

FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA

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9TH SSTE HYBRID International Conference

THEME:

RE-THINKING THE FUTURE THROUGH

STEM AND TVET

FOR ACHIEVING SUSTAINABLE DEVELOPMENT GOALS

Conference PROCEEDINGS

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ACKNOWLEDGEMENTS

Local Organizing Committee of the 9th 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 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 to participate 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 worthnoting 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, "Re- thinking the Future through STEM and TVET for achieving Sustainable Development Goals"are based on the prevailing circumstances 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 and poverty Reduction
- STEM and TVET for Hunger Reduction
- STEM and TVET for Sustainable Clean Water and Sanitation
- STEM and TVET for Affordable and Clean Energy
- STEM and TVET for Improving Industry, Innovation and Infrastructure
- STEM and TVET for Achieving Gender Equality
- STEM and TVET for Reducing Inequality within and among Countries
- STEM and TVET for Quality Education
- STEM and TVET for Sustainable Consumption and Production Patterns
- I. C. T. in STEM and TVET for Sustainable Development
- Communication in STEM and TVET for Sustainable Development
- STEM and TVET for Combating Climate Change and it's Impacts
- STEM and TVET for Good Health and Well-Being
- STEM and TVET for Conserving Life on Land and Below Water

The Local Organizing Committee is thankful to the participants of 2023 conference for their contributions.
God bless you all.

Prof. I. Y. Umar
LOC Chairman

WELCOME ADDRESS PRESENTED BY THE VICE CHANCELLOR, PROFESSOR FARUK ADAMU KUTA AT THE OPENING CEREMONY OF THE 9TH INTERNATIONAL CONFERENCE OF THE SCHOOL OF SCIENCE AND TECHNOLOGY EDUCATION (SSTE), FEDERAL UNVERSITY OF TECHNOLOGY, MINNA, NIGER STATE, NIGERIA 2nd - 6th OCTOBER, 2023

On behalf of the Governing Council, Management, Staff and Students of Federal University of Technology, Minna, I am pleased to welcome you to the 9th International Conference of the School of Science and Technology Education of this University. I would like to extend a warm welcome to all the distinguish speakers at this conference, in particular, the Keynote Speaker, Prof. Padma M. Sarangapani, Chairperson of the Center for Excellence in Teacher Education, Tata Institute of Social Sciences, Mumbai, India, and, the Lead Paper presenters, Prof. Hassan Bello, Dean, Faculty of Technology Education, Abubakar Tafawa Balewa University, Bauchi, Nigeria; Prof. AsfaM. Yasin, Director Education, KGN School of Excellence, Bhopal, India; Prof. Nobert Jere, Walter Sisulu University, Eastern Cape, South Africa, and Prof. Rohaida M. Saat, Department of Mathematics and Science Education, Faculty of Science Education, University of Malaya, Kuala Lumpur, Malaysia. This is an impressive lineup of speakers! Also, to all participants who have come from far and near, welcome to this annual Conference which over the years has served as platform for scholars to come together to share their researches on matters of vital concern to the progress of human society.

This year is not an exception, especially when we take into consideration the theme of the Conference which is "Re-thinking the Future through STEM and TVET for Achieving Sustainable Development Goals". As enunciated by UNESCO, Sustainable Development is expected to "meet the needs of the present, without compromising the ability of future generations to meet their own needs. Consequently, this theme is of particular relevance as the world continues to grapple with a variety of challenges that have to do with economics, social development and the environment.

Sustainable Development Goals (SDGs**)** encompass 17 concerns which include Economic diversification and poverty reduction (SDG 1), Zero hunger (SDG 2), Good health and well-being (SDG 3), Quality education (SDG 4), Gender equality (SDG 5), Clean water and sanitation (SDG 6), Affordable and clean energy (SDG7), Industry, innovation and infrastructure (SDG 9) among others. You will agree that our collective ability to achieve these laudable goals would make a tremendous difference to the quality of life for all people around the world, and indeed, even more so in the developing countries of Africa and Asia that are beset with a myriad of competing challenges.The urgency to address these matters was highlighted by Antonio Guterres, the Secretary-General of the United Nations when in 2019, he issued a global call for a *Decade of Action* to deliver the Sustainable Development Goals by 2030. This decade commenced in 2020 to end in 2030, and already, we are rapidly moving into 2024 which means that much has to be delivered in the next six years.

Setting these Sustainable Development Goals (SDGs) is meant to mobilize networks across countries in order to galvanize knowledge and practice into concrete results that will impact on lives and livelihoods. Therefore, if we seek the most appropriate education that is aimed at developing knowledge, awareness, and action for the SDGs, then both STEM (Science, Technology, Engineering and mathematics) and Technical and TVET (Vocational Education and Training) are best positioned to provide solutions that will solve daily life problems, discover new technologies and create career opportunities. This because STEM and TVET education foster critical thinking, problem-solving, creativity, innovation, collaboration, communication and ethical awareness that are essential for the achievement of sustainable development.

The focal drive of this Conference is to exchange ideas and by participating in this exchange on a wide range of related topics, it is hoped that all participants will benefit from the conference experience and would go on to apply the knowledge gained in meaningful ways. So, ladies and gentlemen, scholars, researchers, thank you for being here and for lending your expertise to this important Conference. Thank you also to the Dean of the School of Science and Technology

Education, Professor Amosa Isiaka Gambari and the Conference organizing Committee led by Prof. Ibrahim Yakubu Umar for maintaining the momentum of this important annual Conference.

Again, I welcome you all to Federal University of Technology, Minna and wish you an interesting and very productive Conference.

Thank you.

A WELCOME ADDRESS DELIVERED BY PROFESSOR AMOSA ISIAKA GAMBARI, DEAN, SCHOOL OF SCIENCE ANDTECHNOLOGY EDUCATION, FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA, NIGERIA, AT THE OPENNING CEREMONY OF THE 9TH INTERNATIONAL CONFERENCE OF THE SCHOOL 2ND-6TH OCTOBER, 2023.

I, on behalf of the staff and students of School of Science and Technology Education (SSTE) welcome you all to the 9th international conference of the school. I sincerely appreciate the Chairman, the chief host, and our hardworking Vice- Chancellor for providing the favourable environment that facilitates the hosting of this conference at its usual time of the year.

I seek the indulgence of the Chairman, the distinguished guests, staff of the school and students to join me in appreciating the Keynote Speaker, Professor Padma M. Sarangapani of Tata Institute of Social Sciences, Mumba, India and the Lead paper presenters, Prof. Hassan Bello of Abubakar Tafawa Balewa University, Bauchi, Prof. Asfa M. Yasin of PSS Central Institute of Vocational Education NCERT Bopal, India, Prof. Nobert R. Jere of Walter Sisulu University, South Africa and Prof. Rohaida M. Saat of University of Malaya Kuala Lumpur, Malaya. We appreciate your presence and valuable contributions to this conference. These speakers were carefully selected due to their academic and professional contributions to the field of Science and Technology Education across the globe. I also appreciate all the participants who are physically or virtually connected to the conference to make it a success. I wish you very fruitful deliberations.

Education is a veritable tool for national and human development as it promotes peace, unity, economic, technological, and social development, among others. Undoubtedly, no human, physical and technological development can take place anywhere in the world without education. This is because knowledge, skills, health, wealth, good government and healthy relationship are all products of education.

Science and Technology Education is an important factor to the technological growth and stability of every nation's economy, irrespective of its size or status. It is therefore worthwhile to expose our generation to the benefits and developments of the 21st century. Thus, the 9th International Conference is apt as it will bring together experts, all over the world, to deliberate on emerging trends in STEM and TVET in the 21st century world of Science and Technology considered to be the driving factors of economic growth and development.

The Theme of the conference "Re- thinking the Future through STEM and TVET for achieving Sustainable Development goals" and the several relevant sub- themes of this conference were carefully selected to address the challenges of the present Nigeria and by extension, the entire world as well as the anticipated future challenges. A thorough research, innovations and deliberations into these areas will, in no doubt, provide the desired solutions and the way forward for addressing these challenges for a better 21st century and beyond.

This conference has great interest in capacity building and innovation as modern trends emerge in STEM and TVET. The conference covers current and fundamental issues that relate to research and innovations in science and technology in line with the realities of the contemporary society.

The urgent needs of education in the present day are the necessary skills designed to develop the learners to the top of the ladder of scientific breakthrough in education and technology. Nigeria needs a curriculum where new things in science and technology will be enshrined, where provisions for laboratory or technology study materials are adequately provided, where students have trending materials for reading and writing, and where technological development will be ensured. The various sub- themes of this conference cover such interests, from both local and international perspectives to

equip teachers, learners, education stakeholders and policy makers to revolutionize the curriculum and renew initiatives.

Ladies and gentlemen, you are once again welcome to the conference. I express my heartfelt gratitude to the Vice- Chancellor of this great and dynamic university and his management team for their contributions to our conferences. I am very 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 of this conference. To all the participants, both physical and virtual, I wish you a very successful deliberations and a fruitful outcome.

Thank you very much for your attention.

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Lead Paper Presenter 1

RE-THINKING THE FUTURE THROUGH STEM AND TVET FOR ACHIEVING SUSTAINABLE DEVELOPMENT GOALS.

BEING A LEAD PAPER PRESENTED AT THE 9TH HYBRID INTERNATIONAL CONFERENCE, FEDERAL UNIVERSITY OF TECHNOLOGY MINNA, NIGER STATE, NIGERIA ON THE 03RD OCTOBER, 2023

PROFESSOR HASSAN BELLO
Dean Faculty of Technology Education, ATBU, Bauchi

Protocols

- The Chief-host: Vice-chancellor FUT, Minna: Prof. Faruk Adamu Kuta,
- Host: The Dean, School of Science and Technology Education: Prof. Gambari A. Isiaka,
- The Chairman and Members of the Local Organizing Committee,
- Principal Officers of the University,
- Distinguished Dignitaries,
- Members of the Academia,
- Ladies and Gentlemen.

Introduction

I am extremely happy to welcome you all. I feel greatly honoured and elated to stand before you as the Lead Paper Presenter for this HYBRID International Conference organized by the SSTE. As you are all aware, the theme of the conference is: *`Re-Thinking the Future through STEM and TVET for Achieving Sustainable Development Goals (SDGs).*

My esteemed colleagues in the academia, you will all agree with me that it is only through education individuals become civilized, refined, and cultured. For a civilized and socialized society, education is the only means. The goal of education is to make an individual perfect. Education is indeed a systematic process through which a child or an adult acquires knowledge, experience, skills and sound attitude (Ajibola & Jumoke, 2012). Tertiary education in Nigeria consists of universities, polytechnics and colleges of education which offers variety of courses for students to choose from. STEM and TVET courses are no exception. The teacher also, is an important personality in a nation when we talk of economic development, as no nation can rise without the right caliber of teachers (FGN, 2013). Whatever policy Government intends to achieve, that policy can be more meaningfully achieved through effective and well-coordinated system of education as the instrument for change. Especially, countries that are furthest behind have now adopted what is known as the 'Global Goals' with the view to end poverty, hunger, AIDS …etc., United Nations (2020). Nigeria is one of these Nations.

The major concern of Nigeria since independence has been the quest for national development. Various policy measures such as: Operation Feed the Nation launched by the military government in 1976 to achieve self-sufficiency in food production; establishment of the Directorate of Food Road and Rural Infrastructure (DFRRI) in 1986 to execute rural development programmes; National Directorate of Employment (NDE) in 1986 to promote employment programmes all over the country; National Poverty Eradication Programme (NAPEP) in 2001 to address poverty and related issues in Nigeria; National Economic Empowerment Strategy (NEEDS) 1n 2003; National Environmental Standards and Regulations Enforcement Agency (NESREA) formed in 2007 to ensure cleaner and healthier environment for Nigerians; and recapitalization of banking industry have been evolved to ensure steady economic growth and development. There are also, similar efforts in other sectors recently like education, business enterprises, power, transport and health. All these efforts have been constrained by lack of holistic approach to their implementation. The development landscape is presenting Nigeria's policy makers with new challenges such as: food security, water scarcity, population growth,

unemployment, inflation, insecurity, debt burden, and environmental degradation. It is in the contest of these issues; the sustainable development agenda was evolved by the United Nations.

In this paper, attempt would be made to explore Sustainable Development; some of the Nigeria's transformative actions to achieve Sustainable Development, and challenges at stake. An attempt would also be made to understand what STEM and TVET are all about, and whether sustainable economic growth can be achieved through STEM and TVET in Nigeria and the world over.

Role of the United Nations and the 2030 Agenda

The United Nations (UN) is an intergovernmental organization with193 member states and two observer states, established 25th April, 1945 after the World War II with the aim of preventing future world wars. UN succeeded the League of Nations whose stated purposes are to: maintain international peace and security, develop friendly relations among nations, achieve international cooperation, and serve as a centre for harmonising the action of nations (United Nations Charter, 2023). In 2015 the ***United Nations*** adopted the collection of 17 interlinked objectives known as the Sustainable Development Goals (SDGs) or the 'Global Goals' as a universal call to action to ending poverty, protect the planet, and ensure that by 2030 all people enjoy peace and prosperity.

These goals are: *no poverty; zero hunger; good health and wellbeing; quality education; gender equality; clean water and sanitation; affordable and clean energy; decent work and economic growth; industry, innovation and infrastructure; reduced inequalities; sustainable cities and communities; responsible consumption and production; climate action; life below water; life on land; peace, justice, and strong institutions; and partnerships for the goals (UNDP, 2022).* Although some have no end date, most targets are to be achieved by 2030.

SDGs (a brain-child of the UN) is a global and a nonprofit organization formed by the United Nations General Assembly (UNGA) as part of the Post-2015 Development Agenda (creating a future global development framework) to succeed Millennium Development Goals (MDGs) which ended that year. On the 6th July, 2017 the UNGA identifies specific targets for each goal and provides indicators to measure progress. In June 2018, High-Level Political Forum on Sustainable Development (HLPF), an organ of the UN, launched an 'online SDGs tracker' to help present available data on progress of the SDGs implementation across all member nations. The International Monetary Fund (IMF) is one of the strongest bodies that offers support to low-income developing countries towards achieving the SDGs (SDGs Index, 2020).

Criticisms About The 17 Goals

Since inception, critics and observers have identified trade-offs (balance between two desirable but incompatible features) between some of the goals. Such as between ending hunger and promoting environmental sustainability. Other concerns include being too many goals to achieve within a specified period of time. There are cross-cutting issues and synergies between the different goals couples with some Implementation constrains in many of the developing countries.

Sustainable Development

Sustainable Development involves two seemingly incompatible terms: Sustainability and Development. Sustainability, in the dictionary of English means 'ability to be maintained or improved to certain level without degradation'. While, development on the other hand, refers to 'a ceaseless or constant process of transformation'. Sustainability can be implemented environmentally, economically and socially. According to Goulet (1971), development has three major components: life sustenance, self-esteem and freedom. Thus, the measure concern of development should be to raise people out of poverty and providing basic amenities for live.

Sustainable Development is an idea that was first used in 1980, by the International Union for the Conservation of Nature (IUCN) as an approach which has now became a matter of great concern globally. Cameron (1993) states that, sustainable development entails the progressive economic and social development of human society through maintaining the security of livelihood for all peoples and

by enabling them to meet their present needs, together with a quality of life in accordance with their dignity and well-being, without compromising the ability of future generations to do likewise.

According to World Bank (2000), Sustainable Development is concerned with political mobilization, and the twin issues of environmental protection and economic development. It embodies the notion and ideals of a development process that is equitable and socially responsive, recognizing the extensive nature of poverty, depreciation and inequality between and within nations, classes, and communities. It also, seriously advocates that the world be seen as one eco-system and advocates that economic development process should include ecological and environmental issues as an essential component.

Summarily, sustainability is often thought of as a long-term goal with lots of processes and pathways to achieving it. Also, the main aim of development is improving the quality of life to enable citizens realise their potentials and that, development is real only if it transforms human lives better.

It is absolutely, clear from the foregone analysis, that Nigeria is not yet sustainably developed. This could be due to numerous challenges bedabbling the country that would be examined later in this presentation.

Overview of Transformative Actions to Achieve SDGS in Nigeria

The implementation of 'Global Goals' for all kicked off in January, 2015. Voluntary National Review (VNR) are annual reviews that are being presented at the UN High-level Political Forum (HLPF) meetings on SDGs. In 2017, 2020, 2021 and 2022 Nigeria was among the member nations that presented its Voluntary National Review (VNR) on the implementation of the 2030 Agenda. Summarily, the reviews focus on:

Goal 3: Good Health and Well-being - *The Nigeria Economic Recovery and Growth Plan (ERGP) was launched in 2017. Among its goals are: reviving economy from current recession and the reduction of maternal mortality ratio to 70/100,000 live births.*

Goal 4: Education- *The implementation of the State Universal Basic Education Board (SUBEB) in 2016 to ensure free Universal Basic Education for every Nigerian child of school-going age.*

Goal 5: Gender Equality- *In 2000, Nigeria passed into law the National Policy on Women for the Elimination of All Forms of Discrimination Against Women (CEDAW).*

Goal 6: Clean Water and Sanitation- *According to UNICEF, poor water supply and sanitation cost the Nigerian economy approximately 1.3% of the annual GDP.*

Goal 7: Affordable and Clean Energy- *Nigeria claims to achieve a 13% contribution of hydroelectricity; 1% of wind energy and 3-6% of solar energy to the electricity generation mix by 2020.*

Goal 9: Industry, Innovation and Infrastructure- In 2013 *Small and Medium Enterprises Development Agency of Nigeria (SMEDAN) report showed that there are over 70 million Micro Small and Medium Enterprises (MSMEs) contributing 50% of the nation's GDP.* But it was noted that less than 5% of these businesses have adequate access to financial credit.

All these policies are measures for sustainable development in Nigeria. What then are the challenges?

Challenges to Sustainable Development in Nigeria

Even though, Nigeria is steadily working on its economic challenges as it aspires to be among the top economies in the world someday, there are still many problems hindering the country from realizing its full potential. Some of which are as follows:

1. **Ranking:** Based on the SDGs Voluntary National Review annual report, Nigeria as a member nation was ranked number 160 in 2020 and number 139 in 2022 out of the 193-member nations (SDGs, 2020 & 2022) respectively. That is why some economic problems in Nigeria are reducing while, others are gradually worsening.
2. **Prolong Conditions of Poverty:** One of the greatest challenges of Nigeria is that of evolving progammes to free the vast majority of Nigerians from poverty. As it is, many Nigerians are wallowing in abject poverty and are not taking the daily three-square meal regularly. To achieve sustainable development, poverty must be eliminated such that low-income earners could afford nutritious food to sustain a living. Ending poverty in Nigeria would mean improving access to education, healthcare, clean water, and sanitation (Ortega, 1990).
3. **Poor Funding of Education:** In an assessment reported by the UN Summit for Refugees and Migrants (2016), 'Nigeria has the highest rate of 10.2 million out of school children in the continent of Africa (next to India in the league of poor performing nations)'. Many of whom were in the North, displaced from homes as a result of terrorists' attacks by Boko Haram and Bandits, and are now refugees as internally displaced persons.
4. **Inflation and debts:** Inflation and debts have also, affected Nigeria's economy and commercial activities mainly due to the country's dependence on crude oil as the major source of income. Couples with Nigerian government increased borrowings from the international capital market with the view to offsetting the budget crunch caused by the ongoing revenue shortfalls.
5. **Corruption:** corruption is another greatest threat to Nigeria's development. It becomes a means of living for many Nigerians. That calls for Obasanjo's Anti-corruption act of 2000. Unfortunately, corruption has eaten deep into the fabric of our societies. For instance, Nigeria in 2019 made about $47 billion from mineral fuels, oils, and distillation products. But these natural resources promote corruption and poverty instead of economic development, leaving millions impoverished.
6. **Insecurity and Joblessness:** The Global Terrorism Index (GTI) in 2020, rated Nigeria as the world's third worst country with insecurity and insufficient jobs. Millions of people in Nigeria, mostly youths, are jobless. Unemployment creates additional problems, including increased crime rates and suicides thus, affecting economic growth. Instances are inter-tribal and intra-tribal wars and religious crises between the Tiv and Jukun in Taraba, farmers and pastoralists in Jigawa; and the Bauchi crises in 1991, Kaduna in 2000 and Jos in 2004, respectively.
7. **Poor Health System:** Nigeria faces lots of health challenges, which include: infectious diseases, maternal mortality, fatality rate, poor sanitation, non-communicable diseases, and poor funding of the health sector, leading to the migration of many Nigerian health personnel to abroad for greener pasture.
8. **Environmental Degradation:** This result mostly due to poor leadership, mismanagement of resources and inconsistent policies about environment. For instance, the destruction of forest and emission of toxic materials in the Niger Delta site due to poor exploitation of crude oil and gas in the region. In the northern region, there were, incessant bush barning, poor farming techniques, and wood harvest for fuel couple with the emergence of bandits from rural areas. In the eastern and the southern part, there is gully erosion, densely population and dangerous activities of the Indigenous People of Biafra (IPOB) respectively. These phenomena caused heavy demand for importation of farm products and the dependence of one region on the other for food supplies. The agrarian system in those areas is gradually being destroyed thereby, putting the life of many Nigerians at risk.

These and many other challenges must be overcome if Nigeria is to be sustainably developed.

Achieving Sustainable Economic Growth Through Effective STEM and TVET Programs

Based on the aforementioned state of things, it becomes paramount for Nigeria as a nation to rethink about ways forward for it to be sustainably developed by the year 2030 and beyond. To build a more sustainable Nigeria, our attitudes and behaviours must change at different levels: individual, community, regional, national and global. The role of education in this regard would never be overemphasis. Thus, attention can be positively directed towards addressing issues and problems in

different areas of live by embracing effective STEM and TVET programs (as practice in many developed countries of the world). No doubt, Sound STEM and TVET education as drivers would instill creativity, knowhow, technology and peace in our societies necessary to achieve the SDGs in every context. What then are STEM and TVET all about?

Concept, Definition and Prospects of Stem

STEM is an acronym for Science, Technology, Engineering and Mathematics, said to have been coined by Dr Judith Ramaley of the American National Science Foundation as a shorthand for the four subjects in the acronym. STEM according to Tsupros, Kohle & Hallinen (2009) is an educational programme developed to prepare primary and secondary students for college, graduate study and careers in the field of science, technology, engineering and mathematics (STEM). But, in recent years however, the definition has changed beyond being an acronym. There is a paradigm shift from the traditional teacher-centred classrooms which treat these subjects in bits and pieces. STEM aims at fostering inquiring minds, logical reasoning and collaboration (Fomunyam, 2019 and Rahangmetan, 2021).

Former President Obama (in Ubawuike, 2018) once states that STEM is more than school subjects, he refers STEM as a critical way of understanding and exploring the world, and having the capacity to change it and share the accumulated knowledge. The goal of STEM programs is to increase the supply of qualified high-tech manpower in the country, support innovation, improve competitiveness globally and strengthen economic growth. Shirke (2021) define STEM as education that include the following seven standards of practice or skills:

- ✓ Learn and apply content
- ✓ Integrate content
- ✓ Interpret and communicate information
- ✓ Engage in enquiry
- ✓ Engage in logical reasoning
- ✓ Collaborate as a team
- ✓ Apply technology appropriately.

STEM integrate multiple disciplines and train students how to use cross-disciplinary knowledge in solving problems. It promotes learning-by-doing approach that encourage students' participation in real-world projects. Most STEM majors acquire rigorous problem-solving skills, which are useful in almost any occupation. STEM also, offers students a chance at higher paying jobs in the following areas:

Computing (Computer system analyst, database administrator, I.T director, network administrator, software developer); **Engineering** (Audio engineer, biomedical engineer, civil engineer, electrical engineer, petroleum engineer, etc.); **Physical science** (Chemist, cartographer, agricultural technician, physicist, science teacher, etc); **Life science** (Anesthetist, clinical research associate, oceanographer, orthodontist, science teacher, etc); **Mathematician** (Accountant, economist, financial analyst, statistician, math teacher, etc).

Concept, Definition and Prospects of TVET

On the other hand, TVET is an acronym for Technical Vocational Education and Training. According to UNESCO, a hallmark feature of TVET is that it involves "in addition to general education, the study of technologies and related sciences as well as the acquisition of practical skills, attitudes, understanding, and knowledge relating to occupations in various sectors of economy and social life". TVET may occur in educational (schools) or professional (workplace) settings. It combines formal (theoretical learning that often takes place in the classroom) and informal (this refers to self-directed education that is practical, such as internships and on-the-job experiences) learning to equip students with the knowledge and skills needed in the workplace, with a focus on the technical aspects. When it comes to defining TVET there are notably six key features to take into account (Tom & Norton, 2016):

a) **Employer-centric** – whereby most training providers and institutions have a partnership and cooperate to ensure training outcomes are employability based.
b) **Flexibility** – Within a regulated framework, training providers are relatively autonomous in how they deliver training and students can be given the flexibility to work and study simultaneously.

c) **Quality** – TVET providers are to commit to quality education. The public generally has access to high-quality inspection reports which encourage and reward high performance among TVET institutions.
d) **International** – TVET within the global access where the international community can join courses as students or trainers.
e) **Accessibility** – Where frameworks for complete student support, community involvement, staff development, and technology use are enforced.
f) **Economic Development** – TVET institutions collaborate with local agencies and employers to ensure economic growth is facilitated

Technical Vocational Education and Training (TVET) is the type of education and training that focuses on providing students with practical skills and knowledge for a specific trade or vocation. This type of education prepares individuals that are looking for a more hands-on, practical approach to learning to get into a specific career as quickly as possible. TVET help fill skills gap in the job market, leading to a wide range of career opportunities, and facilitate lifelong learning and career development (Tom & Norton, 2016). In addition, TVET play a vital role in supporting economic growth and development at both the individual and community levels. Some of the TVET occupations include: people who work as **technicians**, **carpenters**, **bricklayers**, and **electricians**. Examples of other such professions include **chef**, underwater **welder**, **piping expert** (in the oil and gas industry), and **dressmaker**.

