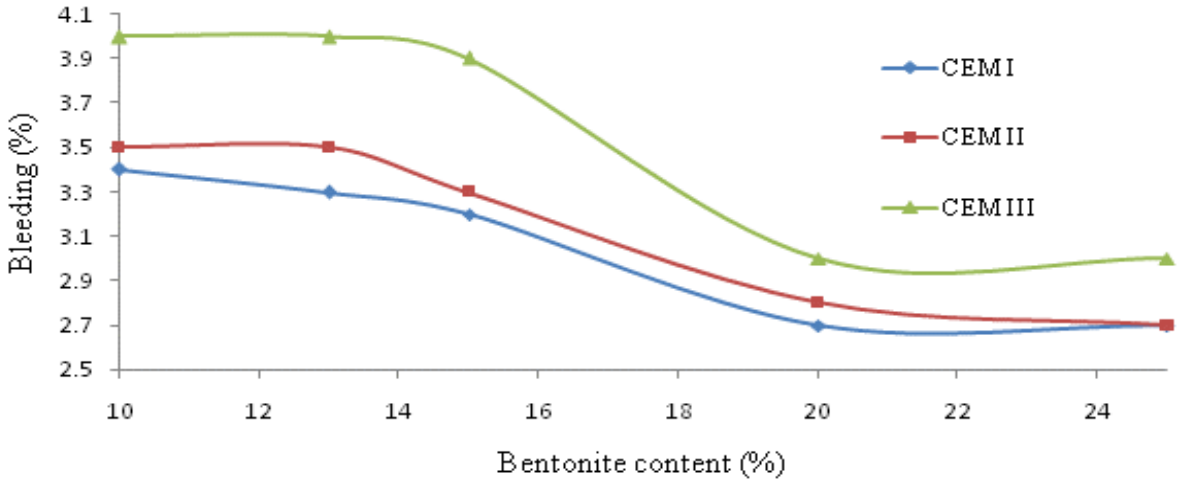

Figure 3: Variation of Bleeding with Bentonite content for different cement types.

Conclusion

An experimental study on physical properties of Cement-Bentonite Slurry made from selected cement types was carried out. From the results, the following conclusions were drawn:

- Density results also show that the bentonite had a remarkable effect on the density of the mixtures that make it attractive for use as a lightweight cementatious material.
- Viscosity results show that the bentonite increased the viscosity of mixtures which indicate high resistance to seepage. While CEM I recorded the lowest viscosity, specimens containing CEM III produced the highest viscosity values.
- From bleeding test results, bentonite content was found to reduce bleeding across CEMI, CEMII and CEM III. However, the optimum mixture in terms of bleeding for the three cement type is at 20% bentonite content.

With regards to recommended threshold values specified in most codes guiding the use of CB slurries, all physical parameters of mixtures measured in this study produced favourable results although CEMIII produced superior values at 10% Bentonite content of 1.4g/cm^{3,} 3, 48 of density, bleeding and viscosity respectively over the others.

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