The value of TVET is widely acknowledged. For instance, Germany, Austria and Switzerland have world renowned dual TVET systems, Canada has excellent reputation for TVET in their community college system, and Finland has the world leading education system in which TVET has major role. Also, Singapore with no natural resources has grown into a south East Asian powerhouse due to intelligent policy decisions regarding public-private collaboration in TVET. Last but not least, Chinas phenomenal growth is partly based on a heavy focus on TVET.

Present Status of STEM and TVET in Nigeria

Formal STEM and TVET in Nigeria are currently operating in an environment characterized by:

1. Unstable Staff, the problem is no longer unavailability of teachers but their instability. Due to the poor earnings of teachers, many people use teaching professions as a stepping stone to more attractive jobs.
2. STEM and TVET education involve lots of practical activities for students to learn hands-on approach to issues. In general, the quality of training is low, with undue emphasis on theory and certification rather than skill acquisition and proficiency testing.
3. The explosive enrolment due to the UBE programme has resulted in overcrowded classrooms and in most cases; the school environment is not conducive for learning, thus, making students uninterested in school work.
4. In rural areas as well as in Northern part of Nigeria, students do not have access to up-to-date libraries, laboratories, and technical workshops which are necessities for learning.
5. Lack of digitalization in Nigeria education system. Most public schools in Nigeria have not been upgraded in the use of ICT in teaching. Although, federal government has included ICT education in the curriculum, but its application has been discouraging. In this technology driven age, everyone requires ICT competence to succeed.
6. Nigeria schools in the teaching of STEM and TVET, suffer brain drain to other developed countries like Canada, USA, Australia, and so on, for greener pasture. The government remain adamant about the damage this phenomenon is making.
7. Incessant strike actions as a result of lecturers demanding salary increment or failure of the Government to fulfil important obligations. Students also, indulge in this action advocating for better learning environment or decrease in registration fees. This creates imbalance in academic session.
8. There is mismatch between training and labour market skills demand due to lack of collaboration between the training institutions and industries. This account for high incidence of unemployment among graduates from formal school system.
9. There is gross under funding for both STEM and TVET programs in Nigeria probably, due to expensiveness of training equipment and materials involved.

Recommendations

For both STEM and TVET to play a greater role in achieving sustainable economic growth, Nigeria should reposition their status for the better by addressing the following:

1. The curriculum in Nigerian schools must go beyond content knowledge, it should contain skills of the 21st century, such as reasoning, creativity, analytic and so on, to foster industrial revolution.
2. Government at all levels, should invest more in the education sector to cater for facilities, adequate remuneration, and bursary award to aid smooth studentship in place of giving loans to students of tertiary institutions.
3. Establishing strong linkage and collaboration between training institutions and the industries to enable STEM and TVET teachers update their work experience.
4. Strengthening the link between formal and non-formal TVET by designing standard non-formal vocational training centres, and practical examinations to certify the knowledge obtained. ***For the SDGs challenges:***
5. Nigeria can resolve the lingering debt burden by approaching IMF and other lenders in the international capital market with a policy support instrument, debt conversion, and debt restructuring proposals.
6. The Nigerian Electricity Regulatory Commission (NERC) should upgrade its power generation, transmission and distribution equipment, and allow private companies' investment in electricity, this will increase power supply and boost industrialisation in the country.
7. The government should promote transparency in public procurement processes and allow anti-corruption commissions, bureaus, and tribunals to conduct fair investigations into corruption cases without political influence.
8. To impede crime and terrorism in the country, government should create employment for youth and cut channels terrorists use to get weapons and finances to commit crimes.
9. Government should invest in tertiary healthcare education to increase the number of medical professionals and the procurement of standard healthcare facilities and infrastructure.

Conclusion

The main aim of development is to improve the quality of life of the citizens. This paper concludes that Sustainable Economic Development is yet to be achieved in Nigeria. Despite several efforts since independence in 1960, the 63 years of development in Nigeria have revealed a number of challenges policy makers must overcome in order to achieve sustainable development in the 21st century. These include: Low quality education system, prolong-poverty, corruption, inconsistent economic policies, unemployment, poor health system and environmental degradation.

STEM and TVET education are necessities for growth and development in any country. No doubt, the future of this country lies in the knowledge and practice of STEM and TVET. Therefore, all hands must be on deck to ensure that our educational practices instill creativity, knowhow, technology and peace in our societies necessary to achieve the SDGs in every context.

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Lead Paper Presenter 2

THE CONFLUENCE OF TVET AND STEM TOWARDS REALIZING SUSTAINABLE DEVELOPMENT GOALS

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Introduction

The Sustainable Development Goals (SDGs) are well known to the world. Some consider the goals too idealistic while some claim their benefits don't reach far enough. Either way, the significance of SDGs has for long been a scholar favorite topic of debate. In recognition of the same discourse, this paper illuminates a niche yet crucial aspect that warrants a detailed discussion by scholars and practitioners of policy: the importance of integrating TVET and Science Technical Education and Mathematics (STEM) in realizing SDG objectives, globally. Of the 17 Goals, 10 cannot be achieved without a STEM skill set. These include:

1. *Good Health and Well-Being*
2. uality Education
3. *Clean Water and Sanitation*
4. Affordable and Clean Energy
5. Decent work and Economic Growth
6. Industry Innovation and Infrastructure
7. Reduced Inequalities
8. Climate Action
9. Life Below Water
10. Life on Land

Each of these goals require a workforce trained in STEM and equipped with TVET skills to act as agents and harbingers of a new era. The need for STEM and TVET integration towards SDG accomplishment is also validated by the dynamism of geopolitical fabric and the international economy by extension. A common mistake technical education policy often makes is not paying enough attention to geopolitics or the 'big picture'. While it is important to keep a close watch on relevant industrial changes and opportunities or threats stemming from them, one must also not forget that on a macro level, it is the changing world that affects everything from functioning of industries, employment opportunities as well as partnership promises to SDGs.

One such recent change is the trend of de-globalization. As tensions rise between developed and developing nations, globalization seems to be doing more harm than good especially when skill development is concerned. The outsourcing of skills has left half the world without any STEM competencies or technical skills which are required to meet SDG obligations. We are halfway through 2030 and the latest SDG progress report1 shows that the commitment to SDGs is in 'deep' trouble. One way to rescue the People and Planet is the seamless integration of TVET and STEM in achieving SDGs.

Why is STEM Significant now more than ever?

The International Labor Organization is apt in claiming that since critical thinking, problem solving, and innovation abilities have become an inevitable part of modern world of work, a workforce immersed in STEM capabilities will provide a strong backbone, capable of withstanding economic stresses2. A perfect case in point for this is the case of USA moving its Apple manufacturing from China to India. The deteriorating US-China relations have laid bare the lack of technical skills in USA's workforce which it needs to fulfil its SDG promises as well as for facing economic pressures.

For decades, USA like many other western countries, has depended on the East for providing cheap labor and set up its manufacturing locations in the "third-world". This is called the 'core-periphery' system of economic dependence between a developed country (core) and the developing countries

(periphery). The core reaps the benefits of the periphery's markets, resources, and cheap labor, often at the cost of the periphery's economic growth. As a result, asymmetrical power relations emerge, reinforcing underdevelopment and poverty in the periphery. However, there has been a departure from an open acceptance of this trend as nations have begun to realize the importance of self-reliance to meet SDG objectives. USA and China are expected to embark on what is being called 'de-globalization'. Deglobalization means reduced inter-dependence on each other for production of goods and services. While this reduced interdependence may not appear ideal in the beginning, yet it is necessary for skill development in STEM skill-lacking countries.

Haiti is another example of a region which may benefit from TVET-STEM integration towards fulfilling its SDG promises instead of relying on outside aid. In 2012, the Global Fund to Fight AIDS, Tuberculosis, and Malaria, and the US-based Centers for Disease Control and Prevention (CDC) mass-distributed Insecticide-treated bednets (ITNs) to combat malaria in Haiti. A few years later, an observational study found no evidence of reduction in malaria due to these aid-imported ITNs3. Millions of dollars were spent on this project just like in several other regions, yet no significant change happened. In fact, the million pouring in aid in places like Congo have made these regions a playground for celebrity humanitarianism4. Places like Congo and Haiti do not need mindless western aid. Instead, they need skill development amongst the local population. The need for ITNs in Haiti could have been used as an opportunity to impart vocational skills and STEM knowledge to locals. An entire job sector could have been created for locally made ITNs. Then, even if the product itself failed, the people would still be left with skills and knowledge to mitigate similar future crises.

Globalization has caused dependence and need for skill development has long been ignored in favor of outsourcing and off-shoring. The emphasis on TVET-STEM is therefore necessary to meet SDG objectives especially now that de-globalization seems a reality. As the core-periphery arrangement becomes redundant and countries aim for self-reliance, de-globalization will generate a fresh demand for technical skill sets all over the world. This will naturally affect domestic industries in the West but more importantly, it will affect the international promise of SDGs. More countries will need STEM and TVET skilled human resource to fulfil its domestic as well as international obligations towards at least the 10 SDGs mentioned above. The following sections of the paper will dive further into the integration of TVET and STEM towards meeting Sustainable Development Goals.

Rescuing the SDGs: The Inevitable TVET-STEM Integration

TVET programs have a strong emphasis on practical skills and hands-on training in a variety of professions and vocational sectors. These programs are intended to equip learners for employment in mechanics, healthcare, beauty and wellness and other technical industries. TVET includes a wide range of non-academic skills and knowledge. STEM, on the other hand, is concerned with academic fields such as science, technology, engineering, and mathematics. In these domains, STEM education stresses conceptual understanding, problem-solving, critical thinking, and creativity. It is natural that the confluence of TVET and STEM will bring together non-academic and academic skill sets to the table and serve as a catalyst in achieving SDG objectives. For instance:

a. *Quality Education (SDG 4):*

Integrating STEM-related subjects into TVET curricula can improve vocational education quality. This method guarantees that students not only develop practical skills, but also a solid foundation in STEM-related knowledge, which promotes critical thinking and problem-solving capacity.

a. *Gender Equality (SDG 5):*

Encouraging women to participate in TVET and STEM programs is critical to attaining SDG 5. Developing focused programs to recruit and retain women and girls in STEM-related TVET programs can aid in closing gender inequalities and advocate for women's rights. 5

a. *Affordable and Clean Energy (SDG 7)*

Integrating renewable energy and green technology training into TVET programs can assist in fulfilling SDG 7 by developing a competent workforce adept to working on sustainable energy projects and increasing access to clean energy solutions.

a. *Skill Development for Decent Work and Economic Growth (SDG 8):*
TVET programs may collaborate with STEM sectors to provide skill training that meets the needs of modern businesses. Offering vocational training in disciplines such as renewable energy, IT, or advanced manufacturing, for example, can assist prepare a workforce for careers in sustainable industries.

a. *Industry Innovation and Infrastructure (SDG 9):*
TVET programs that emphasize STEM skills can help foster innovative enterprises and infrastructure. Graduates with technical competencies in fields such as engineering and technology may help enhance infrastructure, manufacturing, and sustainable technologies through AI and other upcoming tools.

a. *Climate Action (SDG 13):*
TVET programs can train students for professions in environmental and sustainability-related fields. This includes courses in domains like as environmental science, renewable energy, and sustainable agriculture, all of which are critical for combating climate change and reaching SDG 13. TVET can also help nurture 'green skills' in individuals to help combat the alarming climate crises we face today.

a. *Partnerships (SDG 17)*
Networking and cooperation between educational institutions, governments, corporations, and international organizations is essential for successful TVET and STEM integration. Partnerships between the public and private sectors can help with the creation of appropriate curriculum, increased access to resources, and employment prospects for graduates. 6

. *Data collection and Monitoring:*
Governments and organizations may track progress toward SDG fulfillment and make informed policy decisions by using knowledge of data and analytics from STEM sectors. STEM-trained people may contribute to the creation and use of data for long-term growth and help mitigate challenges.

Conclusion
In conclusion, combining TVET and STEM can result in a synergistic approach to education and skill development, aligned with several SDGs. It has the potential to facilitate individuals in preparing for the needs of a quickly changing employment market while simultaneously tackling vital global issues like as sustainable development, innovation, and equality on a macro level.

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Lead Paper Presenter 3

REDESIGNING A STEM-FOCUSED CURRICULUM FOR TVET COLLEGES TOWARDS ACHIEVING SUSTAINABLE DEVELOPMENT GOALS

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Abstract

Technical and Vocational Education and Training Colleges (TVET) have been identified as a driver for skills development. Most TVET Colleges aim to provide technical skills that are vital for economic growth and transformation. In principle the TVET Colleges curriculum is designed to address the specific issues that different communities are facing. However, new problems emerge and as the United Nations (UN) Sustainable Development Goals (SDGs) emerge the TVET Colleges curriculum requires revision. It is also evident that the current SDGs require new Science, Technology, Engineering and Mathematics (STEM) approaches and innovative thinkers and the TVET Colleges have a critical role to play in preparing the future graduates. Thus, the current curriculum needs to be revamped. In this study secondary data using systematic review has been considered. Results shows that there are efforts and initiatives undertaken by TVET Colleges to achieve the SDGs. The study recommends a relook at the current curriculum at TVET Colleges to be redesigned towards attaining the SDGs.

Keywords: Technical and Vocational Education and Training Colleges; Science, Technology, Engineering and Mathematics (STEM), Sustainable Development Goals (SDG); Redesigning; Emerging Trends

Introduction

The agenda to global prosperity encouraged by the United Nations Development Programme countless years ago as the Millennium Development Goals (MDGs), has been replaced by Sustainable Development Goals (SDGs) to reflect existing realities. The Sustainable Development Goals demand for a significant increase in universal engagements. This includes engagements with key stakeholders such as academic institutions and communities. Ina achieving the SDGs, Technical and Vocational Education and Training Colleges (TVET) play a critical role. Irikefe (2021) highlights the position of TVET as real tools to combat and control draught and proliferation of countless crimes across Nigeria, specifically among the youth. Irikefe (2021) found that the instrumentality of vocational training, especially in the form of short-term vocational training, the provision of job-specific starter packs and post-training support, can go a long way in reducing unfriendly events in communities. It is also proven that skills training and empowerment platforms are a focal stage to curb prevalent unemployment, growing poverty, increasing insecurity as well as destabilisation of communities in countries.

Irikefe (2021) reveals that due to the lack of professional skills on the youths, some of them have resorted to committing several terrible crimes to earn a living. Improving livelihoods is key to poverty reduction as the United Nations has acknowledged the next decade a period of action to achieve Sustainable Development Goals (SDGs). Auta (2022) observed the need for a universal partnership with TVET to make sure that the sustainable development goals are realistically achieved. Auta (2022) addresses some dimensions of the SDGs namely economic, social and environmental and regarding to the economy, it advocated for adequate investment in agriculture and manufacturing. Masoabi and Alexander (2021) examines the feasibility of incorporating entrepreneurial teaching into engineering studies at Technical and Vocational Education and Training Colleges (TVET). In addition, students must leave vocational colleges with appropriate entrepreneurial skills to enhance employability and economic growth. In general, vocational colleges ought to provide for labor market-related skills, values and knowledge in response to the economic needs. In some African nations, entrepreneurship training is encompassed, although it is fundamental in its structure. Therefore, the inclusion of entrepreneurship education is obligatory to improve the employability of TVET students. According to Auta (2022) there is a need to build a solid partnership with vocational training institutions to train the unemployed

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without regard to gender, tribal affiliation, religion and disabilities has been highlighted as a solution to some of the challenges facing Nigerian society for sustainable green TVET. His Nevertheless, the connections between global student mobility and sustainable development remain uncertain. Masoabi and Alexander (2021) examines the feasibility of incorporating entrepreneurial teaching into engineering studies at Technical and Vocational Education and Training Colleges (TVET). In addition, students must leave vocational colleges with appropriate entrepreneurial skills to enhance employability and economic growth. In general, vocational colleges ought to provide for labor market-related skills, values and knowledge in response to the economic needs. In some African nations, entrepreneurship training is encompassed, although it is fundamental in its structure. Therefore, the inclusion of entrepreneurship education is obligatory to improve the employability of TVET students.

Relevant Literature

Moreover, the goal of sustainable nutrition, economic growth and development is required by all stakeholders. Ibrahim (2023) recommended the need for increasing funding TVET institutions, improving their quality by incorporating soft skills to meet industrial demands and strengthening public-private partnership. Ovwiroro (2017) pointed out that TVET is fundamental for national and economic enhancement. TVET institutions must be instituted by government at all levels, including multinational corporations and stakeholders from riverine and rural communities to meet the skills needs of industries operating in the riverine and rural communities. Ovwiroro, (2017) recommended that all riverine and rural communities ought to establish vocational education committees to address issues related to the acquisition of vocational skills areas concerned in their communities. In addition, a funding should be available to the government and stakeholders of rural communities to establish TVET institutions and promote economic development.

In addition, a well-coordinated TVET can provide people specifically the youth with the knowledge, skills and competences they need for the jobs. Imparting relevant professional skills can be an effective means of enabling people to seize employment opportunities to prepare them for self-employment. The 2020-2030 Agenda for Sustainable Development has set an ambitious goal within the framework of Sustainable Development Goal (SDG) 4 on quality education and SDG 8 on decent work and economic growth. Under this foundation the competence needs of TVET providers are determined to safeguard that the training meets the needs and opportunities of the labour market. These consist of the use of needs assessment concept to identify and justify needs and task analysis approach (Omole & Omole, 2020). Policy considerations to confirm that TVET contributes to the Sustainable Development Goals incorporate the TVET qualifications agenda to offer a long-term vision for TVET and to ensure future-oriented skills, including green skills and skills for sustainable development (Omole & Omole, 2020).

Similarly, Edokpolor and Dumbiri (2019) pointed out that the physical services for the teaching and learning processes for TVET programs were insufficient and that the instructional resources were underused during teaching and learning in TVET programmes. Therefore, TVET leaders should seek to work with significant stakeholders to support resources that help to ensure suitable provision of physical amenities for effective teaching and learning activities in TVET programmes. In doing so, this would further help foster an enabling environment for teaching and learning TVET courses, which would help equip students with the skills they need.

The role of STEM in addressing SDGs

Ramnarain and Ndlovu (2023) stated that African nations hold great emphasis on the centrality of integrating ICT into STEM education. There is a policy to provide schools and university students with ICT and digital skills that would permit them to contribute to the contemporary workforce and entrepreneurship in STEM fields. According to Ramnarain and Ndlovu (2023) STEM education is an engine of economic progress and is vital in helping less developed economies like those in Africa to compete in the global market, create jobs, specifically STEM jobs with high levels of exchange and improving prosperity. In Africa, Astronomy for Development aim to use astronomy to stimulate educational, technological and socioeconomic growth (McBride, Venugopal, Hoosain, Chingozha & Govender, 2018).

Additionally, Tikly, Joubert, Barrett, Bainton, Cameron and Doyle (2018) require the MasterCard Foundation with considered options to improve the quality of education in science, technology, engineering and mathematics (STEM) across sub-Saharan Africa critical if nations are to accomplish the SDGs and close the gap between Sub-Saharan Africa and the rest of the world. Tikly et al., (2018) found that student performance at the secondary level is low, resulting in low enrolment at the secondary level. However, to address this, the African Union has set targets for STEM enrolment, which involve addressing the current poor quality of secondary education.

Corts, Guix and Carbonell (2021) highlight changes in research performance following global announcements like the UN Earth Summits however, addressing the complex energy access challenges on the African requires a skilled local workforce. Similarly, Pailman and de Groot (2022) specified that given the role of distributed and renewable energy in achieving (SDG) 7, the development of local specialists with skills in these areas is crucial to reaching universal energy access. Therefore. TVET also play a pivotal role in closing the skilled African energy workforce gap through various courses that respond to SDG 7. Pailman and de Groot (2022) propose a lever framework for gender in energy access as part of the Transforming Energy Access Learning Partnership which supports a network of eight African universities in the development of energy-related courses. Pailman and de Groot (2022) initiate that integrating a gender standpoint can help course leaders and lecturers redesign energy access education and contribute to a standard shift in education, values and practices. Thus, inclusivity encourages diversity and prominently advances SDG 7.

In addition, the world is on the verge of a complete transformation and redesign of society and workplaces. This change is also caused by the Fourth Industrial Revolution, which is transforming different aspect of life, including education. The revolution is typified by advances in areas like artificial intelligence, robotics, biotechnology and quantum computing. Yingi, Hlungwani and Nyagadza (2022) explained that this is happening at a time when the United Nations has theorised the SDGs as part of the 2030 Agenda. The application of 4IR technologies like artificial intelligence (AI), learning analytics and the Internet of Things encourages inclusive, equitable and quality education which is in line with SDG4.

Furthermore, the significant role of environmental education to promote the SDGs has been evidently identified in national policy visions and strategies in Nigeria. However, despite this collective recognition, the implementation and delivery of environmental education programs continues to be hampered by several practical implementation challenges (Babalola & Olawuyi, 2021). Babalola and Olawuyi (2021) proposed that formulation of a clear national strategy on environmental education, specific budgetary allocation, reform of present laws to ensure coherent execution of these programs and designation of priority units in tertiary institutions are substantial steps towards the development and implementation of environmental education programs in Nigeria.

Emerging trends in technology that address community challenges

Community-based operations research are becoming important in various areas that benefit from empirical and analytical attempts to problem solving. These areas focus mainly on community services and local enhancement. Johnson, Midgley and Chichirau (2018) identify a number of these distinguishing between emerging trends generally in well-studied areas of operations research, and new frontiers found in traditions not classically focused on empirical and analytical methods are for problem solving where community decision modeling presents new ways to generate knowledge, policies and regulations.

According to Wang, Mang, Cai, Liu, Zhang, Wang and Innes (2016) watershed management is a constantly evolving practice that comprises the management of land, water, biota and resources in a defined area of ecological, social and social reasons embrace economic purposes. Wang et al., (2016) review the process of developing combined watershed management approaches for sustainable management by incorporating adaptive management systems and traditional ecological knowledge. Wang et al., (2016) address the various benefits of integration through disciplines and jurisdictional boundaries, as well as incorporating technological advances like remote sensing, GIS, big data, and multi-level social-ecological systems analysis into watershed management strategies.

Furthermore, the emergence of smart cities and sustainable development has become a globally accepted form of urbanisation. The epitome of smart city development has been made possible by the latest innovative combination of information and communication technology. Citizens of smart cities can enjoy the benefits of a smart living environment, ubiquitous connectivity, seamless access to services, smart decision-making through smart governance, and optimised resource management (Haque, Bhushan & Dhiman, 2022).

The extensive adoption of smart cities has led to issues in data security, authentication, unauthorised access, device-level vulnerability, and sustainability. Furthermore, academics and others are grappling not only with how to implement the new insights promised by personalised medicine, but also with the central questions of application in early drug development, implications for health technology assessment, and new requirements to traditional health economics and outcomes and implications for reimbursement and access (O Donnell, 2013). Despite of these issues, physicians are gradually forced to find practical solutions to the challenges and opportunities presented today by the advancement of personalised medicine. Goldberg, Lide, Lowry, Massett, O'Connell, Preece and Shneiderman (2011) noted that it is a platitude that, for innovative eHealth systems to deliver real value and impact, they must be used primarily by physicians and consumers and must be accessible.

According to Zhou, Greenspan, Davatzikos, Duncan, Van Ginneken, Madabhushi and Summers (2021), deep learning has been extensively used in several medical imaging tasks since its renaissance and has attained remarkable success in countless medical imaging applications, bringing into the world of medicine era of artificial intelligence. It is well known that the success of AI is largely due to the accessibility of large data sets with annotations for a single task and advances in high-performance computing. However, medical imaging presents unique challenges that deep learning approaches face currently.

Methodology

The study used a systematic review approach to collect data. This systematic review the role of TVET colleges in addressing SDGS. The Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) protocol for determining the inclusion and exclusion criteria was followed. These criteria were formulated based on the current study goals and the research question. All relevant studies were identified and reviewed.

Kitchenham and Charters, (2007) used a formal, structured procedure for reviewing the literature. A strategy was created as part of the process, comprising of the research question and data extraction procedures and the approach used for the review as indicated below.

Research questions

This study addresses the following research issues to establish the role of TVET in SDGs.

Question 1: What role does TVET colleges and STEM play in SDG goals?

Question 2: What are some of the emerging trends in technology that address community challenges?

Search strategy

The search for resources was conducted using several digital libraries that were employed to search for various resources. The digital libraries that were used includes Google Scholar, SCOPUS (https://www.scopus.com/) and Web of Science (WOS) (www.webofknowledge.com)

Thus, these databases were preferred due to their international recognition and the standards they use to index articles. The databases have more content on the issues investigated. After selecting the databases, the descriptors and keywords were chosen as well as the search equations were formed. To get the best output, countless Boolean search strings were formed. The strings were used to string the keywords searched in a structured way. Additional search terms were added to make sure that the results encompassed the principal component factors.

Search results
The initial search returned 30 articles from various databases. Titles and abstracts were sufficient to remove articles that did not meet the inclusion requirements. About 25 full articles were checked that were unclear if they were included in the keywords. Articles were screened against a fixed structure based on the PRISMA method. After applying all the mentioned inclusion and exclusion conditions, 23 articles were selected for inclusion in this review. The first of these dates to 2011, thus from 2011, the corresponding theme were developed. It is however, imperative to note that some important studies may have been unintentionally skipped.

Search validation
The identification of respective well-known primary research by the search strings served as proof of its validity. A prior search was done with a list of general search phrases, and a number of pertinent papers were found. Kitchenham and Charters, (2007) stated that using list of articles and the publications is crucial for the search phrases to be validated before the review is started.

Additional search criteria
Digital libraries also formed the foundation of the search method. In contrast, all primary sources were scrutinised for additional pertinent citations.

Study selection criteria and procedures
A set of inclusion and exclusion conditions was applied to the entire list of primary studies disclosed by the searches. The manner by which the inclusion and exclusion criteria was directed to the lists of primary studies is highlighted below.

Inclusion criteria
The study explored the role of TVET in SDGs, therefore, the following inclusion criteria was applied:
* Only TVET college papers were included.
* The course includes the keywords, TVET, STEM, SDGs.
* All work must be published between January 2011 and 2023.
  Other relevant studies such as letters were excluded from this study.

Exclusion criteria
Studies that met the following criteria were excluded from the review:
* Studies that did not report on the TVET in relation to SDG.
* Publications/reports for which only an abstract or a PowerPoint slideshow was available.

Choosing primary sources
A review of the title, keywords and abstract served as the basis for the initial selection of primary sources. Only the primary sources that seemed to be entirely unrelated were excluded. Hence, to compare all primary sources against the inclusion/exclusion criteria specified above, full copies of all those that were included during this initial selection process were obtained.

As advocated by Kitchenham and Charters, (2007), every primary sources entry in the bibliography database has been updated to reflect whether it has been used in the review and the justification for this.

Data extraction strategy
To respond to each of the research questions, the study only retrieved data from the chosen studies. The publication containing the most inclusive information on the study was included if publications contained the same information about the original study, as specified in the inclusion criteria.

Findings from Current Literature
Irikefe (2021) highlights the position of TVET as real tools to combat and control draught and proliferation of countless crimes across Nigeria, specifically among the youth. Irikefe (2021) found that the instrumentality of vocational training, especially in the form of short-term vocational training, the provision of job-specific starter packs and post-training support, can go a long way in reducing unfriendly events in communities. It is also proven that skills training and empowerment platforms are

a focal stage to curb prevalent unemployment, growing poverty, increasing insecurity as well as destabilisation of communities in countries.

Irikefe (2021) reveals that due to the lack of professional skills on the youths, some of them have resorted to committing several terrible crimes to earn a living. Improving livelihoods is key to poverty reduction as the United Nations has acknowledged the next decade a period of action to achieve Sustainable Development Goals (SDGs). Auta (2022) observed the need for a universal partnership with TVET to make sure that the sustainable development goals are realistically achieved. Auta (2022) addresses some dimensions of the SDGs namely economic, social and environmental and regarding to the economy, it advocated for adequate investment in agriculture and manufacturing. According to Auta (2022) there is a need to build a solid partnership with vocational training institutions to train the unemployed without regard to gender, tribal affiliation, religion and disabilities has been highlighted as a solution to some of the challenges facing Nigerian society for sustainable green TVET.

Campbell, Kelly-Weber & Lavallee (2021) indicate that scholars from Ghana and Nigeria value and advocate education as a process for social change and view both formal and informal education as imperative development mechanisms. Campbell eta al., (2021) specified that Ghanaian and Nigerian alumni identified separate pathways through which education leads to social change namely university teaching and citizenship, voter, and human rights education.

Masoabi and Alexander (2021) stated that entrepreneurship education is becoming a requirement worldwide, and is flourishing in response to increasing economic distress, innovation and unemployment. On the other hand, pollution and climate change is a challenge Nwosu and Micah (2017) therefore, if this change, then it must be disseminated through the correct channel like education. Education, mainly the way it leads to vocational and skill acquisition, industrial and technological progress, has always been the ideal, if not the only instrument for national growth, economic insight and self-reliance and strengthening of citizenship. Therefore, TVET have a pivotal role for sustainable development. According to Adediran and Ishola (2023), TVET extents education systems, from toys for young children to sending children to school to learn science, engineering and technology. Vocational training and SDGs work if they are well executed. Connecting TVET and SDGs is a main issue that must be addressed if Nigeria is to meet its UN obligations and Sustainable Development Goals agenda (Adediran and Ishola, 2023). Inclusive education promotes a fair and equal society which is UN's agenda by activating interest groups. Thus, schools, vocational centres, technical colleges and universities should have high-quality teaching and training opportunities and well-trained teaching staff.

Summary of Findings and key themes

Some major themes were identified in the study. The themes listed below serve as proof of this. Guided by the findings and current literature, key themes were formulated evidenced by the following themes:

- Embracing ICT skills on TVET to address SDGs.
- Policy implementation in support of TVET and SDGs
- Collaboration of TVET with key stakeholders (government, schools, communities and NGOs)
- TVET qualifications agenda to offer a long-term vision to ensure future-oriented skills, including green skills and skills for SDGs.

Conclusion

Current studies have shown the role of TVET Colleges in different parts of the world. In an effort to understand different initiatives undertaken by the TVET Colleges, key stakeholders have to be engaged. The Community engagement processes assist in understanding the SDGs and how the curriculum will be redesigned. The required TVET Colleges curriculum with more focus on the STEM. The study argue that appropriate understating and application of STEM concepts and discipline has a positive impact in enabling SDGs to be achieved.

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Lead Paper Presenter 4

ENHANCING SCIENCE EDUCATION THROUGH INNOVATIVE PARTNERSHIPS: THE SCIENTIST-TEACHER-STUDENT PARTNERSHIP (STSP) APPROACH

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Abstract
Science education is essential in developing a knowledgeable and competent workforce, especially in this present era of STEM-driven economy. This paper highlights the challenges faced in science education, particularly in Malaysia, where a decline in students pursuing science streams poses a significant concern. In order to address this issue, innovative and collaborative teaching strategies are required to instil interest in science subjects among students. One such strategy is the Scientist-Teacher-Student Partnership (STSP), a tripartite collaboration involving scientists, teachers, and students. This paper discusses the importance of partnerships in science education, defines STSP, describes the research process, and highlights the roles and benefits of each participant. The contributing factors that affect the success of STSP are also examined in this paper. Lastly, this paper advocates the importance of innovative partnerships in science education to enhance the quality of teaching and learning.

Keywords: Partnership, science education, STSP approach

Introduction

In today's world, the mastery of science and technology is crucial for the development of knowledgeable and competent human capital. This need for a scientifically literate workforce is reflected in national agendas worldwide, including Malaysia's. The twelfth Malaysian Plan (2021–2025) has placed more emphasis on the science, technology, engineering, and mathematics (STEM) workforce, under one of the three dimensions identified, specifically the economic empowerment dimension. However, science education faces significant challenges globally, with a particular concern in Malaysia being the decreasing number of students pursuing science streams. Many are not interested in pursuing science subjects as many perceived science subjects are difficult, ineffective teaching methodology, ad-hoc changes in policies, and a low level of awareness of the demand for specialized talent in science or STEM subjects at large. To address this issue and ensure a sustained interest in science subjects, a collaborative and innovative approach to teaching is imperative. This paper explores the concept of partnerships in science education, with a specific focus on the Scientist-Teacher-Student Partnership (STSP) (e.g. Fadzil et al., 2019; Shein & Tsai, 2015; Ufnar & Shep- herd, 2019) as a means to expose students to authentic science experiences.

Why Partnership?

Partnerships have become increasingly important in science education, as no individual or party can effectively operate in isolation (e.g. Maina et al., 2021; McClusky & Farland-Smith, 2021; Munson et al., 2013; Rushton, 2021). Collaborative efforts have long been recognized as a valuable strategy to enhance student engagement and promote trans-disciplinary learning in STEM education.

Previous research on such collaboration (e.g., Fadzil et al., 2019; Hasanah & Tsutaoka, 2019; Saat et al., 2021) discovered that students' perceptions changed in a positive direction after participating in a scientists-teachers partnership programme. Students who had the opportunity to learn from scientists were more motivated to learn STEM subjects. As a result, we should not underestimate the importance of this collaboration in our efforts to reform science education. While mutual learning appears to be ideal for science and STEM education, only a few mechanisms exist to support this cross-institutional collaboration. The majority of studies have concentrated on the collaboration of scientists and teachers, with little work done to understand how such partnerships influence science learning and the mechanisms to ensure effective partnerships in science or STEM learning.

The STSP approach enables science teachers to work closely with professional scientists, allowing them to acquire the latest scientific knowledge and skills. In turn, professional scientists can make their research more applicable at the societal level, while students gain direct exposure to authentic scientific experiences and provide valuable feedback to scientists and teachers.

Definition of Scientist-Teacher-Student Partnership (STSP)

In this study, STSP is a mutually beneficial partnership involving upper secondary science teachers, university scientists (in fields such as biology, chemistry, physics, and engineering), and secondary science students (Saat & Fadzil, 2022). Through this collaboration, each party contributes to the learning process, creating a rich environment for science education.

The Research Process

The STSP model involves several key steps, including planning, development of teaching and learning modules and training workshops for the teachers. In biology for example, modules like "Introduction to Stem Cell" are created for both students and teachers. Scientists train teachers in the use of these modules, and teachers then conduct experiments in their classrooms, such as the isolation of rat bone marrow mesenchymal stem cells. Additionally, students visit university laboratories to witness the cultivation of cells, providing them with a first-hand view of the scientific process in this investigation.

After the modules had been implemented, scientists, teachers, and students were interviewed. They were asked about their teaching and learning experiences, the usability of the modules, their experience working with scientists, and the scientists' experience working with teachers. The students were also questioned about their learning experiences in such an environment, where both their teachers and the scientists were present during the lessons. Figure 1 summarizes the flow of the research.

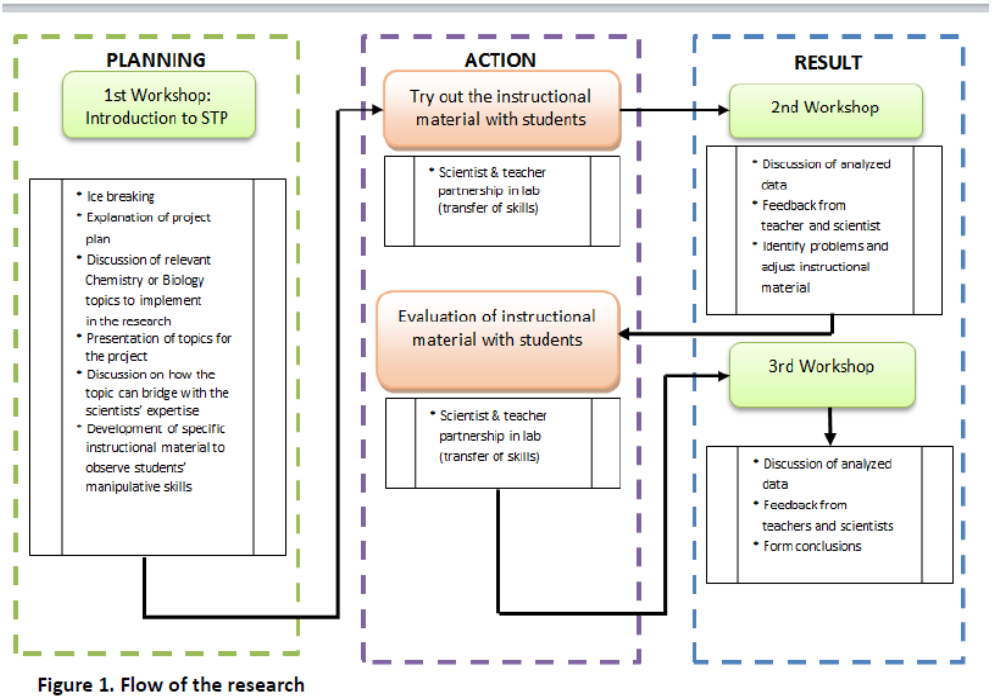

Figure 1. Flow of the research

Role of Each Participant

Each participant in this partnership has a role to play in this STSP Model of partnership. The roles are as follows:

- **Role of Teacher:** Teachers serve as mediators, instructional designers, and synchronizers of concepts and terminologies. They benefit from gaining insight into the scientific inquiry process, expanding their content knowledge beyond the syllabus, learning practical techniques, and networking with universities.

- **Role of Scientist:** Scientists act as mentors, role models, and trainers, transferring knowledge and coaching teachers. This partnership enhances their communication skills and enriches their pedagogical abilities.
- **Role of Student:** Students are the end-users of the collaboration and provide feedback on activities. Their benefits include enriched learning experiences, access to the scientific community, expanded content knowledge, motivation through direct exposure, and a broader perspective.

What Makes the Partnership Work?

There are several factors that affect the effectiveness of any partnership or collaborative work. Saat et al. (2022) outlined the contributing factors for an effective partnership. The three factors are internal factors which consist of two sub-categories, that is, the suitability of time and commitment; external factors, that is, the support system and availability of resources; and the institutional factor, that is, the application of curriculum-related activities. Table 1 explains the factors that affect the partnership, and the sub-categories.

Table 1: Explanation of Contributing Factors in STSP (Saat et al., 2021)

Contributing Factors	Sub-categories	Explanation
(i) Internal Factors	Suitability of Time	Suitability of time of the activities during formal or informal classroom sessions
Commitment		Commitments of teacher, student, and scientist
(ii) External Factors	Supporting System	Supporting system at school and university
Availability of Resources		Resources such as modules or guidebook to enhance the transfer of knowledge
(iii) Institutional Factors	Curriculum Related Activities	The alignment of the activities to the science curriculum

- Internal Factors: These include the suitability of the time allocated for activities during formal or informal classroom sessions and the commitment of teachers, students, and scientists.
- External Factors: Supporting systems in schools and universities play a crucial role, as do the availability of resources, such as modules or guidebooks, to enhance the transfer of knowledge.
- Institutional Factors: Alignment of partnership activities with the science curriculum is essential for integration into the educational system.

Figure 2 depicts the collaborating factors and the contributing factors in the partnership (Saat et al., 2022).

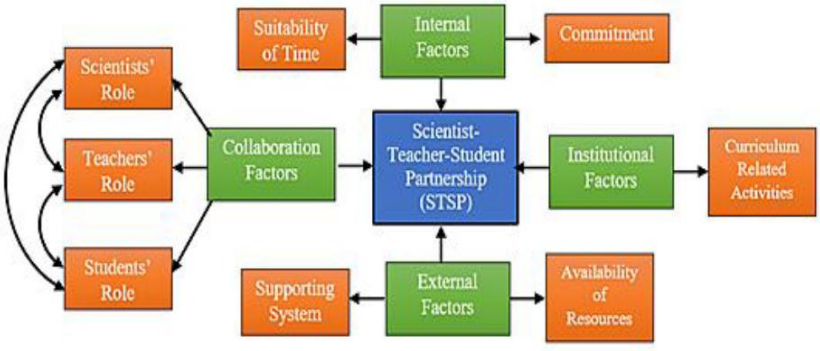

Figure 2. Factors Affecting Scientist-Teacher-Student Partnerships (Saat et al., 2022)

Conclusion

Addressing the challenges of science education necessitates innovative solutions, one of which is smart partnerships that bring together relevant stakeholders. Synergy among participants is critical for the success of these collaborations, in which each participant understands and executes their role. Scientist-Teacher-Student Partnership initiatives have the potential to improve science education by providing students with authentic, engaging, and insightful learning experiences. In an ever-changing technological landscape, fostering a strong scientific foundation is critical for the development of competent and innovative individuals who can contribute to societal progress.

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TVET AND SUSTAINABLE DEVELOPMENT GOALS PERCEIVE USE OF INFORMATION COMMUNICATION TECHNOLOGY FOR INSTRUCTION OF MOTOR VEHICLE MECHANICS WORK TRADE IN TECHNICAL COLLEGES IN ADAMAWA STATE.

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Abstract
The advent of Information and Communication Technology (ICT) worldwide has brought some challenge to spheres of education and human endeavor specifically Technical, Vocational Education and Training (TVET). It is therefore imperative to look at the use ICT in the effective Teaching and learning Motor Vehicle Mechanic Work Trade (MVMW) courses in Technical Colleges in Adamawa State for a well sustainable development in Nigeria. Three research questions guided the study. The target population of the study consisted of twenty-four (24) MVMW Trade teachers in the three Technical Colleges of Adamawa State Structured questionnaires were used for the data collection. Mean and standard deviation was used for the analysis of the data. Out of the forty-five (45) structured questionnaire items, thirty-eight (38) were agreed/ accepted, while seven (7) were disagreed upon. The findings among others revealed that MVMW trade teachers used Information and Communication Technology (ICT) in Teaching and learning of Motor Vehicle Mechanic work trade in Adamawa State. ICT has impacted positively in the teaching and learning in improving quality educational outcomes. Recommendations were made based on the findings, among which are the followings: Alternative power supply should be provided to Technical Colleges by Government and non-governmental organizations, to enable Motor Vehicle Mechanic Work Trade teachers use Information and Communication Technology facilities, organizing training and workshop on the use of ICT facilities for Motor Vehicle Mechanic work Trade teachers should be on regular basis and to update teachers on relevant modern software packages, the use of projector in teaching and learning situation, use of simulators to describe the background knowledge on scientific findings and experiments, and use slides that contain information that aids teaching and learning should be supply to Technical Colleges by Government and non-governmental organizations for a functional practical skills in achieving sustainable development goals to our teeming youths in Motor Vehicle Mechanic Work Trade.

Keywords: Technical College, Motor Vehicle Trade, Teaching & Learning And Information Communication Technology (Ict).

Introduction

Technical College is an institution that provides trade courses in Technology; which involves the teaching of Science, Technology, Mathematics, Business and Engineering Craft. It prepares students for careers into various occupations. Technical Colleges in Nigeria are established purposely to produce crafts men at the craft level and master crafts men at advance craft level (Audu, Aede and Muhammad, 2014). The training programmes of Technical College are classified into clusters of areas of specialization, termed as trades. National Business and Technical Examination Board (NABTEB, 2015) Identified traders offered in Nigerian Technical Colleges which includes Motor Vehicle Mechanic Work Trade (MVMW) Block Laying and Concreting Carpentry and Joinery, Welding and Fabrication. Business trade, Computer trade, Electrical and Electronic trade, Hospitality, Printing trade, plumbing trade, Textile and General Education.

Similarly, Technical Colleges are established purposely to produce craftsmen in various disciplines. Okoye and Okwelle (2017) stressed that the main purpose of technical colleges in Nigeria is to kindle technological and industrial development by developing and utilizing technologies for industrial and economic advancement. It contributes towards the development of good citizenship by developing the physical, social, civic, cultural and economic competencies of the individual (Saidu & Ajuji, 2017). Motor Vehicle Mechanic Work Trade (MVMW) as a trade offered in Technical Colleges, is refers to a vocational trade geared towards producing competent Motor Vehicle Mechanics with sound practical skills, knowledge and ability to diagnose and carryout repairs and maintenance on motor vehicles.

MVMW as a trade is offered at technical College level leading to the award of National Technical Certificate (NTC) and Advance National Technical Certificate (ANTC) for craftsman and master respectively. In the same vein, MVMW trade is part of the approved trade under the National Board of Technical Education Board (NATEB) who are shouldered with the responsibility of monitoring and evaluating trade courses in Technical Colleges in Nigeria.

Teaching and learning in MVMW trade is pragmatic in nature, that is, learning by doing. It is a process that includes many variables, these variable interact as learners work towards their goals and incorporate new knowledge behavior and skills that add to their range of learning experiences. Mustapha (2011) further confirmed that Information Communication Technology (ICT) facilities can accelerate, enrich and deepen basic skills; motivate and engage students in academic, experiences. Unfortunately most of the graduates of Motor Vehicle Mechanic Works Trades (MVMW) are deficient and do not possess requisite skill needed in the labour market, as a result of the recent increase of modern changes in technology, the incorporation of modern technology in motor vehicles and machine tools industries.

Adegbemile, (2012) identified (ICT) package that can promote skill acquisition and self–reliance in the teaching and learning motor vehicle mechanic works trade, which includes Computer Assisted Instruction (CAI), Web Based System, Computer Aided Design(CAD), Auto Card, Graphic package, Power Point Application, Tutorial. Packages like Computer Conferencing, Internet Interactive, Video, CD Rom and many others assist a lot. Motor Vehicle Mechanic Trade (MVMW) Teachers ICT skills needed include their ability to use the wide variety of technology related tools and their application to classroom teaching, in particular, and to the totality of teaching-learning process in general. Knowledge and Skill of ICT is necessary for effective teaching and learning. The major challenge to teacher education in Nigeria is that of insufficient knowledge and skills in teaching using ICT (Rastogi & Malhotra, 2013). ICT skill is a necessity for all teachers to guarantee relevance of the system and its products in the 21st century. Many Technical Colleges in Nigeria still operate the traditional education system with little or no adaptation to ICT. To benefit from the ubiquity of information and to facilitate communication among professional networks, school teachers need, not only to be trained and re-trained in ICTs, but also facilities must be provided by government to enable teacher and their students access Information Communication Facilities. In a study by (Odede & Enakerakpo, 2014), the researchers stated that if teacher possess adequate ICT skills, they can efficiently make use of the internet and other online teaching application.

The fact that information and communication Technology (ICT) has move into the society so rapidly. Thus the need arises for everyone to quickly acquire basic Information and Communication Technology skills. Although skills depend essentially on learning, it also includes the concept of efficiency and economy in performance. Skills, in general, should be understood as being something that can be learnt and improved with practice. ICT skills also known as digital competency, involve confident and critical use of ICT in the general population and provide the necessary context (Knowledge, Attitude and Skills, KAS) for working, living, and learning in a society (UNESCO, (2015).

In Motor Vehicle Mechanic Works (MVMW) Trade, teaching and learning includes interaction between the teacher, the component, or the concept and the learner as the learner works towards acquiring the new information, knowledge, skills to their range of learning experience. ICT is an extensional term for Information Technology (I.T) that stress the role of unified communication and the integration of telecommunication, (telephone phone lines, and wireless signals) and computers as well as necessary enterprises software, middle ware storage and audiovisual that enable users to access, store, transmit, understand and manipulate information. Oluwatumbi (2015) stressed that teaching and learning of a particular Technical trade demands engagement of students with array of ICT facilities that will arouse the interest of students. It is pertinent to note that for a student of MVMW trade to practice optimum level, he need to acquire modern and relevant ICT knowledge and skills to competently perform.

Statement of the Problem

Knowledge and Skill of ICT is necessary for effective teaching and learning. The major challenge to teacher education in Nigeria is that of insufficient knowledge and skills in teaching using ICT (Rastogi

& Malhotra, 2013). ICT skill is a necessity for all teachers to guarantee relevance of the system and its products in the 21st century. Many schools in Nigeria still operate the traditional education system with little or no adaptation to ICT. To benefit from many information and to facilitate communication among professional networks, school teachers need, not only to be trained and re-trained in ICTs, but also facilities must be provided by government to enable teacher and their students access to remain uninterrupted, more so that the world is gradually becoming a global village. For our future teachers to be able to operate effectively and efficiently, they must imbibe the new technologies and methodologies of the modern times (Mohammed & Yarinchi, 2013). In today's rapid technological changes, it is imperative to undertake ICT skills assessment to encourage a consultative approach towards identifying workforce skills and key areas of learning and development.

There is low utilization and sometimes non - availability of information and communication Technology (ICT) facilities in teaching of Motor Vehicle Mechanic Work Trade in Technical Colleges. The pattern of teaching adopted by teachers today is mostly abstract in form, without been supported by the use of appropriate aids. In other cases, instructional materials are not readily available for use by its teachers. Consequently, the end result is producing half bake or unqualified Motor Vehicle Mechanic Work graduates without the requisite competency on modern technics in diagnosis and repairs of modern Motor Vehicles.

Purposes of the Study

The main purpose of this study is to examine the use of Information and Communication Technology (ICT) for effective teaching and learning of Motor Vehicle Mechanic Work Trade (MVMW) in Technical Colleges in Adamawa State specifically the study is to:

i. Determine the impact of Information and Communication Technology (ICT) in teaching and learning of Motor Vehicle Mechanic Work Trade in Adamawa State.

ii. Determine the challenges of using ICT in teaching and learning of Motor Vehicle Mechanic Work Trade using Information and Communication Technology (ICT) in Adamawa State.

iii. Ascertain the benefits of using ICT in teaching and learning Motor Vehicle Mechanic Work Trade using Information and Communication Technology (ICT) in Adamawa State.

Research Questions

The researcher provides answers to the following questions:

i. What are the impact of Information and Communication Technology (ICT) in teaching and learning of Motor Vehicle Mechanic Work trade in Adamawa state?

ii. What are the challenges of using ICT in teaching and learning of Motor Vehicle Mechanic Work trade using Information and Communication Technology (ICT) in Adamawa state?

iii. What are the benefits of using ICT in teaching and learning Motor Vehicle Mechanic Work trade using Information and Communication Technology (ICT) in Adamawa state?

Methodology

This study employed descriptive survey research design. According to Akuezuilo & Agu (2017) descriptive survey is a study which aimed at collection of data and describing in systematic manner, the characteristics feature or facts about a given population. The research design refers to the overall strategy that you choose to integrate the different components of the study in a coherent and logical way, thereby, ensuring you will effectively address the research problem; it constitutes the blueprint for the collection, measurement, and analysis of data.

The study was conducted within Technical Colleges in Adamawa State. Adamawa State occupies about 36.917 square kilometers. It bordered by Borno State to the Northwest, Gombe State to the West and Taraba State to the South West. Its Eastern border is with Cameroon. Topographically it is a mountainous land crossed by the large river village. Benue Gongola and Yedsarem. Adamawa lies between latitudes 7028 – 10056/N and longitudes 110301 – 130 – 130 – 75 /E there are five educational zones in Adamawa State comprises of Numan zone, Ganye zone, Yola zone, Gombi zone and Mubi zone and three technical College are in Adamawa one in Mubi one in Numan and one in Yola.

The population of the study was twent-four (24) Teachers teaching Motor Vehicle Mechanic Work Trade from the three (3) Technical Colleges in Adamawa State. Which comprises of Government Science and Technical College Mubi, eight (8) MVMW trade Teachers, Government Science and Technical College Yola, Nine (9) MVMW trade Teachers and Government Science and Technical College Numan, with seven (7) MVMW trade Teachers respectively, making a total of twenty two (24) Motor Vehicle Mechanic Work Trade Teachers. (Source 2021. Statistic Office Post Primary School Management Board Yola, Adamawa State)

Sample size and Sampling Techniques

Three (3) Technical Colleges were selected using purposive sampling techniques, that is all the Motor Vehicle Mechanic Work Trade Teachers were considered from the three selected Technical Colleges in Adamawa State having a total of 24 Motor Vehicle Mechanic Work Trade Teachers

The instrument used for collecting data in this study was a structured questionnaire which comprises a four- point rating scale which is as follows:

Strongly Agreed (SA) 4 Point
Agreed (A) 3 Point
Disagreed (SD) 2 Point
Strongly Disagreed (D) 1 Point

The instrument was subjected to face validation by three (3) experts from the School of Secondary Education Technical Federal College of Education Colleges of (Technical) Gombe. All observations and adjustments made by the experts were considered in the final copy of the instrument.

Structure Questionnaires was administered to the respondents by the researcher. The consent of the respondents was obtained by the researcher before administering the questionnaire.

The data was obtained from the respondents in each questionnaire items was computed and tabulated into frequency table. The data collected was analyzed using mean. The mean is the most accurate and representative of measure of central tendency which is often represented by the symbol X can be described as the sum of the individual score divided by the number of cases which also is represent by N. the mean can be referred to as the arithmetic average of a group of score Mean.

The decision rule was based on the four- point rating scale where Mean response that are 2.5 points and above was regarded as positive (Agree) while those below was regarded as negative (Disagreed).

Research Question One

(1) What are the impacts of Information and Communication Technology (ICT) in teaching and learning of Motor Vehicle Mechanic Work trade in Adamawa state?

Table 3: Opinion of respondents on the impact of Information and Communication Technology (ICT) in teaching and learning of Motor Vehicle Mechanic Work trade in Adamawa state.

S/N	Question	SA	A	SD	D	Mean $\overline{X}$	Remarks
1	Information and Communication Technology aid the teacher, students during teaching and learning of Motor Vehicle Mechanic work trade when teaching on engine component	8	14	2	0	2.70	Agreed
2	Using Network Computing Device (NCD) machine, slide and digital multimedia help to balance theory and practical aspect as picture of the component can be seen as they operate	7	11	2	4	2.80	Agreed
3	Slide/overhead projectors are used in teaching four strokes cycle concepts of engine operation	8	9	5	2	2.95	Agreed

4	The use of Information and Communication Technology provide a clear understanding of the concept in teaching Motor Vehicle Mechanic Work Trade especially the injector pump operations	5	15	0	4	2.87	Agreed
5	The use of Information and Communication Technology help ease teachers during lesson preparation of the topic to be treated	8	8	2	6	2.75	Agreed
6	The number of computers needed are provided in relation to the number of the students of Motor Vehicle Mechanic Work Trade	2	2	7	13	1.70	Disagreed
7	There are no enough Network Computing Device (NCD) machine in the Technical Colleges for effective teaching and learning Motor Vehicle Mechanic Work Trade	8	8	2	6	2.75	Agreed
8	All teachers of Motor Vehicle Work Trade have sufficient knowledge of the application of ICT equipment in teaching and learning of Motor Vehicle Mechanic Work Trade	7	4	5	8	2.41	Disagreed
9	ICT assist in learning simulation of vehicle operations	8	14	2	0	2.70	Agreed
10	Using ICT helps teachers in better ways of explaining scientific concepts	8	9	5	2	2.95	Agreed
11	Students understands practical stages better through the use of ICT	7	8	8	0	2.83	Agreed
12	Students grasp better some workshop processes better when taught without ICT	8	7	8	1	2.91	Agreed
13	Some workshop safety practices were clearly understood using ICT	9	8	7	0	3.08	Agreed
14	Physical views of various MVM workshop organizations were clearly taught when using ICT	8	8	7	1	2.95	Agreed
15	Using ICT simplifies better understanding of systems in MVMW	8	9	5	2	2.95	Agreed

Key: No. of Teachers = 24 **SA** = Strongly Agreed A = Agreed **SD** = Strongly Disagreed **D**= Disagreed **X =** Mean

Table: 3 above represent mean responses on the impact of Information and Communication Technology (ICT) in teaching and learning of Motor Vehicle Mechanic Work trade in Adamawa State. The respondents agreed with items comprising 1,2,3,4,5,7,9,10,11,12,13,14, and 15 having a mean above the average mean. While, item 6 and 8 was disagreed with mean average of 1.70 and 2.41. This clearly showed that Information and Communication Technology (ICT) is having an impact in teaching and learning of Motor Vehicle Mechanic Work trade Information and Communication Technology aid the teacher, student during teaching and learning of Motor Vehicle Mechanic work trade when teaching on engine component, using Network Computing Device (NCD) machine, slide and digital multimedia help to balance theory and practical aspect as picture of the component can be seen as they operate, Slide and overhead projectors are used in teaching four strokes cycle engine operation, The use of Information and Communication Technology gives a clear understanding of the concept in teaching Motor Vehicle Mechanic, The use of Information and Communication Technology help teachers during lesson preparation of the topic to be treated and There are no enough Network Computing Device (NCD) machine in the Technical Colleges for effective teaching and learning Motor Vehicle Mechanic Work Trade these are the impact of Information and Communication Technology (ICT) in teaching and learning of Motor Vehicle Mechanic Work trade in Adamawa State.

Research Question Two.

(2) **What are the challenges of using ICT in teaching and learning of Motor Vehicle Mechanic Work trade using Information and Communication Technology (ICT) in Adamawa state?**

Table 4: Opinion of respondents on the challenges of using ICT in teaching and learning of Motor Vehicle Mechanic Work trade using Information and Communication Technology (ICT) in Adamawa State

S/N	Question	SA	A	SD	D	Mean $\overline{X}$	Remarks
16	Power failure affects the use of Information and Communication Technology for effective teaching and learning Motor Vehicle Mechanic Work Trade	18	4	1	1	3.62	Agreed
17	Lack of relevant software packages affect effective teaching /learning of Motor Vehicle Mechanic Work Trade	8	12	0	4	3.00	Agreed
18	Teachers reluctance to the new Technology amount to ineffective use of Information and Communication Technology in teaching Motor Vehicle Mechanic Work trade.	11	6	0	4	3.16	Agreed
19	Some Motor Vehicle Mechanic Work Trade teachers lack the knowledge and skills of using Information and Communication Technology	9	12	3	0	3.25	Agreed
20	Time allocated in the teaching time table which is 45 minute per period is not enough for teacher to effectively use the ICT facilities in Teacher Motor Vehicle Mechanic Work Trade	6	5	4	9	2.28	Disagreed
21	Lack of planning using ICT facilities by the teachers teaching Motor Vehicle Mechanic Work Trade effect the effectiveness teaching topics in Motor Vehicle Mechanic Work Trade	6	16	1	1	3.12	Agreed
22	Inability of teacher to use computer hinders the effectiveness of their teaching and learning	7	13	0	4	2.95	Agreed
23	Lack of projector in the Technical Colleges effect the efficiency of teaching transmission unit.	7	12	2	3	2. 96	Agreed
24	Teachers Inadequate knowledge of power point presentation	12	4	8	0	3.16	Agreed
25	Availability of ICT facilities in the school.	10	8	6	0	3.16	Agreed
26	Non Availability of current learning packages on modern vehicles system	9	10	5	1	3.20	Agreed
27	Lack of ICT assistance in the school	9	9	4	2	3.04	Agreed
28	MVMW trade doesn't have software programs relevant to the curriculum	11	7	5	1	3.16	Agreed
29	Lack E – learning materials	12	8	4	0	3.33	Agreed
30	Lack of Standard ICT studio	11	9	4	0	3.29	Agreed

Key: No. of Teachers = 24. **SA** = Strongly Agreed, **A** = Agreed, **SD** = Strongly Disagreed **D**= Disagreed, **X**= Mean —

Table: 4 above represent mean responses on the challenges of using ICT in teaching and learning of Motor Vehicle Mechanic Work trade using Information and Communication Technology (ICT) in Adamawa State. The respondents agreed with items comprising of 16, 17, 18, 19, 21 ,22, 23, 24, 25, 26, 27, 28,29 and 30 with mean is above average. While item 5 was disagreed with mean average of 2.28. This clearly showed challenges of using ICT in teaching and learning of Motor Vehicle Mechanic Work trade using Information and Communication Technology (ICT) in Adamawa State are, Power failure affect the use of Information and Communication Technology for effective teaching and learning Motor Vehicle Mechanic Work Trade, Lack of relevant software packages affect effective teaching and learning of Motor Vehicle Mechanic Work Trade, Teachers reluctance to the new Technology amount to ineffective use of Information and Communication Technology in teaching Motor Vehicle Mechanic Work trade, Some Motor Vehicle Mechanic Work Trade teacher lack the knowledge and skills of using Information and Communication Technology, Lack of planning using ICT facilities by

the teachers teaching Motor Vehicle Mechanic Work Trade effect the effectiveness teaching topics in Motor Vehicle Mechanic Work Trade, Inability of teacher to use computer hinders the effectiveness of their teaching and learning and Lack of projector in the Technical Colleges effect the efficiency of teaching transmission unit. Challenges of using ICT in teaching and learning of Motor Vehicle Mechanic Work trade using Information and Communication Technology (ICT)

Research Question Three

(3) What are the benefits of using ICT in teaching and learning Motor Vehicle Mechanic Work trade using Information and Communication Technology (ICT) in Adamawa state?

Table: 5. Opinion of respondents on the benefit of using ICT in teaching and learning Motor Vehicle Mechanic Work trade using Information and Communication Technology (ICT) in Adamawa State

S/N	Question	SA	A	SD	D	Mean $\overline{X}$	Remarks
31	The use of Information and Communication Technology provides students cognitive knowledge of a concept during teaching/learning of two strokes cycle	7	14	2	1	3.12	Agreed
32	Computer can display the operation of a process when use in teaching Motor Vehicle Mechanic Work such as cam shaft and crank shaft arrangement	7	6	3	8	2.62	Agreed
33	Information and Communication Technology enable teacher and students to manipulate all the ICT facilities to draw diagrams, chart and drawing of vehicle part	6	11	2	5	2.75	Agreed
34	The use of Information and Communication Technology can produce Motor Vehicle Mechanic Work Trade graduates with a sound knowledge on ICT usage and fit in the world of work when employed	8	12	1	3	3.04	Agreed
35	The use of Information and Communication Technology in Teaching Motor Vehicle mechanic work trade can provides students wide knowledge of modern vehicle in diagnosis and electronic use in Motor Vehicle Mechanic Work Trade	8	14	1	1	3.12	Agreed
36	Use of optical fibers, videos digital multimedia can aid in the display of vehicle frame, and the transmission arrangement in the teaching process	6	16	1	1	3.12	Agreed
37	Some teachers see the utilization of ICT facilities in teaching Motor Vehicle Mechanic Work Trade topics like piston reciprocation in a cylinder as simple than drawing it	7	13	0	4	2.95	Agreed
38	The use of diagnosing machine help the students Motor Vehicle Mechanic Work Trade in detecting fault on engine during practical	7	12	2	3	2.96	Agreed
39	Some ICT soft wares allows an interactive session by both teachers, students and the outer world	7	7	2	8	2.75	Agreed
40	Rehearsals that aids permanent learning are allowed when using ICT	11	8	5	0	3.25	Agreed
41	Easy marking of work is carried out when using ICT	10	7	6	0	3.04	Agreed
42	Results are easily recorded when test are conducted with ICT	9	6	7	2	2.91	Agreed

43	Electronics systems can be easily identify when learning using ICT	9	8	5	1	2.95	Agreed
44	System location on vehicles is made easier using ICT	10	9	5	0	3.20	Agreed
45	A lot of content coverage is possible when using ICT	8	9	5	1	2.91	Agreed

Key: No. of Teachers = 24 SA = Strongly Agreed A = Agreed SD = Strongly Disagreed D= Disagreed Mean = X ——

Table 5 above represent mean responses on the benefit of using ICT in teaching and learning Motor Vehicle Mechanic Work trade using Information and Communication Technology (ICT) in Adamawa State. The respondents agreed with items comprising all 15 items are agreed upon. This clearly showed that there are benefits of using ICT in teaching and learning Motor Vehicle Mechanic Work trade using Information and Communication Technology (ICT) The use of Information and Communication Technology give students true knowledge of a concept during teaching and learning of two stroke cycle**,** Computer can display the operation of a process when use in teaching Motor Vehicle Mechanic Work such as cam shaft and crank shaft arrangement, Information and Communication Technology enable teacher and students to manipulate all the ICT facilities to draw diagrams, chart and drawing of vehicle part**,** The use of Information and Communication Technology can produce Motor Vehicle Mechanic Work Trade graduates with a sound knowledge on ICT usage and fit in the world of work when employed**,** The use of Information and Communication Technology in Teaching Motor Vehicle mechanic work trade can give student wide knowledge of modern vehicle in diagnosis and electronic use in Motor Vehicle Mechanic Work Trade, Use of optical fibers, videos digital multimedia can aid in the display of vehicle frame, and the transmission arrangement in the teaching process and The use of diagnosing machine help the students Motor Vehicle Mechanic Work Trade in detecting fault on engine during practical these are the benefit of using ICT in teaching and learning Motor Vehicle Mechanic Work trade using Information and Communication Technology (ICT)

Summary

This research work focused on the use of Information and Communication Technology for effective teaching and learning of Motor Vehicle Mechanic work trade in Technical Colleges in Adamawa State. The study was guided by three research questions and three objectives the data was obtained using structure Questionnaire. This was administered to Twenty-four (24) teachers. Purposive sampling was used. Data collected for the study were analyzed using mean. Based on the findings of the study it was reveals that Information and Communication Technology (ICT) has an impact in teaching and learning of Motor Vehicle Mechanic Work trade Information and Communication Technology aid the teacher, students during teaching and learning of Motor Vehicle Mechanic work trade when teaching on engine component, Using Network Computing Device (NCD) machine, slide and digital multimedia helps in balancing theory and practical aspect as picture of the component can be seen as they operate, Slide and overhead projectors are used in teaching four strokes cycle engine operation.

Discussion of the findings

The data collected was analyzed and findings inferred the discussion of the findings are arranged according to research questions in identifying the impact of information and communication Technology (ICT) facility for effective teaching and learning motor vehicle Mechanic Work Trade in Technical Colleges in Adamawa State. Some Motor Vehicle Mechanic Work trade teachers agreed that if information and communication Technology facilities are use in Teaching and learning of Motor Vehicle Mechanic Work Trade subjects it can have a great impact in the teaching and learning process.

In identifying the challenges of using ICT in teaching and learning Motor vehicle Mechanic Work Trade, Some teachers agreed that there is a challenge in using ICT facilities in Teaching and learning of Motor Vehicle Mechanic Work Trade as a result of power failure, lack of relevant soft were package, Teachers reluctance to new technology, lack of knowledge of ICT facilities by some Motor Vehicle Mechanic Work Trade Teachers inabilities of teachers to use computer and lack of projector in teaching Colleges of Adamawa State.

Regarding responses on the benefit of using ICT facilities for effective teaching and learning of Motor Vehicle Mechanic Work Trades in Adamawa State, teacher agreed that the use of ICT facilities has a

great benefit to both student and the teachers of Motor Vehicle Mechanic Work Trade as it give students true knowledge of any aspect of the Motor Vehicle part during learning, it can display the operation of a process when use in teaching Motor Vehicle engine component; can produce Motor Vehicle Mechanic Work Trade graduate with a sound knowledge on ICT usage and fit in the world of work when employee it give Motor Vehicle Mechanic Work trade knowledge of modern vehicle in diagnosis and electronic use in Motor Vehicle.

Conclusion

It was the purpose of this study to find out whether it using information and communication Technology ICT can help to promote knowledge development of students and to help the teacher of Motor Vehicle Mechanic Work Trade in Teaching and learning in Technical Colleges of Adamawa State. It was as well the purpose of the study that the findings of the research shall be used to suggest the possible solution to the Adamawa State Government where the ICT equipment are not being use and where inadequate used is not been given priority, also where the computer are not enough to meet requirement of the teachers of Motor Vehicle Mechanic Work Trade in Adamawa State.

The government from review of literature on the application of ICT facilities in Teaching Mechanical Trade place high premium on the issues of the use of ICT on teaching and Motor Vehicle Mechanic Work Trade Subject.

Among the major short falls observed from the survey of the schools. It was discovered that there are school where the ICT equipment do not exist at all and the teachers are not even literates. In the field of ICT as a result it can hinder the use of ICT facilities it there are, and in some of the schools there are computers but are not use in teaching Motor Vehicle Work Trade subject. But are only use for teaching ICT as a subject and typewriting of which it cannot facilitate the use of ICT in the area of Motor Vehicle Mechanic Work trade.

It is therefore hoped and believed that other researches, the government in the state as well as the ministry of Education or and education body and planners in their efforts to find out the necessary implementation problems of ICT equipment utilization for the teaching Motor Vehicle Mechanic Work trade. Programme as well as to resolve such problems Government should show enough interest and to provide a lasting solution to the lack of using ICT facilities and equipment for effective teaching and learning Motor Vehicle Mechanic Work trade subjects enumerated as the findings and put to use the finding on ICT for the growth, progress and development of ICT and use in teaching and learning of Motor Vehicle Mechanic Work trade subjects.

Recommendations

Base on the findings of the study the following recommendation were made.

1. Alternative power supply should be provided to Technical Colleges by Government and non-governmental organization, to enable Motor Vehicle Mechanic Work Trade teachers use Information and Communication Technology facilities.
2. Training and workshop on the use of ICT facilities for Motor Vehicle Mechanic work Trade teachers should be organized regularly to update teachers.
3. Relevant software packages, projectors, simulators and slide should be supply to Technical Colleges by Government and non-governmental organization for the use by Motor Vehicle Mechanic Work Trade teachers.
4. Projectors, slides and computers should be used during teaching of Motor Vehicle Mechanic Work Trade subject.

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RECONFIGURATION OF RADIAL DISTRIBUTION NETWORK WITH INCORPORATION OF DISTRIBUTED GENERATOR FOR DETERMINING COST BENEFIT USING WHALE OPTIMIZATION ALGORITHM FOR SUSTAINABLE DEVELOPMENT

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Abstract
The electrical Distribution Network (DN) delivers generated electrical power to its final consumers. However, a significant portion of the power generated is lost in the distribution process due to the radial nature of the network resulting in substantial operating costs. This problem has been solved previously using optimal reconfiguration of the DN, but cannot achieve a global optimum solution and high cost-benefit. Therefore, this study developed an optimal reconfiguration of DN with the incorporation of a distributed generator using the Whale Optimization Algorithm (WOA) to maximize the cost-benefit for sustainable development.

The line and load data for the Ayepe 34-bus system, Osogbo, were collected from Ibadan Electricity Distribution Company (IBEDC), Ibadan. In contrast, the IEEE 33-bus system was sourced from the Institute of Electrical Electronic Engineers (IEEE) database. Then, the load flow analysis was performed on the distribution network using the forward/backward sweep technique to determine the initial state of the DN. The objective function of the cost-benefit was formulated using the costs of the DG, tie switches, and active power purchased over a twenty-five years planning period. The WOA was utilized for optimal DN reconfiguring after the DG had been analytically placed in the DN to maximize the formulated cost-benefit. The effectiveness of the developed model was validated on the IEEE 33-bus DN and implemented on the Ayepe 34-bus DN for different scenarios; base case, DG only, reconfiguration only, and DG with reconfiguration. The performance metrics used were active power loss, voltage profile, and cost-benefit.

The result of DG with reconfiguration gave a better power loss reduction, voltage profile, and cost-benefit compared to reconfiguration only. Hence, this research can be employed in electrical power systems for future expansion and effective DN planning.

Keywords: Distribution Network, Electrical Power, Reconfiguration, Distributed Generator

Introduction

In power system operation, electrical distribution system (DS) is the final stage of the electrical energy supply chain, where electricity is delivered to individual consumers via a radial network. The fact is that the operating cost in the distribution system is huge with power system losses accounting for the majority of the cost. Technically, power losses reduce the total voltage profile of the network, particularly in systems that are heavily loaded (Kashyap *et al*., 2022). Because of the need for better service quality and better use of available energy, the problem of minimizing distribution system losses has been a major focus for researchers and utility companies.

Distribution systems are planned as radial systems, with tie (Normally Open, NO) and sectionalizing (Normally Close, NC) switches playing an important part in deciding the system's architecture (Prakash and Lakshminarayana, 2018). As a result, in order to effectively manage the open/close status of sectionalizing and tie-switches in the distribution system network, the process of reconfiguration is done by altering the feeder topological structure (exchanging the functional links between its elements). Hence, reconfiguration is the process of varying the topology of distribution network by changing the closed/open status of sectionalizing and tie switches while satisfying the system constraints. (Prasad *et al*., 2005; Abubakar *et al*., 2015; Badran *et al*., 2017).

Due to the possible switching combinations, reconfiguration of distribution systems is a complicated combinatorial, non-differentiable constrained optimization problem (Abubakar *et al*., 2015). Many researchers have created and used a variety of methods to address the reconfiguration issue, such as branch and bound techniques, analytic approaches, heuristic approaches, expert systems, linear programming, artificial intelligence. The problem of network reconfiguration was previously defined as a single objective function targeted at lowering active power losses in the network (Abdelaziz *et al*., 2012). However, one of the key drawbacks of these studies is that their findings do not guarantee a successful solution, raising the risk of becoming caught in local minima. The challenges of distribution network can be organized into objective functions that can be reduced while adhering to certain constraints and boundaries. (Nagaballi & Kale, 2021).

Problem Statement

The process of connecting cables from one point to other and switching of electrical appliances cause electrical power loss in form of heat (I^2R) of about ten to twenty percent of total power supply. It may also causes voltage drop which are dangerous or hazardous to electrical equipment being used by the consumers and in turn result into loss of income or profit to the utility company. Power loss is inevitable on distribution network and it is very important to keep voltages at load points within standard limits. Although, considerable number of researchers have used diverse conventional methods such as Newton-Raphson, Gauss-seldel to solve these problems, but most of these techniques are laborious and time consuming. This work therefore, proposed to reduce electrical power loss along radial distribution networks, improved voltage magnitude across line and determined economic cost-benefit by the reconfiguration of radial distribution network with incorporation of DG using whale optimization algorithm.

Aim and Objectives

The aim of this research is to use the reconfiguration of radial distribution network with the incorporation of Distributed Generator for determining cost benefit using Whale Optimization Algorithm for sustainable development.

The specific objectives were to:

i. formulate an objective function for the optimal reconfiguration of an electrical distribution network;
ii. incorporate and simulate the formulated objective function in (i) into Whale Optimization Algorithm;
iii. carry out performance evaluation of WOA in objective (ii) on a standard IEEE-33-bus radial distribution system and Ayepe-34-bus distribution system using power loss, voltage profile and cost benefit as metrics.

Methodology

The forward/backward sweep load flow was adopted and used to determine the base case of the system. The WOA was then used for the optimal reconfiguration of the radial distribution network. WOA was chosen due to its effectiveness in solving complex optimization problems.

Data required for carrying out the research was collected from the Ibadan Electricity Distribution Company, Ayepe and IEEE 33-bus system was sourced from the IEEE database. The data captured the network diagram, rating of each transformer, capacity of feeder and the length between each connected transformer. The WOA and the objective function was implemented in MATLAB R(2020a) environment. Thereafter, the performance of the Whale Optimization Algorithm, when applied to a standard IEEE 33-bus radial distribution network and Ayepe 34-bus distribution network, was evaluated using the Loss Reduction Index and Voltage Profile Improvement Index.

Algorithm for Distribution Network Load Flow with and without Compensation

The simulation was carried out according to the algorithm steps hereunder;

Step 1: Read the distribution networks line data and bus data.
Step 2: Determine the initial status of the tie switches of the radial distribution network.
Step 3: Calculate the node current injection matrix. The relationship can be expressed as:

$$[I] = \left[\frac{S}{V}\right]^* = \left[\frac{P-jQ}{V^*}\right] \quad (1.0)$$

Step 4: Calculate the NIBC matrix

Step 5: Evaluate the branch current by using Node Injection to Branch Current (NIBC) matrix and Equivalent Current Injection Matrix (ECI). The relationship can be expressed as-

$$[I_B] = [NIBC][I] \quad (2.0)$$

Step 6: From the Branch Current to Node Voltage (BCBV) matrix
The relationship can be expressed as-

$$[\Delta V] = [BCBV][I_B] \quad (3.0)$$

Step 7: Calculate the Distribution Loss Flow (DLF) matrix.
The relationship will be-

$$[DLF] = [BCBV][NIBC] \quad (4.0)$$

$$[\Delta V] = [DLF][I] \quad (5.0)$$

Step 8: Set iteration $k = 0$.

Step 9: Iteration $k = k + 1$.

Step 10: Update voltages by using equations (6.0, 7.0 and 8.0)

$$I_i^k = I_i^P(V_i^k) + jI_i^kV_i^k = (\frac{P+jQ}{V_i^k})^* \quad (6.0)$$

$$[\Delta V^{K+1}] = [DLF].[I^k] \quad (7.0)$$

$$[V^{K+1}] = [V^0] + [\Delta V^{k+1}] \quad (8.0)$$

Step 11: If $\max((|V(k+1)| - |V(k)|) > tolerance$ go to step 8

Step 12: Calculate branch currents, losses from final node voltages.

Step 13: Display the node voltage magnitudes and angle, branch currents, losses and tie switches

Step 14: Stop

Evaluation of cost-benefit due to reduced energy purchased

Utilities (Transcos or Discos) purchase power from the transmission grid to satisfy end-users' power demand but a portion of this power is wasted as losses in feeder lines. The purchase price (PP_{Grid}^{Before}) of energy from the substation before reconfiguration and integration of DG is given by (Aruraj and Kumarappan, 2018):

$$PP_{Grid}^{Before} = C_{Grid} \times \left(P_{Grid}^{Before} + P_{loss}^{After}\right) \times T$$

(9.0) where C_{Grid} is the grid electricity price in \$/MWh, P_{Grid}^{Before} is the total real power (in MW) drawn from the substation before integration of DG, and P_{loss}^{After} is the total real power loss after integration of DG.

By optimally installing DG, the utilities (Transco or Disco) can supply a portion of system power demand and also minimize the system power losses. Therefore, the purchase price of energy from the substation including energy loss after reconfiguration and DG integration, PP_{Grid}^{After} is given by:

$$PP_{Grid}^{After} = C_{Grid} \times \left(P_{Grid}^{After} + P_{loss}^{After}\right) \times T \quad (10.0)$$

where P_{Grid}^{After} is the total real power (in MW) injected at bus 1 from the substation after reconfiguration and integration of DG and P_{loss}^{After} is the total real power loss (in MW) after reconfiguration and integration of DG.

Therefore, after reconfiguration and DG installation, the annual cost-benefit (CB_P) due to reduction in the cost of power purchased from the substation including energy loss is given by (Aruraj and Kumarappan, 2018):

$$CB_P = PP_{Grid}^{Before} - PP_{Grid}^{After} \quad (11.0)$$

Substituting (9.0) and (10.0) in (11.0), then

$$CB_P = C_{Grid} \times \left[\left(P_{Grid}^{Before} - P_{Grid}^{After}\right) + \left(P_{loss}^{Before} - P_{loss}^{After}\right)\right] \times T \quad (12.0)$$

The Present Worth Factor (PWF) of (10.0), (11.0) and (12.0) was evaluated as:

$$PWF\left(PP_{Grid}^{Before}\right) = PP_{Grid}^{Before} \times \sum_{y=1}^{N_{yrs}} \left(\frac{1+\inf R}{1+\text{int} R}\right)^{y} \quad (13.0)$$

$$PWF\left(PP_{Grid}^{After}\right) = PP_{Grid}^{After} \times \sum_{y=1}^{N_{yrs}} \left(\frac{1+\inf R}{1+\text{int} R}\right)^{y} \quad (14.0)$$

$$PWF\left(CB_{P}\right) = CB_{P} \times \sum_{y=1}^{N_{yrs}} \left(\frac{1+\inf R}{1+\text{int} R}\right)^{y} \quad (15.0)$$

Evaluation of the total cost-benefits (CB_T)

Finally, the various DG cost and benefits mentioned in the previous sub-section are modeled into one unique objective function expressed as follows:

$$Maximise\left(CB_{T}\right) = PWF\left(CB_{P}\right) - \left(PWF\left(SW_{Cost}\right) + DG_{COST}\right) \quad (16.0)$$

where CB_T is the total cost-benefit achieved for the number of planning years $\left(N_{yrs}\right)$ through reconfiguration of the network and optimal DG integration. The objective function expressed in equation (16.0) was optimized subject to the technical equality and non-equality constraints in the next sub-sections.

Constraints

The objective function is subject to the following constraints:

(i) Power flow equations

The power flow equation is solved using Back/Forward Sweep technique in the optimization process. These equations are given as:

$$P_{gi} = P_{Di} + \sum_{j=1}^{n_b} |V_i||V_j|\left[G_{ij}\cos\theta_{ij} + B_{ij}\sin\theta_{ij}\right] \quad (17.0)$$

$$Q_{gi} = Q_{Di} + \sum_{j=1}^{n_b} |V_i||V_j|\left[G_{ij}\sin\theta_{ij} - B_{ij}\cos\theta_{ij}\right] \quad (18.0)$$

where V_i and V_j are the voltages of buses '*i*' and '*j*' respectively; P_{gi} and P_{Di} are the real power generated and power demanded at bus '*i*'; Q_{gi} and Q_{Di} are the reactive power generated and demanded at bus '*i*'; and θ_{ij} is the difference between the voltage angles of buses '*i*' and '*j*'.

(ii) Real power generation constraint of DG

The size of each of the installed shunt capacitors is constrained within the limits as in equations (19.0) and (20.0);

$$P_{DG(\min)} \le P_{DG} \le P_{DG(\max)} \quad (19.0)$$

$$Q_{DG(\min)} \le Q_{DG} \le Q_{DG(\max)} \quad (20.0)$$

where $P_{DG(\min)}$ = 100 kW and $P_{DG(\max)}$ is 75% of the total real power demand of the network and $Q_{DG(\min)}$ = 150 kVAr and $Q_{DG(\max)}$ is 75% of the total reactive power demand of the RDN.

(iii) Bus voltage limitation

The voltage must fall within the standard limits for RDN

$$V_{\min} \le V_i \le V_{\max} \quad (21.0)$$

where $V_{\min}$ is the minimum voltage ($V_{\min}$ = 0.95), $V_{\max}$ is the maximum voltage ($V_{\max}$ = 1.05), and V_i is the bus voltage.

(iv) Radial configuration constraint

The radial nature of the RDN must be maintained such that there is just a unidirectional flow of power to all buses associated with the network.

Implementation of Whale Optimization Algorithm for Optimal System Reconfiguration

For the optimization of power flow with reconfiguration of switches, Whale Optimization Algorithm (WOA) was implemented to determine the interval and which switch device is required to be closed or opened in order to minimize system losses. Those characteristics of whales was formulated based on objective function of equation (16.0) and a script was written in MATLAB R(2020a) to solve the resulting optimization method based on equation (22.0).

$$\text{Optimize } f(x) = \alpha \cdot P_L + \beta \cdot VPII + \delta . \text{CB}_T \quad (22.0)$$

where; $x = [\ V_i, P_{SWi}, Q_{SWi}, n_{SWbus}, \text{CB}]$ is the vector of variables or particles

The following parameters were considered in the optimization process:

i. The optimal network reconfiguration switches position will be considered as the first step of optimization process. The network variables such as voltage changes, power loss and system balance condition will be incorporated with the optimization algorithm.
ii. The capacity of switches according to the working range of distribution network reconfiguration will be determined.
iii. The power flow model of distribution network will be examined and also the stability of the system will be evaluated.

Based on the above processes, the Whale Optimization Algorithm is initiated and the encircling prey location, spiral bubble-net feeding updating position and global search updating position will be calculated using equations (23.0) to (27.0).

The humpback whales encircling prey location is calculated as:

$$D = \left| \vec{C}.\vec{X}^{*}(t) - X(t) \right| \quad (23.0)$$

The spiral bubble-net feeding updating position of whales during optimization is calculated as:

$$\vec{X}(t+1) = \begin{cases} \vec{X}^{*}(t) - \vec{A}.D \\ \vec{D}.e^{bl}.\cos(2\pi l) + \vec{X}^{*}(t) \end{cases} \quad p \le 0.5 \quad (24.0)$$

Whale Optimization Algorithm global search updating position is calculated as:

$$D = \left| \vec{C}X_{rand} - \vec{X} \right| \quad (25.0)$$

$$\vec{X}(t+1) = X_{rand} - \vec{A}.\vec{D} \quad (26.0)$$

The fitness function of the Whale Optimization Algorithm in solving the optimum location of the switches for loss minimization is the objective function given in equation (22.0). The fitness function will be computed as:

$$FF = P_{Loss}^{0} - P_{Loss}^{\text{Rec}} \quad (27.0)$$

where

$\overline{A}$ and $\overline{C}$ are coefficient vectors; t indicates the current iteration,

b is a constant for defining the shape of the logarithmic spiral

p is a random number in the range [0,1]; l is a random number in the range [-1,1]

X_{rand} is a random position vector chosen from the current population

a is linearly decreased from 2 to 0 over the course of iterations; X is the position vector

$\overline{X}$ is the position vector of the best solution obtained

D is the ith whale to the prey (best solution obtained)

FF is the fitness function

The following are the steps involved in the Whale Optimization Algorithm for optimal power flow with network reconfiguration.

Step 1: Read the system data while satisfying different equality and inequality constraints.

Step 2: Initialize the whale population and set the maximum number of iterations.

Whale population of N prey is represented by

$$X_i = \left[X_1^i ....., X_{d-1}^i, X_d^i \right] \ with\ i = 1,2,.....N_{ts} \quad (28.0)$$

In which each X_i represents a solution vector of variables given by:

$$X_i = \left[SW_1^i, SW_2^i ....., SW_d^i\right] with\ d = 1,2,.....N_{ts} \quad (29.0)$$

Step 3: Run FBS load flow for initial network status

Step 4: Evaluate the fitness value of each search agent using the mathematical representation of objective function in equation (16.0) for maximum loss reduction and identify the best switch candidate solution without violating the constraints.

Step 5: For each search agent, Update the values of a, A, C, l and p

Step 6: Update the position of the current search agent using equation (24.0)

Step 7: Select a random search agent (X_{rand}) and update the new position of the current search agent using equation (26.0).

Step 8: Check if there is any search agent violating the boundary of search space, amend accordingly and go to step 2

Step 9: Calculate the new fitness function of each search agent

Step 10: Update X^* if there is a better solution, otherwise go to step (8)

Step 11: Output the optimal solution.

Performance Evaluation

The proposed optimal network reconfiguration method was validated on an IEEE 33 standard bus and its performance was evaluated on Ayepe 34-bus distribution system using Power Loss Reduction, Voltage Profile Improvement Index, DG cost, Switch cost and cost benefits as a result of reduced energy purchased as performance metrics. The data for the Nigerian distribution system were sourced from Ibadan Electricity Distribution Company Plc.

Results and Discussions

The summary of results for all the cases considered for the IEEE 33-bus RDN are summarized in Table 4.1. US dollars was chosen for this research for its international recognition and the official rate during the work is #740 to $1 for easy conversion.

Case 1: Base Case without DG and Reconfiguration

The open branches (tie switches) for the initial configuration of the network are 33, 34, 35, 36 and 37 with a real power loss and reactive power loss of 202.67 kW and 140.00 kVAr, respectively. The cost of the power purchased (C_{PP}) from the transmission grid for the considered period for the initial configuration before changing the RDN (Base case) is $19,570,533.20.

Case 2: DG Integration only

After optimal installation of DG, the cost of the DG (DG_{COST}), the reduced energy cost purchased ($C_{\Delta PP}$) from the transmission grid and the overall cost-benefit for the number of planning years were $ 9,527,638.14, $ 12,427,036.56 and $ 2,899,398.40, respectively for IEEE 33-bus RDN. From the third column of Table 4.1a, it is crystal clear that the cost of energy purchased from the transmission grid was reduced from $ 19,570,533.20 to $5,248,283.25. The decrease in the cost of the energy power purchased was due to significant reduction of the total power purchased from the grid and lower power loss in the distribution systems due to the optimal installation of DG.

This eventually resulted into an appreciable cost benefits of $ 2,899,398.40 despite the high DG cost incurred. This cost-benefit obtained was equivalent to 14.8% cost savings with respect to the power purchased.

Table 4.1: Summary of Results for all cases of IEEE 33-bus RDN

Parameters	Base Case	DG only	Rec only	DG and Rec
Optimal size (kW)	--------	2389	-------	2389
Location	--------	6	--------	6
Tie Switch	33-34-35-36-37	33-34-35-36-37	5-7-10-21-23	11-14-32-33-37
P_{loss} (kW)	202.67	104.00	127.85	89.07
Q_{loss} (KVAr)	140.00	70.00	130.00	70.00
V_{min} (p.u.)	0.9131 (18)	0.9484 (18)	0.9372 (7)	0.9595 (32)

VSI (p.u.)	0.6969 (18)	0.8091 (18)	0.7714 (7)	0.8477 (32)
DG cost ($) $\times 10^6$	--------	9.5276	--------	9.5276
Switch cost ($)$\times 10^3$	--------	--------	28.969	17.382
Cost of PP ($)$\times 10^6$	19.571	5.2482	19.1968	7.0686
Cost of ΔPP ($)$\times 10^6$	--------	12.427	0.3737	12.502
Cost-benefit ($)$\times 10^6$	--------	2.8994	0.3448	2.9566
% Savings	--------	14.815	1.762	15.107

Case 3: Reconfiguration only

After reconfiguration, the open branches (tie switches) for the new configuration are 5, 7, 10, 21 and 23 with real and reactive power loss of 127.85 kW and 130.00 kVAr, respectively. The reduced energy cost purchased ($C_{\Delta PP}$) from the transmission grid, the switch cost (S_{COST}) and the overall cost-benefit for the number of planning years were $ 373,759.73, $ 28,969.81 and $ 344,789.92, respectively for IEEE 33-bus RDN. From the fourth column of Table 4.1a, it was crystal clear that the cost of energy purchased from the transmission grid were reduced from $ 19,570,533.20 to $ 19,196,773.47. The decrease in the cost of the energy power purchased were due to significant reduction of the power loss in the distribution systems due to alteration of the topological structure of the RDN. This eventually resulted to a cost benefits of $ 344,789.92 which is equivalent to 1.8% cost savings with respect to the power purchased.

Case 4: Reconfiguration and DG

After reconfiguration of the RDN in the presence of DG, the open branches of the RDN were 11, 14, 32, 33 and 37, and the DG size was 2, 389 kW. The real and reactive power losses are 89.07 kW and 70.00 kVAr, respectively. The obtained DG_{COST}, switch-cost, $C_{\Delta PP}$ and cost-benefit over the number of planning years were $ 9,527,638.14, $ 17,381.89, $ 12,501,618.67, and $ 2,956,598.64, respectively. From the fifth column of Table 4.1a, it can be seen that the cost of energy purchased was reduced from $ 19, 570, 533.20 to $ 7, 068, 564.86. The decrease in the cost of the energy power purchased were due to significant reduction of the total power purchased from the grid and minimal power loss due to alteration of the topological structure of the RDN and integration of DG. This eventually resulted into an appreciable cost benefits of $ 2,956,598.64 despite of the high DG cost incurred. This cost-benefit obtained was equivalent to 15.1 % cost savings with respect to the power purchased from the transmission grid.

Comparative Study of Results for the Different Cases

All the cases considered in research are compared in terms of real power loss, reactive power loss, cost-benefit, voltage profile and VSI profile are illustrated in Figures 4.1 – 4.4, respectively. In Figure 4.1b it was clearly depicted that case 4 (Reconfiguration and DG) gave the least power loss followed by case 2 (DG only), while case 3 (reconfiguration only) had the highest power loss after the base case. Case 4 gave the highest cost-benefit as illustrated in Figure 4.4 even though it incurred the highest cost comprising of DG and switch expenses. This was closely followed by case 2 (DG only) and case 3 (Reconfiguration). The percentage cost-savings of cases 2, 3 and 4 are 14.8%, 1.8% and 15.1%, respectively. Figures 4.3 and 4.4 depict the voltage and VSI profiles of all the four cases for the IEEE 33-bus RDN. It was clearly illustrated in the Figures that case 4 gave the best improvement in the voltage and VSI values throughout the buses and branches of the RDN.

Comparative Study for IEEE 33-bus distribution system

The results obtained for cases 2 – 4 were compared with that of other publications who utilized other optimization techniques in terms of real power loss and cost-benefit for the purpose of validation of the proposed technique. Although the compared literatures used power loss and other parameters for their objective function, their cost-benefits were calculated using the same cost specification used in this research for fair comparison. From Table 4.1 it was crystal cleared that the proposed technique gave a superior cost-benefit and percentage power loss reduction compared to existing techniques.

4.3 Ayepe 34-bus RDN Results

The results for the considered cases are summarized in Table 4.2.

Case 1: Base Case without DG and Reconfiguration
The open branches (tie switches) for the initial configuration of the network are 34, 35, 36, 37 and 38 with a real power loss and reactive power loss of 762 kW and 150 kVAr, respectively. The cost of the power purchased (C_{PP}) from the transmission grid for the considered period for the initial configuration before changing the RDN (Base case) is \$24,387,797.62. All the parameters obtained for the base case are shown in the second column of Table 4.2.

Case 2: DG Integration only
After optimal installation of DG, the cost of the DG (DG_{COST}), the reduced energy cost purchased ($C_{\Delta PP}$) from the transmission grid and the overall cost-benefit for the number of planning years are \$ 14,038,211.07, \$ 20,736,122.07 and \$ 6,697,911.00, respectively for Ayepe 34-bus RDN. From the third column of Table 4.2, it is crystal clear that the cost of energy purchased from the transmission grid were reduced from \$ 24,387,797.62 to \$3,651,675.56. The decrease in the cost of the energy power purchased were due to significant reduction of the total power purchased from the grid and lower power loss in the distribution systems due to the optimal installation of DG. This eventually resulted to an appreciable cost benefits of \$ 6,697,911.00 despite of the high DG cost incurred. This cost-benefit obtained is equivalent to 27.5 % cost savings with respect to the power purchased.

Case 3: Reconfiguration only
After reconfiguration, the open branches (tie switches) for the new configuration are 10, 14, 30, 31 and 32 with real and reactive power loss of 406.8kW and 120.0 kVAr, respectively. The reduced energy cost purchased ($C_{\Delta PP}$) from the transmission grid, the switch

Table 4.2: Summary of Results for all cases of Ayepe 34-bus RDN

Parameters	Base Case	DG only	Rec only	DG and Rec
Optimal size (kW)	--------	3520	-------	3520
Location	--------	14	--------	14
Tie Switches	34-35-36-37-38	34-35-36-37-38	10-14-30-31-32	16-32-34-36-38
P_{loss} (kW)	762.24	131.13	406.79	127.12
Q_{loss} (KVAr)	150.00	30.00	120.00	30.00
V_{min} (p.u.)	0.8300 (25)	0.9860 (24)	0.8599 (25)	0.9843 (17)
VSI (p.u.)	0.4743 (25)	0.9462 (25)	0.5192 (24)	0.9387 (18)
DG cost (\$) $\times 10^6$	--------	14.0382	--------	14.0382
Switch cost (\$)$\times 10^3$	--------	--------	23.1759	11.588
Cost of PP (\$)$\times 10^6$	24.3878	3.6517	23.0317	3.5754
Cost of ΔPP (\$)$\times 10^6$	--------	20.7361	1.3561	20.2477
Cost-benefit (\$)$\times 10^6$	--------	6.6979	1.3329	7.1766
% Savings	--------	27.464	5.465	29.427

cost (S_{COST}) and the overall cost-benefit for the number of planning years are \$ 1,332,939.56, \$ 23,175.85 and \$ 1,332,939.56, respectively for IEEE 33-bus RDN. From the fourth column of Tables 2, the cost of energy purchased from the transmission grid were reduced from \$24,387,797.62 to \$ 23,031,682.21. The decrease in the cost of the energy power purchased were due to significant reduction of the power loss in the distribution systems due to alteration of the topological structure of the RDN. This eventually resulted to a cost benefits of \$1,332,939.56 which is equivalent to 5.5 % cost savings with respect to the power purchased.

Case 4: Reconfiguration and DG
After reconfiguration of the RDN in the presence of DG, the open branches of the RDN are 16, 32, 34, 36, and 38 and the DG size is 3, 520 kW. The real and reactive power losses are 131.12 kW and 30.0 kVAr, respectively. The obtained DG_{COST}, switch-cost, $C_{\Delta PP}$ and cost-benefit over the number of planning years are \$ 14,038,211.07, \$ 11,587.95, \$ 20,247,719.65, and \$ 14,049,799.02, respectively. From the fifth column of Table 4.2, it can be seen that the cost of energy purchased was reduced from \$ 24,387,797.62 to \$ 3,575,422.43. The decrease in the cost of the energy power purchased were due to significant reduction of the total power purchased from the grid and minimal power loss due to alteration of the topological structure of the RDN and integration of DG. This eventually resulted to an appreciable cost benefits of \$7,176,601.10 despite of the high DG cost incurred. This cost-benefit

obtained is equivalent to 29.4% cost savings with respect to the power purchased from the transmission grid.

Comparative Study of Results for the Different Cases

All the cases considered in research are compared in terms of P_{loss}, cost-benefit, voltage profile and VSI profile are illustrated in Figures 4.5 – 4.8, respectively. In Figure 4.5, it is clearly depicted that case 4 (Reconfiguration and DG) gave the least power loss followed by case 2 (DG only) while case 3 (Reconfiguration only) had the highest power loss after the base case. Case 4 gave the highest cost-benefit as illustrated in Figure 4.8 even though it incurred the highest cost comprising of DG and switch expenses. This is closely followed by case 2 (DG only) and case 3 (Reconfiguration). The percentage cost-savings of cases 2, 3 and 4 are 27.5 %, 5.5 % and 25.3 %, respectively. Figures 4.7 and 4.8 depict the voltage and VSI profiles of all the four cases for the IEEE 33-bus RDN. It is clearly illustrated in the Figures that case 4 gave the best improvement in the voltage and VSI values throughout the buses and branches of the RDN.

Conclusion

In each case, results were presented and showed that there was decease in the cost of the energy power purchased. This was as a result of significant reduction of the total power purchased from the grid and lower power loss in the distribution networks due to the optimal installation of DG into the system for economic sustainable development in the power sector.

Recommendations

The following recommendations are made for further studies:

i. dynamic nature of load was not considered in this research. Future work can take into consideration the dynamic nature of loads.
ii. in this work, the radial distribution networks were assumed to be balanced. Future works can consider the impact of optimal reconfiguration on unbalanced radial distribution networks.

Contribution to Knowledge

The following contributions were made:

i. formulation of a model for the evaluation of total cost-benefits of optimal reconfiguration of radial distribution network in the presence of DG was done; and
ii. implementation of WOA for optimal reconfiguration of Nigerian Distribution Network in the presence of DG has been done successful

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LEVEL OF AWARENESS AND COMPLIANCE WITH ROAD SIGNS AND SYMBOLS AMONG MOTORIST IN NIGER STATE

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Abstract
The study was designed to determine the level of awareness and compliance with road signs and symbols among motorists in Niger State. Five research questions, and five null hypotheses guided the study. A descriptive survey research design was used for the study. The study was conducted in five major towns of Niger State. A total of 400 respondents consisting of 60 Vehicle Inspection Officers and three hundred and forty licensed motorist drawn from each major towns of Niger State, through the accidental sampling techniques the. A structured questionnaire titled: Motorist Road Signs and Symbol Questionnaire (MRSSQ) developed by the researcher and validated by three experts was used for the study. The reliability coefficient of the study was 0.89 through Cronbach Alpha statistics. Statistical package for social sciences (SPSS) version 23 was used for the data analysis. Mean and Standard deviation were the statistical tools used for answering research questions, while t-test was used to test the hypotheses at 0.05 level of significance. The findings of the study among others revealed that; Majority of the road safety signs and symbols are not available in major towns and cities in Niger State and motorist do not complied with road safety signs and symbols. The findings also revealed that driving on hard drugs, reckless driving and drunkenness were the constraint responsible for effective compliance with road safety signs and symbols among motorist in Niger State. The grand mean/standard deviation of various sections of research questions are; 1.16/0.12, 1.88/0.13, 2.07/0.09, 3.29/0.22 respectively. Based on the findings it was recommended that the agencies such as VIO, FRSC and Traffic Management Officer should ensure 100% level of compliance with road safety signs and symbols among motorist and other road users. There should be considerable efforts to control vehicle speeds, mostly through speed limit device /enforcement so as to reduce accident rate.

Keywords: Awareness, compliance, road signs and symbols, motorists,

Introduction

Road signs and symbols are signs inserted at the side of or above the road to give instructions or provide information to the road users. They are silent speakers to the road conditions. Jankaro (2016) describes road signs and symbols as the means of providing valuable information to drivers and other road users. They represent rules that are in place to keep you safe and help to communicate messages to drivers, pedestrians and other road users that can maintain law and order to reduce accidents. Federal Road Safety Corps (FRSC) (2013), states that road signs and symbols are symbolized, illustrative guidance for road users for safer and more convenient travelling while neglecting them can be dangerous. It does not matter you drive a car, ride a bike or just walk, it is mandatory that road users obey or comply with all the road signs as they are not decorators of urban design, nor they are there for reference. Kumuyi (2012) identified road signs as the simple illustration of traffic laws and substitutes for traffic management officers. However, in spite of the provisions of all these road signs and symbols in most cities and towns in Nigeria, some of these road signs and symbols have been identified to have posed difficult threats for motorist and other categories of road users in terms of interpreting, understanding and complying with them correctly and in returns with its attendant consequences on the increased accidents in most urban cities in Nigeria. Although road signs and symbols exist in different shapes and classifications.

Road signs and symbols are classified into varieties of shapes, colour and symbols with its different roles. Idris (2019), classified road signs and symbols into four (4) main groups as follows: Regulatory signs mandatory; Regulatory signs prohibitory; informative signs; and warning signs. Regulatory Signs Mandatory is one of those signs that control the free flow of traffic as well as ensuring safety on the road. They are circular but covered in a blue background without perimeters. Mandatory signs typically

give directions, and the directions are usually noted in white colours. This sign includes among others; diversions, one way, roundabout, keep left, keep right, turn left, and turn right, minimum speed kilometer per hour (kph), end of restriction (Ladan, 2011). The different shapes and colours of road signs are there to help identify them as quickly as possible without interrupting the driver. Despite the installation of road safety signs and symbols in Niger State, series of reported cases of road crashes (accidents) still occurs. The occurrence of road accidents within Niger State might not be unconnected to either neglect or disobeying of road signs and symbols by motorists.

Motorists are individuals who have undergone the process or processes of learning how to drive/driving and are certified by the relevant authority. FRSC (2015), described motorists as those categories of road users who are enclosed in a motor vehicle. Because of their enclosure, they feel protected and assume absolute immunity from accidents. It further stated that the driver of a vehicle has only the protection guaranteed by his or her strict compliance to road safety signs and symbols through the exhibition of the following characters: The driver should be skilled enough to handle any situation on the road, must Hear, must See (most important), must be able to evaluate, alertness and react to information. FRSC (2015) also suggested that drivers must be self-discipline, must have Patience, must have mechanical skills, must be responsible and have enough practice to respond on time in a critical situation on the road (when driving) to avoid road accident. An accident is an unfortunate incident that happens unexpectedly, unintentional or events that happens by chance and typically resulted in damages, injury or death. Globally, people drive several hours from their initial (starting point) to their destination or places of desire daily and this exposed them to the risk of road crashes and injuries. According to Ezenwa (2015), a road traffic accident is referred to any accident involving at least one road vehicle, occurring on a road open to public circulation and in which at least one person is injured or killed." Killed persons" are accidents victims who died immediately or within thirty days of following accidents. The rate of accident is worrisome in Nigeria due to the state of disrepair of Nigerian roads, lack of road caution, road signs and other road safety devices. The forgoing assertion clearly revealed that even though there are provisions for road safety signs and symbols across Nigeria roads it appears that they are not available.

Availa ility is the degree at which facilities, service or functional materials are provided and made ready for use. Availability of road safety signs and symbols is a holistic term which is directed towards accident free among motorists as an entity. It expresses how materials can easily be gotten and used for a particular purpose and time. Availability refers to resources ready to be used, able to be used or that can easily be found and used. Availability refers to service/resources that can be obtained in the discharge of certain functions. Therefore, availability in the context of this study is a state of making provision for a satisfactory, standard requirements in terms of road safety signs and symbols to enhance effective road policing with a view of minimizing or avoiding accidents on our roads among motorists and other categories of road users. Unfortunately, these road safety signs and symbols seems not to be available in sufficient quantities on our major roads for the motorists and all categories of road users thus causing the problem of awareness.

Awareness simply referred to knowledge that something exists, or understanding of a situation or subject at the present time based on information or experience.
According to Gafoor (2012), awareness of road sign and symbols specifically means, knowledge of being conscious; cognizant, informed alert on road safety signs and symbols. In this level of consciousness, sense signs and symbols can be confirmed by motorist without necessarily implying understanding. The processes of any knowledge mUst contain awareness but mere awareness does not contain any type of knowledge. Road safety awareness is an important way to spread information among people about road safety measures and rules. Road safety awareness are flexible tools that communities can use to increase the spread of information and knowledge about specific road safety problems in their own community and can be adapted to a wide range to increase the level of compliance among motorist and other road users.

Compliance is the act of obeying a particular law or rule, or of acting according to an agreement. The state of being too willing to do what other people want you to do. Kumuyi (2012) described Compliance in road safety as the act of carefully followed or obedience to rules guiding the usage of

the roads by road users. Compliance with road safety signs and symbols is important in the reduction of road accidents. While it has been observed that a careful road user/travelers who comply with road signs and symbols usually arrive at his/her destination safely while road user/travelers who do not complied with the road safety signs and symbols will end up in serious accidents. Any road accident is all the more depressing as the victims are very healthy just before the crash. More than one million people die on the road every year according to World Health Organization (WHO, 2011) and road traffic injuries are the leading cause of death among young people. It is against this backdrop that the researcher intends to identify the level of compliance with road safety signs and symbols among motorists in Niger State.

Statement of the Problem

The overall goal of the decade of action for safety on our roads is to reduce and stabilize the level of road traffic accidents around the world. Safety on the road is a foremost priority in the mind of all road users, and the important aspect of the driving task is that of detection of road signs and symbols. Arosanyin *et al.*, (2012) explained that safety road regulation protects the general public, users and operators from crashes as well as unhealthy environment.

However, Idris (2019) argued that most motorist often failed to recognize road safety signs and symbols or obey (complied) the order they represent. The reason for these disobedience or phenomenon always lead to road fatalities, injury, loss or damage properties, and death. The capacity to respond to accident reduction on our roads, compliance with road safety signs and symbols among motorist towards speed management is an important component and effort. Several kinds of research have been conducted on road crashes (accident) and most of these reports blame accident rates to the negligence of road users, drivers' attitudes and behaviour towards compliance with road safety signs and symbols (Ovuweri & Asalor, 2010). It has been noticed by the researcher that in Niger State, the average driver (motorist) has a habit of being reckless; the roads have been death traps. The significant gap exists between compliance with road safety signs and symbols, speed and the risk of being involved in road accident in which the study attempt to fill by determine level of compliance with roads signs and symbols among motorist toward speed management and accident reduction in Niger State, and hence conserving life on land as one of the sustainable development goals.

Purpose of the Study

1. Identify the road signs and symbols available in Niger State
2. Find out the level of awareness of road signs and symbols among motorist in Niger State
3. Determine the level of compliance with road signs and symbols among motorist in Niger State

Research Questions

1. What are the road signs and symbols available in Niger State?
2. What is the level of awareness of road signs and symbols among motorist in Niger State?
3. What is the level of compliance with road signs and symbols among motorist in Niger State?

Hypotheses

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

H_{O1}: There is no significant difference between the mean response of motorist and Vehicle Inspection Officer (VIO) on the availability of road signs and symbols installed in Niger State.

H_{O2}: There is no significant difference between the mean response of motorists and Vehicle Inspection Officer (VIO) on the level of awareness with road signs and symbols in Niger State

H_{O3}: There is no significant difference between the mean response of motorists and Vehicle Inspection Officer (VIO) on the level of compliance with road signs and symbols in Niger State.

Methodology

A descriptive survey design was employed for the study. The study was conducted in Niger State, Nigeria. The targeted population for this study was sixty (60) Vehicle Inspection Officers (VIO) from Niger State Motor Vehicle Administration Agency, while that of licensed motorist is unknown. A multi-stage sampling techniques was adopted for the study. A Cluster sampling technique was used to cluster Niger State into five clusters as follows: Minna, Bida, Suleja, Kontagora and Mokwa respectively.

Accidental Sampling technique was used to drawn Sixty-eight (68) licensed motorist from each Cluster for the study. Since the population of Vehicle Inspection Officers is manageable size no sampling techniques was adopted for it, hence their entire population was used for the study. A structured Questionnaire was used for data collection. The instrument for data collection was validated by two lecturers in the Department of Industrial and Technology Education, Federal University of Technology, Minna and one Chief Vehicle Inspection Officer (CVIO) in Motor Vehicle Administration Department Minna Niger State. To establish the reliability of the instrument, a pilot test was carried out at Ilorin Kwara State which does not form part of the study area, in which data of sixteen (16) respondents were collected consisting of four VIO and twelve motorists. Cronbach Alpha and Statistical Package for Social Sciences (SPSS) version 23 was used in computing reliability coefficient base on standardized items and results were given as follow; cluster A, 0.76; Cluster B, 0.99; cluster C, 0.87; cluster D, 0.84; cluster E, 0.98. The reliability coefficient for the overall 141 items was determined to be 0.89**.** The result indicated that the instrument is reliable and it is therefore considered appropriate for use.

The instrument for the study was administered to the respondents by the researcher through the help of ten (10) research assistants who were guided on the approach and process of obtaining data from the respondents. The data collected for the study was analyzed using mean, standard deviation and t-test statistics. Mean and Standard Deviation were used to answer the research questions while t-test statistics was used to test the null hypotheses formulated for the study at 0.05 level of significance.

Results

Research Question One: What are the road signs and symbols available in Niger State?

Table 1: Mean and Standard Deviation of Respondent on the Road Signs and Symbols Available in Niger State

S/N	ITEMS	$\bar{X}_1$ n_1=60	$\bar{X}_2$ n_2=340	$\bar{X}_T$ N=400	SD	Decision
1	Speed Bumps Ahead	1.70	1.96	1.83	0.13	A
2	No Right Turn	1.18	1.02	1.10	0.12	NA
3	No Horn	1.20	1.01	1.10	0.16	NA
4	T-Junction	1.23	1.02	1.13	0.15	NA
5	No Left Turn	1.15	1.00	1.08	0.15	NA
6	No U-Turn	1.22	1.01	1.11	0.16	NA
7	No Parking	1.52	1.96	1.74	0.15	A
8	No Waiting	1.43	1.96	1.69	0.15	NA
9	Double Bend	1.33	1.00	1.17	0.21	NA
10	Stop Sign	1.25	1.01	1.13	0.16	NA
11	Speed Limit (Maximum)	1.17	1.01	1.09	0.13	NA
12	Pedestrian Crossing	1.37	1.01	1.19	0.18	NA
13	Narrow Bridge	1.23	1.08	1.15	0.08	NA
14	Hospital	1.15	1.04	1.10	0.08	NA
15	Airport	1.15	1.01	1.08	0.12	NA
16	Bus Stop	1.17	1.03	1.10	0.10	NA
17	Mechanic Station	1.15	1.01	1.08	0.12	NA
18	Telephone Call	1.15	1.02	1.08	0.11	NA
19	Restaurant	1.15	1.01	1.08	0.14	NA
20	Rest Area	1.15	1.01	1.08	0.12	NA
21	Fuel Station	1.15	1.03	1.09	0.09	NA
22	Parking Area	1.15	1.03	1.09	0.10	NA
23	Round About	1.15	1.03	1.09	0.09	NA
24	Keep Right or Left	1.15	1.02	1.09	0.10	NA
25	U-Turn to Left or Right	1.27	1.03	1.15	0.14	NA
26	Right Turn	1.15	1.01	1.08	0.14	NA
27	Left Turn	1.15	1.00	1.08	0.15	NA
28	Y-Junction	1.28	1.08	1.18	0.09	NA
29	2-Way Ahead	1.15	1.05	1.10	0.07	NA
30	Cross Road	1.15	1.04	1.09	0.09	NA
31	Give Way					

Continuation Table 4.1

32	Children Crossing	1.15	1.13	1.14	0.01	NA
33	Traffic Light Ahead	1.15	1.01	1.08	0.12	NA
34	Road Work Ahead	1.15	1.02	1.08	0.11	NA
35	One Way Sign	1.15	1.01	1.08	0.12	NA
36	Wild Animal Sign	1.15	1.02	1.08	0.11	NA
37	Falling Rock	1.27	1.01	1.14	0.18	NA
38	Road Narrows on Both Side	1.25	1.05	1.15	0.11	NA
	Grand Mean	**1.22**	**1.10**	**1.16**	**0.12**	**NA**

Source: Author's fieldwork (2022)

Key: $\overline{X}_1$ = Mean response of Vehicle Inspection Officer, $\overline{X}_2$ = Mean response of Motorist, n_1 = No of VIO , n_2 = No of trainees, $\overline{X}_T$ = Average mean response of both Vehicle Inspection Officer and Motorist, SD = Standard deviation of both Vehicle Inspection Officer and Motorist, NA= Not Available, A= Available

The analysis on Table 1 shows the mean responses of the respondents on the 38 items posed to determine the road signs and symbols available in Niger State with a grand mean of 1.16 which implies that majority of the road safety signs are not available. The standard deviation of the items ranges from 0.01 – 0.21. The 38 items had their standard deviation less than 1.96 implying that the respondents were not too far from the mean and were close to one another in their responses. This closeness of the responses adds value to the reliability of the mean.

Research Question Two: What is the level of awareness of road signs and symbols among motorist in Niger State?

Table 2: Mean and Standard Deviation of Respondent on the Level of Awareness with Road Signs and Symbols among Motorist in Niger State

S/N	ITEMS	$\overline{X}_1$ n_1=60	$\overline{X}_2$ n_2=340	$\overline{X}_T$ N=400	SD	Decision
1	Speed Bumps Ahead	2.37	1.96	2.16	0.14	NA
2	No Right Turn	2.30	1.01	1.65	0.19	NA
3	No Horn	2.40	1.01	1.70	0.21	NA
4	T-Junction	2.28	1.01	1.65	0.14	NA
5	No Left Turn	2.08	1.01	1.55	0.08	NA
6	No U-Turn	2.28	1.01	1.65	0.17	NA
7	No Parking	2.53	1.96	2.24	0.15	A
8	No Waiting	2.43	1.96	2.19	0.15	NA
9	Double Bend	2.33	1.01	1.67	0.18	NA
10	Stop Sign	2.33	1.01	1.67	0.19	NA
11	Speed Limit (Maximum)	2.20	1.02	1.61	0.13	NA
12	Pedestrian Crossing	2.33	1.00	1.67	0.21	NA
13	Narrow Bridge	2.38	1.06	1.72	0.13	NA
14	Hospital	2.35	1.03	1.69	0.15	NA
15	Airport	2.33	1.07	1.70	0.11	NA
16	Bus Stop	2.27	2.03	2.15	0.10	NA
17	Mechanic Station	2.25	2.02	2.14	0.12	NA
18	Telephone Call	2.25	2.02	2.14	0.11	NA
19	Restaurant	2.25	2.02	2.14	0.12	NA
20	Rest Area	2.25	2.00	2.13	0.15	NA
21	Fuel Station	2.25	2.02	2.14	0.12	NA
22	Parking Area	2.25	2.02	2.14	0.10	NA
23	Round About	2.25	2.02	2.14	0.11	NA
24	Keep Right or Left	2.25	2.02	2.14	0.10	NA

Continuation Table 4.3

25	U-Turn to Left or Right	2.27	2.08	2.17	0.09	NA
26	Right Turn	2.25	2.04	2.14	0.09	NA
27	Left Turn	2.25	2.00	2.13	0.15	NA
28	Y-Junction	2.28	2.08	2.18	0.09	NA
29	2-Way Ahead	2.25	2.05	2.15	0.07	NA
30	Cross Road	2.25	1.01	1.63	0.12	NA
31	Give Way					
32	Children Crossing	2.25	1.12	1.69	0.02	NA
33	Traffic Light Ahead	2.25	1.01	1.63	0.12	NA
34	Road Work Ahead	2.25	1.05	1.65	0.07	NA
35	One Way Sign	2.25	1.04	1.65	0.08	NA
36	Wild Animal Sign	2.25	1.02	1.63	0.11	NA
37	Falling Rock	2.27	1.01	1.64	0.17	NA
38	Road Narrows on Both Side	2.25	1.07	1.66	0.09	NA
	Grand Mean	**2.28**	**1.47**	**1.88**	**0.13**	**NA**

Source: Author's fieldwork (2022)

Key: $\overline{X}_1$ = Mean response of Vehicle Inspection Officer, $\overline{X}_2$ = Mean response of Motorist, n_1 = No of VIO, n_2 = No of trainees, $\overline{X}_T$ = Average mean response of both Vehicle Inspection Officer and Motorist, SD = Standard deviation of both Vehicle Inspection Officer and Motorist, NA = Not Aware, A = Aware

The analysis on Table 2 shows the mean responses of the respondents on the 38 items posed to determine the level of awareness with road signs and symbols among motorist in Niger State with a grand mean of 1.88 which implies that majority of the respondents are not aware of the road safety signs and symbols. The standard deviation of the items ranges from 0.02 – 0.21. The 38 items had their standard deviation less than 1.96 implying that the respondents were not too far from the mean and were close to one another in their responses. This closeness of the responses adds value to the reliability of the mean.

Research Question Three: What is the level of compliance with road signs and symbols among motorists in Niger State?

Table 3: Mean and Standard Deviation of Respondent on the level of Compliance with Road Safety Signs and Symbols among Road Users

S/N	ITEMS	$\overline{X}_1$ n_1=60	$\overline{X}_2$ n_2=340	$\overline{X}_T$ N=400	SD	Decision
1	Speed Bumps Ahead	2.43	1.96	2.19	0.14	NC
2	No Right Turn	2.23	1.01	1.62	0.17	NC
3	No Horn	2.20	1.03	1.61	0.12	NC
4	T-Junction	2.23	1.02	1.62	0.14	NC
5	No Left Turn	2.30	1.01	1.66	0.17	NC
6	No U-Turn	2.33	1.01	1.67	0.18	NC
7	No Parking	2.60	1.96	2.28	0.14	C
8	No Waiting	2.43	1.96	2.19	0.15	NC
9	Double Bend	2.23	2.01	2.12	0.16	NC
10	Stop Sign	2.33	2.03	2.18	0.15	NC
11	Speed Limit (Maximum)	2.25	2.01	2.13	0.18	NC
12	Pedestrian Crossing	2.37	2.03	2.20	0.18	NC
13	Narrow Bridge	2.30	2.06	2.18	0.11	NC
14	Hospital	2.20	2.03	2.11	0.12	NC
15	Airport	2.28	2.02	2.15	0.17	NC
16	Bus Stop	2.23	2.03	2.13	0.13	NC
17	Mechanic Station	2.27	2.00	2.13	0.16	NC

18	Telephone Call	2.37	2.01	2.19	0.20	NC
19	Restaurant	2.23	2.00	2.11	0.18	NC
20	Rest Area	2.40	2.04	2.22	0.15	NC
21	Fuel Station	2.25	2.00	2.13	0.15	NC
22	Parking Area	2.25	2.02	2.14	0.11	NC
23	Round About	2.25	2.00	2.13	0.15	NC
24	Keep Right or Left	2.25	2.02	2.14	0.12	NC
25	U-Turn to Left or Right	2.27	1.03	1.65	0.14	NC
26	Right Turn	2.38	1.01	1.69	0.20	NC
27	Left Turn	1.27	2.00	1.63	0.19	NC
28	Y-Junction	1.28	2.08	1.68	0.09	NC
29	2-Way Ahead	1.15	2.05	1.60	0.07	NC
30	Cross Road	1.15	2.03	1.59	0.11	NC
31	Give Way					
32	Children Crossing	1.15	2.22	1.69	0.02	NC
33	Traffic Light Ahead	1.15	2.00	1.58	0.15	NC
34	Road Work Ahead	1.15	2.02	1.59	0.12	NC
35	One Way Sign	2.15	2.03	2.09	0.09	NC
36	Wild Animal Sign	2.15	2.02	2.09	0.11	NC
37	Falling Rock	2.48	2.03	2.26	0.18	NC
38	Road Narrows on Both Side	2.25	2.04	2.15	0.11	NC
	Grand Mean	**2.12**	**2.02**	**2.07**	**0.09**	**NC**

Source: Author's fieldwork (2022)

Key: $\overline{X}_1$ = Mean response of Vehicle Inspection Officer, $\overline{X}_2$ = Mean response of Motorist, n_1 = No of VIO, n_2 = No of trainees, $\overline{X}_T$ = Average mean response of both Vehicle Inspection Officer and Motorist, SD = Standard deviation of both Vehicle Inspection Officer and Motorist, NC = No Compliance, C = Compliance

The analysis on Table 3 shows the mean responses of the respondents on the 38 items posed to determine the level of compliance with road signs and symbols among motorist in Niger State with a grand mean of 2.07 which implies that motorist do not complied with the road safety signs and symbols. The standard deviation of the items ranges from 0.02 – 0.20. The 38 items had their standard deviation less than 1.96 implying that the respondents were not too far from the mean and were close to one another in their responses. This closeness of the responses adds value to the reliability of the mean.

Hypothesis one: There is no significant difference between the mean responses of motorist and Vehicle Inspection Officer (VIO) on the availability of road signs and symbols in Niger State.

Table 4: t-test analysis on the availability of road signs and symbols in Niger State

Variables	N	Mean	SD	df	t	p-value
VIO	60	1.22	0.12	398		
					7.23	0.01
Motorist	340	1.10	0.14			

P<0.05= Significant, P>0.05= Not Significant

Table 4 shows the comparison of t-test of the mean rating of the responses of the respondents as regard the availability of road signs and symbols in Niger State. The results revealed that the mean and standard deviation of VIO are 1.22 and 0.12 while the mean and standard deviation of motorist are 1.10 and 0.14 respectively. Since the p-value (0.01) is less than 0.05, the result revealed that there was a significant difference between the mean response of motorist and Vehicle Inspection Officer (VIO) on the availability of road signs and symbols in Niger State. Therefore, the null hypothesis was rejected.

Hypothesis two: There is no significant difference between the mean response of motorist and VIO on the level of awareness with road signs and symbols in Niger State.

Table 5: t-test analysis on the awareness with road safety signs and symbols in Niger State

Variables	N	Mean	SD	df	T	p-value
VIO	60	2.28	0.35	398		
					7.27	0.01
Motorist	340	1.47	0.17			

P<0.05= Significant, P>0.05= Not Significant

Table 5 shows the comparison of t-test of the mean rating of the responses of the respondents as regard the level of awareness with road signs and symbols in Niger State. The results revealed that the mean and standard deviation of VIO are 2.28 and 0.35 while the mean and standard deviation of motorist are 1.47 and 0.17 respectively. Since the p-value (0.01) is less than 0.05, the result revealed that there was a significant difference between the mean response of motorist and VIO on the level of awareness with road signs and symbols in Niger State. Therefore, the null hypothesis was rejected.

Hypothesis three: There was no significant difference between the mean response of motorist and VIO on the level of compliance with road signs and symbols in Niger State

Table 6: t-test analysis on the level of compliance with road signs and symbols in Niger State

Variables	N	Mean	SD	df	T	p-value
VIO	60	2.12	0.24	398		
					6.23	0.01
Motorist	340	2.02	0.28			

P<0.05= Significant, P>0.05= Not Significant

Table 6 shows the comparison of t-test of the mean rating of the responses of the respondents as regard the level of compliance with road signs and symbols in Niger State. The results revealed that the mean and standard deviation of VIO are 2.12 and 0.24 while the mean and standard deviation of motorist are 2.02 and 0.28 respectively. Since the p-value (0.01) is less than 0.05, the result revealed that there was a significant difference between the mean response of motorist and VIO on the level of compliance with road signs and symbols in Niger State. Therefore, the null hypothesis was rejected.

Discussion of Findings

The findings on research question one revealed that the road signs and symbols are not available in Niger State. Among the findings are No Right Turn, No Horn, T-Junction, No Left Turn and No U-Turn. The findings was corroborated by Clement (2018) who said that one-way sign, road work ahead, 2-way ahead among others are not available in most States in Nigeria. Furthermore, Makinde and Opeyemi, (2012) perceived that informative Signs are those signs that provides useful information on where you can look for example rest area or the status of airport school, mosque, and church but most of this signs are not available on the road.

The findings on hypothesis one revealed that there was a significant difference between the mean response of motorist and Vehicle Inspection Officer (VIO) on the availability of road signs and symbols in Niger State. The findings of the study on hypothesis one was in line with the findings of Makinde & Opeyemi (2012) where it was found out that there is significance difference in the mean ratings of the responses of VIO and motorist.

The findings on research question two revealed that there is no awareness of road signs and symbols in Niger State. The findings is in support of Abdur (2005) who carried out a study on driver understanding of traffic signs, the study found that that most of the driver's in Dhaka city may not be understood the meaning or they are confused about the meaning of the following warning, regulatory and informatory signs encoded.

The findings on hypothesis two revealed that there was a significant difference between the mean response of motorist and VIO on the level of awareness with road signs and symbols in Niger State. Generally, the findings of the study on hypothesis two was in line with the findings of Jankaro, (2016*)*

where it was found out that there is significance difference in the mean ratings of the responses of VIO and motorist. The findings of Ibrahim & Bashir (2018*)* gave credence to the findings of this study on hypothesis two as regards the level of awareness with road signs and symbols.

The findings on research question three revealed that there was no compliance of road signs and symbols in Niger State. The findings agreed with Mubarak *et. al.* (2015) they found that there is a high rate of traffic violations among motorists and it is leading to fatal accidents. The types of violations include driving without wearing a seatbelt, wrong overtaking, running a red light or failing to stop while the traffic warder instructs the motorists, speed up and following the wrong lane. Among other reasons, traffic laws are violated by the drivers because of illiteracy, impatience, and lack of awareness, disobedience of law by people of all classes in the country, including law enforcement agents, and poverty.

The findings on hypothesis three revealed that there was a significant difference between the mean response of motorist and VIO on the level of compliance with road signs and symbols in Niger State. The findings of the study in agreed with Federal Road Safety Corps (2013) where it was found out that there is significant difference in the mean ratings of the responses of VIO and motorist.

Conclusion

The study determines the level of awarenss and compliance with road signs and symbols among motorists in Niger State. Both the Vehicle Inspection Officers (VIO) and motorist collaboratively agreed that there are unavailability of road signs and symbols in Niger State. The study also revealed that there was no awareness on road signs and symbols. The study also showed that there was no compliance with road signs and symbols. Negligence and drunkenness are among the constraint affecting the effective compliance with road signs and symbols among motorists in Niger State. Furthermore, VIO required appropriate retraining through workshops and seminars to provide valuable information to drivers where the road signs and symbols are not available in order to enhance movement of motorist on the road.

Recommendations

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

1. The VIO should regularly organized an enlightment campaign to educate the drivers as regard the awareness of road safety signs and symbols
2. There should be enforcement of speed limit device for both private, commercial and official vehicles by the VIO to maintain speeding order, and installation of CCTV camera with visual analyzes at the traffic lights to track traffic lights violators.
3. There should be construction of speed bumps before T-junctions, pedestrian crossing, traffic lights and cross-roads (road interceptions). Thus, violators should be arrested and force to pay a fine.

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COMPETENCY NEEDS OF TECHNICAL COLLEGES CARPENTRY AND JOINERY TEACHERS IN THE USE OF COMPUTER NUMERICAL CONTROL CIRCULAR SAW MACHINE IN NORTHWEST, NIGERIA

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Abstract
The study was designed to determine the competency needs of technical colleges carpentry and joinery teachers in the use of Computer Numerical Control (CNC) Circular Saw Machine (CSM) in technical colleges offering National Technical Certificate (NTC) in Carpentry and Joinery in North-West States, Nigeria. Two research questions guideD the study while three null hypotheses formulated were tested at 0.05 level of significance. The study made use of descriptive survey research design. The population for the study were 255 subjects comprising of 78 Technical Colleges Carpentry and Joinery Teachers 130 Technical Colleges Carpentry and Joinery Students as well as 57 Carpentry and Joinery Workshops Personnel in the seven North-West States. A 30 items questionnaire were used as on instrument for data collection. The instrument was validated by five woodwork technology education experts. The reliability of the instrument was determine using cronbach alpha reliability method and internal consistency 0.85. The data collected was analyzed using mean and standard deviation to answer the three research questions while Analysis of Variance (ANOVA) was employed to test the null hypotheses at 0.05 level of significance with help of SPSS version 25. The findings of the study revealed that Technical Colleges Carpentry and Joinery Teachers teaching NTC Carpentry and Joinery Programme need competency in setting CNC (CSM) parameters such as: cutting speed and allowance tolerance with average mean value of 3.10 and also, finding on setting-up, programming, operation of computerized CNC (CSM) for ripping operation with average mean value 3.20. There is no significant difference in the mean responses between carpentry and joinery teachers at the technical colleges on the competency needs on ripping operation with computer numerical control circular saw machine and also, There is no significant difference in the mean response between carpentry and joinery teachers at the technical colleges on the competency needs on cross-cutting operation with computer numerical control circular saw machine. It was concluded that technical colleges carpentry and joinery teachers needs competency on setting of CNC (CSM) parameters, such as cutting speed, allowance tolerance, programming, operation with computerized CSM for ripping operation. Based on the findings, it was recommended that: The National Board for Technical Education (NBTE) should include ripping and other carpentry and joinery operations using Computer Numerical Control Circular Saw Machine (CSM) in NTC Carpentry and Joinery Programme Syllabus and also, Carpentry and Joinery Administrators should organize seminars and workshops for Carpentry and Joinery Teachers on how to operate CNC (CSM) especially, on different carpentry and joinery operations

Keywords: Carpentry and Joinery Teachers, Technical Colleges, Competency, Computer Numerical Control Circular Saw Machine

Introduction

Carpentry and Joinery involves carrying-out advanced skilled work, primarily using timber products, either on a construction site, or in a workshop, creating and installating building components. Example of complex tasks include curved products, irregular joints and bespoke work. Carpentry and Joinery are two special trades in woodworking construction. Carpentry entails the assembly of sawn timber, chiefly for structural timber works.

In a simplest possible terms, joiners 'Join' wood in a workshop and carpenters construct the building elements on site of course, this is too far simplified a definition for understanding the important different between the two. Therefore, we need to delve a bit deeper.

Carpentry works tends to focus on larger elements, such as constructing and fitting roof trusses, stud work and fitting floors and staircases. It also tends to be performed on site. You can usually distinguish between it and joinery by remembering that joinery work tends to focus more on creation of wooden components or using them in some way to create something else, like a roof truss. Carpentry is mostly on structural works such as rafters, floor-wedges, formed floor construction, construction wooden roofs. Carpentry deals more on exterior work construction which do not require machining, finishing making proper joints or through seasoned timber.

Joinery is the process in which two or more sections of wood are connected. The work performed by joiners is usually associated with creating a range of timber products. This include windows, doors and staircases to specialized furniture, such as chairs, cabinets or tables. Usually, but not extensively, joinery work based in a workshop due to the use of heavy machinery. Joinery deals more in interior finished items such as furniture constructions making paneled framing for doors, windows, timber used for joinery works requires more thoroughly seasoned red-wood proper jointing, machining, finishing and so on.

The objective of Carpentry and Joinery Programm in Technical College is to provide knowledge, practical skills, and sound moral training for students. Carpentry and Joinery is a trade that involves using materials such as wood, nails, screws, iron-mongery and numerous chemicals in the construction of doors, windows, roofs, wooden floors, and numerous other wood projects associated to occupations in building trade, boat and ship building, vehicle body building, civil engineering, to mention but a few.

Craft work involves the use of implements to perform a desired task. Such performances require the demonstration of skills. Skill is an ability to perform specific task (Department of Education, Science & Training, 2006). Ogwo and Oranu (2006) described skilled actions in terms of sight, sound, or other impressions sent to the mind which in turn directs the muscle. Later, through practice and repetition, the actions become automatic or habitual.

Factors such as safety practices, selection and use of appropriate tools and materials, sound construction technique, speed, expertness, exhibiting the right attitude to work, co-operation with other students, obeying instructions, and quality of finished product are common features of skill disposition in carpentry and joinery craft. Generally, skills comprise two components – the knowledge component and activity component. The latter is made up of motor and perceptual skills. Haven stein's model can effectively be applied to teach and assess practical skills.
Carpentry and Joinery Basic Skills:

- Interpreting instructions and planning own work.
- Adopting safe working practices.
- Identifying, maintaining and using hand tools.
- Setting-up and using portable power tools.
- Handling timber-based materials and components.

The National Board for Technical Education (NBTE) Curriculum in Carpentry and Joinery Crafts provides a guide for training of Technical, & Vocational Education and Training (TVET) "Experts" leading to the award of National Technical Certificate (NTC) for Technical Colleges. The curriculum of the carpentry and joinery programme is broadly divided into three components:

- General Education: This accounts for 30% of the total hours required for the programme.
- Trade Theory, trade practice and related studies all account for 65%, of which 30% and 70% of the 65% are allocated to theory and practice respectively.
- Supervised Industrial/Work Experience – This accounts for 5% of the total hours.

The trade practice for the carpentry and joinery craft at NTC level are presented in the following modules:

- CBM 12 – Basic Construction Management I
- CBC 11 – Introduction to Building Construction
- CTD 14 – Building Drawing I

- CMW 11 - Machine Woodworking I
- CMW 12 - Machine Woodworking II
- CCJ 11 – Joinery I
- CCJ 12 – Joinery II
- CCJ 13 – Carpentry I
- CCJ 14 – Carpentry II
  (Source: NBTE, 2007)

Technical Colleges (TCs) 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 programmes 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 programme or necessary certification. Often, technical colleges focus on hands-on programmes in allied health or mechanical trades including medical and dental assisting, welding, HVAC/R-MAR, and truck driving. (Midwest Technical Institute, 2020). The National Policy on Education (FGN, 2013) identified five types of technical education institutions outside the universities.

The institutions include the pre-vocational and vocational schools at post primary level, the polytechnics, colleges of technical teachers' education and technical colleges at the post junior secondary school level (Olaitan, 2014). The NBTE decree number 9 of 1977 stipulated the functions of the technical colleges in the country to include:

- Provision of full time or part time course of instruction and training in technology, applied science and commerce and in such other field of applied learning, relevant to the needs of the development of Nigeria in the areas of industrial, commercial and vocational agriculture.
- Training in professional studies in engineering and other technologies.
- Perform such other functions as in the opinion of the society as may serve to promote the objectives of the technical colleges.

Technical Colleges are under the umbrella of National Board for Technical Education (NBTE). According to (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). The administration and supervision of technical colleges is under the patronage of the ministries of education and the National Board for Technical Education. Each technical college is headed by a Principal who supervises the college (Excellence and Education Network, 2021).

The courses offered by the technical colleges According to NBTE (2017) the list of available programmes in technical colleges is presented below:

- Automobile Trade: These trades comprise of auto electric works, motor vehicle mechanics, vehicle body building, and agricultural implement mechanics
- Building and Woodwork Trades: These trades cover block laying, bricklaying & concreting, carpentry and joinery, draftsmanship craft practice, furniture design and construction, machine wood working, painting and decorating.
- Business Trades: consist of business studies, parts merchandising, typewriting, stenography
- Computer Trades: contain computer maintenance & GSM repairs, computer studies.
- Electrical/Electronic Trades: encompass appliances maintenance & repairs, electrical installation and maintenance works, instrument mechanics, radio, television & electronics work.
- Hospitality Trades: contain catering craft practice.
- Mechanical Trades: embrace fabrication and welding, foundry craft, marine engineering, mechanical engineering craft practice, plumbing and pipe fitting, refrigeration and air condition work.
- Printing Trades: are ceramic, graphic arts, and printing craft.
- Textile Trades: comprise garment making, leather trades, textile trades.

- General Education Courses: include biology, chemistry, entrepreneurship education, ICT, mathematics, physics, economics, technical drawing.

The programmes in the college were designed to train craftsmen and artisans for the profiting of the individual and the economy. The curriculum for each trade shall consist of five components such as: General education, theory and related courses, workshop practice, industrial training/ production work, entrepreneurial training. And the teacher students' ratio for effective participation of students shall be at 1:20 (FRN, 2014).

The technical colleges play vital roles in Nigeria. They train and produce technicians for industry, they impart vital technical skills in the youths, and they help towards the goal of self-employment and job creation and in the struggle towards technological advancement and acquisition. Through the Technical colleges, youths acquire such skills as skilled technicians: bricklayers, carpenters, painters and auto mechanics; laboratory and pharmacy technicians, electrical/electronic technicians and skilled vocational nurses.

According to the Federal Ministry of education "Technical Education is defined as that aspect of education which leads to the acquisition of practical and applied skills as well as basic scientific knowledge". Technical education provides opportunities for the mastery of skills and knowledge in selected occupations as well as for the development of personality for useful living. They essentially: Provide general education, provide training in selected occupations, help trainees to develop the requisite skills and abilities necessary for securing and retaining a job, help in creating employment and self-employment. The curricula of vocational schools are centered on craft/engineering trades, agriculture, business and home economics. Today there are over 130 Technical Colleges made up of: 19 Federal Technical Colleges, 110 State technical Colleges, and 3 private Technical Colleges. The duration of courses at Technical Colleges is three years (for intensive instruction in classroom work and workshop practice) at the end of the programme candidates can apply and write the:

- City and Guilds of London Institute examinations and obtain their certificates.
- Federal Craft Certificate.
- Ministry of Labour Trade Tests. On completion, students can move to polytechnics or federal universities of technology through JAMB (Excellence and Education Network, 2021).

To get the competency for the carpentry and joinery teachers in the use of Computer Numerical Control (CNC) Circular Saw Machine for teaching practical class that always produces number of graduates in NTC in Carpentry and Joinery Programme is of paramount. The Carpentry and Joinery Teachers' competence calls for compelling alternatives needs to help improve the level of knowledge and competence of NTC students/graduates of Carpentry and Joinery NTC programme in the use of digital circular saw machine to operate effectively and efficiently. This could be improvement because the carpentry and joinery teachers must be competent in operating these kinds of new modern machines, but reverse is the case (Ugwu & Agbo, 2015). Competency is an essential ability obtained in a profession and those which the professional in the field must possess and be able to demonstrate at optimal level of functioning. Olaitan (2003) referred to competency as knowledge, skill and attitude that are required for successful performing of the task. Competency as applied in this study is the knowledge, skills and attitude or training ability woodwork technology education lecturers must possess to operate CNC Circular Saw Machine (CSM) for effective delivery of practical skills class without difficulties. CNC Circular Saw Machine (CSM) also known as Computer Numerical Control (CNC) circular saw machine has revolutionized the world of highly precise woodworking.

The CNC circular saw machine can be defined as the computerized technology in which the functions and the motion of circular saw machine tools are controlled by means of a prepared programme (software) containing coded alphanumeric programme data (Ashley *et. al.* 2016).The CNC circular saw machining processes have been developed to meet extra required machining conditions. Circular Saw CNC Machine is electro-mechanical device that manipulate saw using computer programming inputs. It is the name given to a machine containing a spindle or router that receives its fabricating marching orders from a computer such as a laptop or desktop unit containing Computer Aided Design (CAD) software.

In a Circular Saw CNC machine depending on the models ability, software and accessories, these orders direct the spindle to cut wood (typically, up to ¾" deep) carve drill holes, and shape a work piece along various axes (from three to five) according to the invented design. It allows you to input the most specific commands that would be difficult for a human to do by hand and it is able to complete the woodworking design in just a matter of minutes (Ashley *et. al*. 2016).

The CNC circular saw machine is a manufacturing technology in the 21st century which brought about changes from the manual traditional machining process to a new machining process which is more suitable for precision machining of hard and brittle materials (including wood) (Jan, 2010). That is, the use of computer technology in the world in many aspects of human endeavour comes with computer such as woodworking machinery including CNC circular saw machine to save human labour, time, materials both in the process and products.CNC circular saw machine offers many advantages over traditional machining processes such as: providing high accuracy and surface finish; prolong tool life; ability to machine very hard and fragile materials that are difficult for traditional machining, can also be carried-out by successful train students.

To enable carpentry and joinery students at NTC (Carpentry and Joinery) program to acquire workplace skills with the aid of CNC circular saw machine therefore depend on the ability level of woodwork technology education lecturers in getting knowledge on how to operate CNC Circular Saw Machine (CSM). In recent times, several countries of the world and some in African tertiary institutions are acquiring practical skills through the use of digital circular saw machine that is, using computer to direct or control the machines in order to boost learning outcome has become very difficult (Khan *et al.,* 2012). This is because of the different operation and application of the CNC (CSM).

Application of CNC (CSM) in teaching and learning helps inculcating lifelong and workplace skills for future enterprise (Robert, 2014). Ogbuanya & Bakare (2016), introducing newly machining technology advancement into education improves teaching and learning but it cannot take the place of teacher in developing nations like Nigeria. Uwaifo (2009) was the view that the current trend of globalization requires the technical colleges' carpentry and joinery teachers in NTC (Carpentry and Joinery) programme are with the latest technology to produce NTC (Carpentry and Joinery) graduates with skills and competencies to cope in a CNC workplace. Education unlocks the door of modernization but is the teacher who holds the key to the door. Technical Colleges Carpentry and Joinery Teachers are the hubs or pivots on which any successful NTC (Carpentry and Joinery) Programme depend and if teachers perform their tasks dutifully, there will certainly be a myriad of new technologies in the future of carpentry and joinery students. To perform successfully as teachers of carpentry and joinery will have to undergo constant training and competency programme continually to keep them abreast with changing dynamic in practical skills teaching and learning (Jurgen *et al*, 2017).

Statement to the Problem

The inability of carpentry and joinery teachers operate the CNC (CSM) in delivering practical class lesson could be attributed to inadequate experiences or competencies in using CNC (CSM). Jimoh *et al.*, (2018) was of the view that: effective delivery of technology courses using computer in tertiary institutions in South-Western, Nigeria" need capacity building for effective delivery. This implies that for carpentry and joinery teachers to be able to utilize CNC (CSM) effectively and efficiently, they need competency on how to operate CNC (CSM) for effective and efficient delivery of practical class with students, as well as carpentry and joinery students for managing this new technology machine successfully and also, carpentry and joinery workshops personnel for conducting their many wooden constructions operations. It is therefore, pertinent to determine the competency needs of carpentry and joinery teachers in NTC (Carpentry and Joinery) Programme in the use of CNC Circular Saw Machine (CSM) for effective and efficient delivery of practical skills lessons with the students in North-West States Zone, Nigeria. This will go a long way to provide quality education which is one of the sustainable development goals.

Purpose of the Study

(1) Competency needs of technical colleges' carpentry and joinery teachers on ripping operation with computer numerical control circular saw machine.

(2) Competency needs of technical colleges' carpentry and joinery teachers on cross-cutting operation with computer numerical control circular saw machine.

Research Questions

(1) What are the competency needs of technical colleges' carpentry and joinery teachers on ripping operation with computer numerical control circular saw machine?
(2) What are the competency needs of technical colleges' carpentry and joinery teachers on cross-cutting operation with computer numerical control circular saw machine?

Hypotheses

HO_1: There is no significant difference in the mean responses of teachers, students and workshop personnel on the competency needs on ripping operation with computer numerical control circular saw machine.

HO_2: There is no significant difference in the mean responses of teachers, students and workshop personnel on the competency needs on crosscutting operation with computer numerical control circular saw machine.

Methodology

Descriptive survey research design was considered suitable for this study. This research design is mostly applied to real life situation in education where need to determine the competence needs. Olaitan *et al*. (2010) stated that the descriptive survey research design is the plan, structure and strategy that the investigator/researcher wants to adopt in order to obtain solution to research problems using questionnaire in collecting, analyzing and interpreting the data.

The study was carried-out in North-West States of Nigeria. Technical colleges offering NTC (Carpentry and Joinery) Programme in the geographical zone were inclusive. The North-West Geographical Zone of Nigeria comprises seven states of the country's 36 states. These are Jigawa, Kaduna, Kano, Katsina, Kebbi, Sokoto and Zamfara States. The zone covers an area of 216,065 square kilometres or 25.75% of the Nigeria's total land marks (Premium Times Nigeria, 2017).

The reasons of choosing North-West States Zones technical colleges offering NTC (Carpentry and Joinery) Programme on competence needs for the technical colleges carpentry and joinery teachers in the use of computer numerical control circular saw machine for the study is because: These institutions have Digital Circular Saw Machine (DCSM) in their woodwork technology education workshops, but not judiciously utilize in training the students.

The population of the study was 255 respondents, this include: 78 technical colleges carpentry and joinery teachers and 187 technical colleges carpentry and joinery students at NTC (Carpentry and Joinery) Programme all of them from the seven states in the North-West, Nigeria.

Purposive sampling technique was used for selection of the technical colleges carpentry and joinery teachers and technical colleges carpentry and joinery students in seven states of North-West, Nigeria that respondents for the instrument for the study.

A 20-items questionnaire titled: Computer Numerical Control Circular Saw Machine Competence Needs of Technical Colleges Carpentry and Joinery Teachers Questionnaire (CNCTCCJTQ) was developed by the researcher based on literature reviewed. The instrument consisted of section one as the personal data of technical colleges carpentry and joinery teachers and technical colleges carpentry and joinery students while, section two contains the competency needs of technical colleges carpentry and joinery teachers on ripping, cross-cutting, and grooving operations on the computer numerical control circular saw machine in NTC (Carpentry and Joinery) programme and also, each item of the questionnaire was assigned a four point scale response of: Highly Needed (HN) = 4, Needed (N) = 3, Slightly Needed (SN) = 2, Not Needed (NN) = 1.

The instrument was subjected to face for construct and content validity by five woodwork technology education experts, one from Department of Industrial and Technology Education, School of Science and Technology Education, Federal University of Technology, Minna, one woodwork technology education expert from Department of Woodwork Technology Education, College of Technical and Vocational Education of Kaduna Polytechnic. three woodwork technology education experts from Department of Woodwork Technology Education, School of Secondary Education (Technical) of Federal College of Education (Technical) Bichi, Kano State. They were requested to use their woodwork technology education expertise in determining the suitability of the instrument items for data collection. Their observations, corrections and suggestions were used to develop the final copy of the instrument.

The pilot test was conducted at Federal Science and Technical College Shiroro, Niger State which is outside the area of study. The respondents comprised of 53 subjects, 13 technical colleges' carpentry and joinery teachers and 40 technical colleges' carpentry and joinery students. The internal consistency of the questionnaire items was established using Cronbach Alpha Reliability Method. The closer the Cronbach Alpha is to 1, the higher the internal consistency (Olelewa & Agomuo, 2016). The reliability of the instrument was found to be 0.86. The Statistical Packages for Social Sciences/Statistical Product and Service Solutions (SPSS version 23) was employed to analyze data collected from the respondents.

Two hundred and fifty five copies of the questionnaire was administered to technical colleges' carpentry and joinery teachers and 40 technical colleges' carpentry and joinery students offering NTC (Carpentry and Joinery) Programme (using purposive sampling) from each state in the North-West, Nigeria with helps of thirteen (13) Research Assistants (RAs) from each seven states of North-West of Nigeria, for separation of instruments to respondents and collecting the instruments when it is filled by the respondents in North-West, Nigeria.

Mean and Standard Deviation was used to answer research questions one to three. Any item with a mean value of 2.50 or above was regarded as Needed (N) while any item with a mean value of less than 2.50 was regarded as Not Needed (NN). Analysis of Variance (ANOVA) statistics was used for testing the hypotheses using P-Value to determine the level of significance at 0.05, if the level of significant is below or less than ($p<0.05$) therefore the result shows that: there is significant in the testing hypothesis while, if the level of significant is above or greater than ($p>0.05$) therefore the result shows that: there is no significant in the hypothesis tested.

Research Question 1

What are the competency needs of technical colleges' carpentry and joinery teachers on ripping operation with computer numerical control circular saw machine?

Mean and Standard Deviation on the Competency Needs of Technical Colleges' Carpentry and Joinery Teachers on Ripping Operation with Computer Numerical Control Circular Saw Machine

S/NO.	ITEMS	$\bar{X}_1$	$\bar{X}_2$	$\bar{X}_3$	$\bar{X}_A$	SD	REM
1.	Switch ON/OFF the CNC Circular Saw Machine (CSM) computer and machine.	3.19	3.33	3.38	3.40	.74	N
2.	Ability to Interpret drawing and data of ripping dimension using (CNC) CSM.	3.21	3.24	2.75	3.00	.69	N
3.	Programme the code for the CNC (CSM) from the data or set-up the automated software to generate the code for ripping operation.	2.77	2.80	3.20	2.40	.77	NN
4.	Sequencing the ripping operation in the correct order using CNC (CSM).	3.15	3.00	3.20	2.90	.75	N
5.	Select and check appropriate CNC (CSM) for ripping operation.	3.16	3.09	3.20	2.70	.67	N
6.	Set CNC (CSM) parameters such as: cutting speed and allowance tolerance.	3.09	3.43	3.22	3.10	.69	N

7.	Operate the CNC (CSM) computer and machine while ripping.	3.13	3.29	3.18	3.20	.70	N
8.	Inspect the quality of the finished product against industry standards.	3.16	3.05	3.33	3.40	.85	N
9.	Rectify any faults with the end product after ripping operation with CNC (CSM).	3.09	3.24	3.03	3.20	.83	N
10.	Set-up, programme, operate computerized CNC circular saw machine for ripping operation.	3.10	3.23	3.00	3.20	.74	N

Source: Field Work

KEYS: $\bar{X}_1$= Mean Responses of Technical Colleges Carpentry and Joinery Teachers, $\bar{X}_2$ = Mean Responses of Technical Colleges Carpentry and Joinery Students, $\bar{X}_3$ = Mean Responses of Technical Colleges Carpentry and Joinery Workshops Personnel, $\bar{X}_A$ = Average Mean Responses of all the three Respondents, SD = Standard Deviation, REM = Remark, N = Needed & NN = Not Needed.

The results on Table 1 revealed that the respondents needed items (1, 2,4,5,6,7,8,9 & 10) on the extent of need of competency on ripping operation of technical colleges' carpentry and joinery teachers using CNC Circular Saw Machine (CSM) in North-West, Nigeria average mean ranging from 2.40 to 3.40. However, respondents did not need item 3 of competency needs on ripping operation for technical colleges' carpentry and joinery using CNC Circular Saw Machine (CSM) in North-West, Nigeria with mean of 2.40 less than mean value 2.50. Table 1 also showed that the standard deviation of items ranges from 0.63 to 0.83 showing the respondents were close to one another.

Research Question 2

What are the competency needs of technical colleges' carpentry and joinery teachers on crosscutting operation with computer numerical control circular saw machine?

Table 2: Mean and Standard Deviation on the Competency Needs of Technical Colleges' Carpentry and Joinery Teachers on Crosscutting Operation with Computer Numerical Control Circular Saw Machine

S/NO.	ITEMS	$\bar{X}_1$	$\bar{X}_2$	$\bar{X}_3$	$\bar{X}_A$	SD	REM
1.	Switch ON/OFF CNC (CSM) computer and machine.	2.99	3.10	3.50	3.10	.79	N
2.	Programme cutting list on the CNC (CSM) automatically.	3.12	3.40	3.20	3.30	.79	N
3.	Set the CNC (CSM) on up stroke for the cross-cutting operation.	3.21	3.30	3.20	2.90	.75	N
4.	Regulate the volume of stroke to either high or low mode as desired.	3.13	3.40	3.20	3.00	.62	N
5.	Use the CNC (CSM) ultimately for safe and high productivity.	3.24	2.80	3.00	3.40	.76	N
6.	Start the CNC (CSM), adjust controls and make trial cuts to ensure that is operating smoothly.	3.27	3.40	3.20	3.40	.76	N
7.	Examine finish work piece for conformance to specifications and verify dimensions while using CNC (CSM).	3.11	3.20	2.60	3.10	.68	N
8.	Set-up, programme or operate or tend computerized CNC circular saw machine for cross-cutting operation.	3.00	3.00	3.40	3.10	.66	N
9.	Monitor the CNC (CSM) cross-cutting operation and make adjustments to correct problems and ensure conformity with the specifications.	3.11	3.40	3.20	3.00	.74	N

10.	Examine wood stock for defects and to ensure conformity with the size and other specification standards.	3.12	3.40	3.50	3.10	.73	N

Source: Field Work

KEYS: $\bar{X}_1$= Mean Responses of Technical Colleges Carpentry and Joinery Teachers, $\bar{X}_2$ = Mean Responses of Technical Colleges Carpentry and Joinery Students, $\bar{X}_3$ = Mean Responses of Technical Colleges Carpentry and Joinery Workshops Personnel, $\bar{X}_A$ = Average Mean Responses of all the three Respondents, SD = Standard Deviation, REM = Remark, N = Needed & NN = Not Needed.

The results on Table 2 revealed that the respondents needed items (1, 2, 3, 4, 5, 6,7,8,9 & 10) on the extent of needed of competency on ripping operation of technical colleges' carpentry and joinery teachers using CNC Circular Saw Machine (CSM) in North-West, Nigeria average mean ranging from 2.40 to 3.40. However, respondents needed all competency needs on crosscutting operation for technical colleges' carpentry and joinery using CNC Circular Saw Machine (CSM) in North-West, Nigeria with mean of 2.40 less than mean value 2.50. Table 2 also showed that the standard deviation of items ranges from 0.63 to 0.83 showing the respondents were close to another.

Testing Hypotheses

Table 3: One-Way ANOVA of Mean Scores of Respondents on the Competency Needs of Technical Colleges Carpentry and Joinery Teachers on Ripping Operation with Computer Numerical Control Circular Saw Machine

Source	Sum of Squares	Df	Mean Square	F	Sig. (P-Value)
Between Groups	0.928	2	0.464	6.221	0.003
Within Groups	6.044	81	0.075		
Total	6.972	83			

Source: Field Work

The result of analysis as presented on Table 43showed that there is significant difference (P<0.05) in the mean scores of the respondents. The hypothesis one was therefore upheld (Needed). The data supported the one, (2, 81) = 6.221, P(Sig.) = 0.003.

Table 4: One-Way ANOVA of Mean Scores of Respondents on the Competency Needs of Technical Colleges Carpentry and Joinery Teachers on Crosscutting Operation with Computer Numerical Control Circular Saw Machine

Source	Sum of Squares	Df	Mean Square	F	Sig. (P-Value)
Between Groups	0.104	2	0.052	0.705	0.497
Within Groups	5.962	81	0.074		
Total	6.066	83			

Source: Field Work

The result of analysis as presented on Table 4 showed that there is no significant difference (P<0.05) in the mean scores of the respondents. The hypothesis one was therefore upheld (Needed). The data supported the one, (2, 81) = 0.705, P(Sig.) = 0.497.

Discussion

The results of the study revealed that NTC (Carpentry and Joinery) programme carpentry and joinery teachers are ready to receive competency on grooving operation using CNC circular saw machine (CSM) for delivery of practical class together with their students. Mean responses of the respondents

are needed as appropriate because in all the items ranges are from 2.70 on average mean responses of all the three groups of respondents, greater than 2.50. Moreover, the responses of carpentry and joinery students at NTC (Carpentry and Joinery) programme as well as needs of technical colleges carpentry and joinery teachers competency are needed as appropriate because there is significant difference in the mean responses as indicated on the hypotheses with p-value less than the level of significance ($p<.005$), the no significant level at .084 ($p>.005$).

The results of the study revealed that NTC (Carpentry and Joinery) programme technical colleges carpentry and joinery teachers are ready to receive competency on grooving operation using CNC circular saw machine (CSM) for delivery of practical class together with their students. Mean responses of the respondents are needed as appropriate because in all the items ranges are from 2.50, only item number 14 average mean response value at: 2.90 greater than 2.50 and above. Moreover, the responses of technical colleges carpentry and joinery students at NTC (Carpentry and Joinery) programme as well as carpentry and joinery workshops personnel needs of competency are needed as appropriate because there is no significant difference in the mean responses as indicated on the hypotheses with p-value greater than the level of significance ($p>.005$), the significant level at .89.

Conclusion

The purpose of the study was to determine the competency needs of technical colleges' carpentry and joinery teachers in NTC (Carpentry and Joinery) programme in using CNC Circular Saw Machine (CSM). The two research questions were designed for study on skills of how to operate CNC (CSM) as: grooving and crosscutting operations for effective and efficient in the practical skills class. Based on the findings of the study, the mean responses of the three groups of respondents shows the need and ready to receive competency how to operate CNC Circular Saw Machine (that is, for all the three research questions) only one item for the whole instrument at level of not needed for the whole respondents.

On the other hand, there is significant difference in the research question one indicating the level of significant at .084 ($P<.05$) on hypothesis testing on the competency needs of technical colleges carpentry and joinery teachers on grooving operation with CNC circular saw machine. There is no significant in the research question two indicating the level of significant at .89 ($P>.005$) on hypothesis testing on the competency needs of technical colleges carpentry and joinery teachers on crosscutting operation with CNCS circular saw machine.

Recommendations

The study recommended the following based on the findings of the study:

1. National Board for Technical Education (NBTE) should include CNC Circular Saw Machine (CSM) in NTC (Carpentry and Joinery) Programme.
2. Government should organize seminars and workshops for NTC (Carpentry and Joinery) technical colleges' carpentry and joinery teachers on how to use CNC Circular Saw Machine (CSM).
3. Technical colleges' carpentry and joinery teachers and their students should be encouraged to make use of the developed CNC Circular Saw Machine for NTC (Carpentry and Joinery) Programme.
4. Governments and Non-Governmental Organizations should try as much as possible to purchase more CNC Circular Saw Machines (CSMs) for carpentry and joinery workshops in technical colleges' offering NTC (Carpentry and Joinery) programme.
5. The management of technical colleges' offering NTC (Carpentry and Joinery) Programme should take care of the maintenance of CNC Circular Saw Machines (CSMs).
6. The management of technical colleges' offering NTC (Carpentry and Joinery) Programme should also, make provision of standby generator incase of failure from National Power Holding Company for operating CNC Circular Saw Machine (CSM).
7. The management of technical colleges' offering NTC (Carpentry and Joinery) Programme should, provide competency needs to technical colleges' carpentry and joinery workshops

personnel on how to operate CNC Circular Saw Machine (CSM) for carpentry and joinery carrying-out operations such as ripping and cross-cutting.

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AGRICULTURAL AND WOODWORK TEACHERS' PERCEPTION ON USE OF COVID-19 ASTRA ZENECA VACCINE IN SENIOR SECONDARY SCHOOLS OF BAUCHI METROPOLIS

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Abstract
The study examined the perception of agricultural and woodwork teachers on use of Covid-19 Astra Zeneca vaccine in senior secondary schools in Bauchi Metropolis. Three objectives and three research questions guided the study. The study adopted a descriptive survey research design. The population of this study comprised 208 agricultural and woodwork teachers in senior secondary schools. A structured questionnaire was used as instrument for data collection and validated by three experts. Data collected was analysed and the result showed that, agricultural and woodwork teachers viewed covid-19 Astra Zeneca vaccine as dangerous, agricultural and woodwork teachers rejected the use of Astra Zeneca Vaccine and refusing Astra Zeneca vaccine by respondents increases the risk of transmission of the virus. It was recommended that, Policy makers should formulate policy that will enable agricultural and woodwork teachers in addressing challenges relating to negative perception on the use of covid-19 Astra Zeneca Vaccine.

Keywords: Astra Zeneca Vaccine, Agricultural and Woodwork Teachers, Corona Virus, Perception

Introduction

Most governments around the world have temporarily closed educational institutions in an attempt to contain the spread of the Covid-19 pandemic. The Covid-19 crisis has significantly affected the educational sector across all regions due to safety preventive measure to curtail the spread of Covid-19. The closure of school has interrupted the functioning of the school system, reducing students learning and restricting the activities of educational authorities, parents and decision makers (UNESCO, 2020). Millions of students have not been able to continue learning in schools, universities, vocational training institutions and adult learning programmes. Many governments responded to the pressing need to provide school children with learning possibilities via online and distance learning (Olumofe, 2021). Although precautions were taken, the students ' learning process was negatively affected. Students who have been stripped of their freedom due to Covid-19 are deeply concerned about when face to face education will happen. However, there were concerns on the impact of prolonged school closures on school-drop-out rates, learner's academic achievement, and numbers of out of school children and the ineffectiveness of remote learning. In an effort to re-open schools, presumptions survey took place in October 2020 with all stakeholders in the educational sectors (parents/guardians, learners, teachers/facilitators and educational managers) with total of 7403 respondents across Nigeria, to determine their perspectives on schools reopening. Federal government of Nigeria orders school to re-open on October 12, urged all state and privates school to work out their modalities to re-open their schools and advice all institutions to adhere to presidential task force guidelines on re-opening of schools (Olivia, 2020).

The official name of covid-19 Astra zeneca vaccine is "Vaxzevria" but most people call it "Astra Zeneca ". There is broad agreement with in the global scientific community that the most effective way to defeat the Covid-19 pandemics through the massive vaccination of populations around the world. The development of vaccines for Covid-19 has been a power fouled menstruation of how substantial public funding, intense focus, and unprecedented levels of scientific collaboration can help spur innovation to address global public needs in very short time (Harris, et al 2021). However, the approval and roll out of vaccines does not raid the immediateness of the health crisis, as attaining herd immunity will require the vaccination of a very substantial proportion of population, and is therefore a major

challenge (OECD, 2021). They need to promote confidence among the public in ensuring effectiveness and safety of the vaccines, as well as the capacity of governments to manage the logistical challenges competently. Nigeria received four million doses of the Modern a Covid-19 vaccine from the United States as the West African nation steps up efforts to battle a third wave of infections. Nigeria home to some 210 million people used the four million doses of the Astra Zeneca vaccine it received to start its nationwide in oculation programme. Reaching Bauchi, Bauchi metropolis, despite widespread recognition that covid-19 is a critical issue to teachers at all level of education. Many remain unwilling to be vaccinated due to past experience with vaccines, level of education and knowledge, perceived importance of vaccination, subjective norms and religious belief, risk perception and trust. More broadly, the pandemic has triggered wide spread disinformation that has undermined both understanding and acceptance of science and public policy that extended to the issue of vaccine acceptance (De-Figueredo, 2020).

Factors that play a role of not receiving or accepting covid-19 Astra zeneca vaccine includes; the speed at which the vaccine was developed and approved within less than one-year is a concerned to many peoples over the safety of the vaccine. The number of questions regarding the durability of the immune response following the vaccination and vaccine effectiveness to limit the asymptomatic spread remained unanswered in the clinical trials which make the peoples to think over the safety of the vaccine. As schools were reopened after covid-19 pandemic which lead to closure of schools, preventive measures were taken such as social distance, washing of hands frequently, wearing of face mask, using hand sanitizer, no shaking of hands, avoiding gathering, which affect academic performance of students due to social distance, fear of the disease etc. The best way of living a normal life, performing well in our academic performance is by taken vaccine to prevent the spread of the disease.

Statement of the Problem

It has been observed that most of the agricultural and woodwork teachers in senior secondary schools of Bauchi metropolis has been discouraged from accepting and using Covid-19 Astra Zeneca vaccine, this is due to fear and lack of trust of the vaccine, lack of knowledge and improper awareness on the vaccine among the teachers. According to WHO (2020) the easiest way to prevent the spread of Covid-19 is by vaccinating the globe. Therefore, agricultural and woodwork teachers need to accept theses vaccines by removing fear and building a trust in vaccine and critically believing on the ability of government to communicate by given a proper knowledge and awareness on vaccine and deliver vaccine safety and effectively to agricultural and woodwork teacher's in senior secondary schools in Bauchi metropolis. This study will design to determine the agricultural and woodwork teacher's perception on the use of Covi-19 Astra Zeneca vaccine in senior secondary schools, Bauchi metropolis.

Purpose of the study

The main purpose of this study is to determine the perception of agricultural and woodwork teachers on the use of Covid-19 Astra Zeneca vaccine in senior secondary schools in Bauchi metropolis. The specific objectives of the study are to:

1. To determine views of agricultural science and woodwork teachers towards covid-19 Astra Zeneca vaccine in senior secondary schools in Bauchi metropolis.
2. To find out agricultural science and woodwork teachers acceptability of Astra Zeneca vaccine in senior secondary schools in Bauchi metropolis on Covid-19.
3. To determine the implication of Covid-19 Astra Zeneca vaccine on agricultural science and woodwork teachers in senior secondary schools in Bauchi metropolis.

Research Questions

1. To what extent does agricultural and woodwork teachers view covid-19 Astra Zeneca vaccine in senior secondary schools in Bauchi metropolis?
2. What is the level of agricultural and woodwork teachers' acceptability of covid-19 Astra Zeneca vaccine in senior secondary schools in Bauchi metropolis?
3. What is the implication of refusing Astra Zeneca vaccine by agricultural and woodwork teachers in senior secondary schools in Bauchi metropolis?

Methodology

Descriptive survey research design was adapted for the study. Sambo (2008) described descriptive survey research as a method of data collection using questionnaire or interview to collect data from a sample that has been selected to represent a population to which the findings of the data analysis can be generalized. Three objectives and three research questions guided the study. The population of this study comprised 208 agricultural and woodwork teachers in senior secondary schools. Simple random sample technique was used for this study.one hundred and twenty-six (126) agricultural and woodwork teachers were sampled. The instrument was administered to the respondents at their various locations with the help of three research assistants and the researcher. Structured questionnaire was used as an instrument for data collection, which contain thirty items grouped under perception of agricultural and woodwork teachers on the use of Covid-19 Astra Zeneca vaccine. The original draft of the instrument was subjected to face and content validation by three experts in department of Vocational and Technology Education, ATBU Bauchi. Data was collected and analyzed using descriptive statistic of mean and standard deviation. The benchmark of five points Likert scale is 3.00 (Okolocha & Nwadiani, 2015). In order to determine the agreement or level of acceptance of each item statement of the questionnaire decision based on real limit of numbers was used, any item with a mean rating above 3.00 is regarded as agree, while any item with a mean rating below 3.00 is regarded as disagree.

Results

Research Question one: To what extent does agricultural and woodwork teachers viewed covid-19 Astra Zeneca vaccine?

Table 1: Mean Responses of the Respondents on the view of Agricultural and Woodwork Teachers toward COVID-19 Astra Zeneca Vaccine

S/N	Items	Mean	Std. Dev.	Remarks
1	Agricultural and woodwork teachers fear the risk of taking the vaccine.	4.67	1.41	Agreed
2	Based on people speculation, those who receive the Covid-19 Astra Zeneca vaccine will die within two years.	4.39	2.12	Agreed
3	Agricultural and woodwork teachers lack trust of taking Covid-19 Astra Zeneca vaccine.	4.64	1.41	Agreed
4	Covid-19 Astra Zeneca vaccine was produced to prevent further spread of the virus.	4.17	2.12	Agreed
5	Agricultural and woodwork teachers perceived that, the Covid-19 Astra Zeneca vaccine have an auto track chip problem.	4.71	2.83	Agreed
6	Covid-19 Astra Zeneca vaccine is less harmful since it was first administered to the political leaders and health workers.	2.89	2.83	Disagreed
7	Agricultural and woodwork teachers view Covid-19 Astra Zeneca vaccine as authentic since it was produced by the foreign countries.	2.75	2.83	Disagreed
8	Covid-19 Astra Zeneca vaccine administrators lack proper knowledge and improper awareness of the vaccine	4.53	2.12	Agreed
9	Do you believe that, the Covid-19 Astra Zeneca vaccine is a western world plan to depopulate black human race	3.82	2.12	Agreed

10	Agricultural and woodwork teachers view Covid-19 Astra Zeneca vaccine have possessed precautionary quality to prevent people after vaccination	3.03	1.41	Agreed
	Grand Mean	**3.96**		

The table 1 above shows ten items with mean values ranging from 2.75 to 4.71. Eight out of the ten items were agreed with the mean ranging from 3.03 to 4.71 and Standard Deviation of 1.41 to 2.83 respectively. While two were disagreed because the mean fell below the cut off mean of 3.00 which ranging from 2.75 to 2.83 and Standard Deviation of 2.83 respectively. The eight items were agreed because their mean values were rated above the cut off mean of 3.00.

Research Question Two: What is the level of agricultural and woodwork teachers on Acceptability of Astra Zeneca Vaccine?

Table 2: Mean Responses of Agricultural and Woodwork Teachers on Acceptability of Astra Zeneca Vaccine

S/N	Items	Mean	Std. Dev.	Remarks
11	Agricultural and woodwork teachers considered Covid-19 Astra Zeneca vaccine to be effective and authentic.	3.07	1.41	Agreed
12	In your school, agricultural and woodwork teachers accept Covid-19 Astra Zeneca Vaccine.	2.60	2.83	Disagreed
13	Agricultural and woodwork teachers accepted the COVID-19 Astra Zeneca vaccine risk.	2.46	2.83	Disagreed
14	Fear of accepting Covid-19 Astra Zeneca vaccine hinder agricultural and woodwork teachers from accepting the vaccine.	4.75	2.12	Agreed
15	Due to lack of innovative genetic-based technologies of knowledge and improper awareness, agricultural and woodwork teachers reject Covid-19 Astra Zeneca vaccine.	3.50	2.83	Agreed
16	Traditional and religious believes influence agricultural and woodwork teachers from accepting Covid-19 Astra Zeneca vaccine.	2.89	2.83	Disagreed
17	Only one year creation framework makes agricultural and woodwork teachers rejection of Covid-19 Astra Zeneca vaccine.	3.78	1.41	Agreed
18	Agricultural and woodwork teachers lack trust on accepting the Covid-19 Astra Zeneca vaccine.	4.71	0.71	Agreed
19	Evident of Covid-19 Astra Zeneca vaccine side effects, force agricultural and woodwork teachers level of rejection.	4.32	2.83	Agreed
20	Covid-19 Astra Zeneca vaccine has an advance effect on patients based on gender in educational setting	3.21	2.12	Agreed
	Grand Mean	**3.52**		

The table 2 above shows ten items with mean values ranging from 2.46 to 4.75. Seven out of ten items were agreed with the mean ranging from 3.07 to 4.75 and Standard Deviation of 0.71 to 2.83 respectively while three were disagreed because the mean fell below the cut off mean of 3.00 which ranging from 2.46 to 2.89 and Standard Deviation of 2.83 respectively. The seven items were agreed because their mean values were rated above the cut off mean of 3.00.

Research Question Three: What is the Implication of covid-19 Astra Zeneca vaccine on agricultural and woodwork teachers?

Table 3: Mean Responses of the Respondents on Implication of Covid-19 Astra Zeneca Vaccine on Agricultural and Woodwork Teachers

S/N	Items	Mean	Std. Dev.	Remarks
21	Use of Covid-19 Astra Zeneca vaccine reduces the transmission of the spread of the virus.	3.14	2.12	Agreed
22	Acceptance of the Covid-19 Astra Zeneca vaccine reduced level of hospitalization among agricultural science teachers.	3.42	2.12	Agreed
23	Covid-19 Astra Zeneca vaccine reduce likelihood of virus symptomatic in our schools	3.14	2.12	Agreed
24	Covid-19 Astra Zeneca vaccine could prevent mortality rate among agricultural and woodwork teachers.	3.21	2.83	Agreed
25	Covid-19 Astra Zeneca vaccine leads to abdominal pain and rash after the administration of the vaccine.	4.42	1.41	Agreed
26	After vaccination, agricultural and woodwork teachers experienced excessive sweating.	4.17	1.41	Agreed
27	After vaccination, agricultural and woodwork teachers experienced excessive dizziness	4.35	2.83	Agreed
28	Agricultural and woodwork teachers experienced excessive fever after vaccination.	4.21	2.12	Agreed
29	Agricultural and woodwork teachers experienced excessive allergic reaction after vaccination.	4.14	2.12	Agreed
30	After vaccination, agricultural and woodwork teachers experienced excessive muscle pain.	4.35	2.83	Agreed
	Grand Mean	**3.86**		

The table 3 above shows ten items with mean values ranging from 3.14 to 4.42. All the ten items were agreed with the mean ranging from 3.14 to 4.42 and Standard Deviation of 1.41 to 2.83 respectively. The ten items were agreed because their mean values were rated above the cut of mean of 3.00.

Findings of the Study

1. Agricultural and woodwork teachers viewed covid-19 Astra Zeneca vaccine as dangerous hence shown high fear or anxiety.
2. Agricultural and woodwork teachers rejected the use of covid-19 Astra Zeneca Vaccine.
3. Refusing Astra Zeneca vaccine by agricultural and woodwork teachers increases the risk of transmission of the spread of the virus.

Discussion of Finding

From the first finding of the study that, there is high fear or anxiety on the use of Covid-19 Astra Zeneca vaccine and high side effect on the use of Covid-19 Astra Zeneca vaccine which makes many Agricultural and woodwork teachers fear the risk of accepting Covid-19 Astra Zeneca vaccine in senior secondary schools, Bauchi metropolis. This figure is however an important pointer that critical stakeholders need to do more in term of vaccine awareness and education to remove negative perception of Agricultural and woodwork teachers to accept Covid-19 Astra Zeneca vaccine. Misinformation and disinformation strengthen vaccine skepticism and rejection Shelley, et al (2020). This could undermine efforts to end the corona virus pandemic. Liu, *et al.* (2020) reported that Potential vaccine takers have highest condense risk and fear among healthcare professionals and their personal physician and health institutions on Astra Zeneca COVID-19. He further emphasized that, there is need for adequate public health enlightenment on the role of safe and potent vaccine in curbing the COVID-19 pandemic. Nasreen, (2021) the sources of false information that risk teachers must be identified and nipped at the bud. Facts must be promoted above false information using appropriate fact-checking and regulatory mechanisms. Efforts to raise the profile of good information, and place a warning label on the bad must

be intensified to avoid the risk of pandemic and probably death. Also study of Baldo, et al (2021) also indicated the vaccine refusal within the health care workers, which is particularly problem antipasti, may impact negatively teacher's decision.

The second finding further state that, agricultural and woodwork teachers rejected the use of covid-19 Astra Zeneca Vaccine. This concur with the study of Malik, *et al.* (2020) that Vaccine administration by those with better understanding of vaccination against Covid-19 is extremely rejected in combating the spread that may be seen among teachers in Nigeria. Further emphasized that, these tasks of awareness should not be left to healthcare providers alone, it must also come from the cross-section of religious, traditional, and political leaders who are revered and respected in society. This will ensure adequate deployment and acceptance of the vaccine by teachers in general. In another of De-Figueredo (2020) revealed that tragedy for the deadly virus to continue to escalate due to poor knowledge, negative perception and outright rejection of vaccine by the teachers. Education is well understood to influence self-care behavior. More engagement and collaborations among research institutions, pharmaceutical companies and regulatory agencies is needed, hence the creation of the "Accelerating and acceptable COVID-19 Therapeutic Intervention and Vaccine (ACTIV) Programme among teachers.

The third finding further state that, refusing Astra Zeneca vaccine by agricultural and woodwork teachers increases the risk of transmission of the spread of the virus. The finding agrees with Adams (2010) medication on vaccination administration intake. Borg and Scicluna (2002) on accepting Astra Zeneca vaccine for safety precautions against risk of COVID-19. Further stated that, there is need for continuous tracking of false rumors about COVID-19 in hopes of curbing their spread. Recommended that, the international and local media companies must come up with effective strategies to 'flatten the curve' of false information regarding the COVID-19 vaccines. There must be deliberate and continuously step up efforts to flag or remove misinformation and to guide teachers to reliable sources of information regarding COVID-19 vaccines. Ema (2020) teachers must take responsibilities for the nature and authenticity of information been circulated on different platforms regarding COVID-19 vaccines. Credible evidence must be available to counter any fake news that went viral regarding vaccines and vaccination (Boytchev, 2021).

Conclusion

In order to engineered towards accepting and vaccinating Covid-19 Astra Zeneca vaccine in our secondary schools, teachers must remove fear and build a trust on vaccine to succeed in the global effort to vaccinate millions of people as rapidly as possible, governments need to give priority to addressing issues of trust both in vaccines and in the institutions responsible for the vaccination endeavor so that such priority information can help to re-strategies reaching out to the general public and support in the decision-making process regarding the COVID-19 vaccination.

Recommendations

The following recommendations were made:

1. Secondary school administrators should create proper awareness on the vaccines by organizing group for vaccines safety to discuss about the vaccines in order to build the capacity of accepting safety and effective vaccines.
2. Government should not take it as game play and should critically improve its ability of to communicate by given a proper knowledge and awareness on vaccine and delivery vaccine safety. 3. Policy makers and planners should formulate policy that will enable Agricultural and woodwork teachers in addressing challenges relating to negative perception use of covid-19 Astra Zeneca Vaccine.

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ASSESSMENT OF INSTRUCTIONAL RESOURCES IN TEACHING AND LEARNING OF AGRICULTURAL SCIENCE IN SENIOR SECONDARY SCHOOLS IN MAIDUGURI METROPOLITAN COUNCIL IN BORNO STATE.

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Abstract
Instructional resources are tools that are used by the teacher to encourage students' learning activities. This study adopted a survey research design to assess the instructional resources for teaching agricultural science in senior secondary schools in Maiduguri metropolitan area council, Borno state. In this research, 10 agricultural science teachers and 5 senior secondary schools were purposively sampled from the population, the selected schools were: Government Day Senior Secondary School Maiduguri, Government College Maiduguri, Yerwa Girls Secondary Schools Maiduguri, Government Girls College Maiduguri, and Shehu sanda Karimi government day senior secondary school Maiduguri. The instrument for data collection was researchers designed questionnaire to elicit information from the teachers. The data were analyzed using frequency and percentage. The findings of this study revealed that instructional resources are relevant in teaching agricultural science subjects in senior secondary schools. The study recommended that government and school officials should work together to ensure that obsolete resources should be rebranded or changed.

Introduction
Instructional aids/materials are resources that help organize and support instructional delivery. It can also be referred to as human and non-human materials and facilities that can ease, encourage, improve, and promote teaching activities. They include both visual and audio-visual aids and could either be concrete or non-concrete (Ng'etich & Chemwei, 2015; Alkali *et a*l., 2016). These instructional materials bring life to learning by stimulating students to learn. For many decades now, the provision of instructional resources has been identified as a key factor in the implementation of agriculture in senior secondary school curricula (Aholi *et al*., 2018). Some of these instructional resources provided initially in the first schools to teach agriculture included; a laboratory, agriculture workshop equipped with metal and woodworking tools, gas and electric welders, power generators, fuel storage tanks, tractors, cultivators, combined harvesters, science laboratory facilities, the school farm, a departmental vehicle and funds for running the department (Konyango & Asienyo, 2015). These instructional resources provide a base upon which teachers can guide students in the learning process.

The use of instructional resources in the classroom has the prospect of helping the teacher explain new concepts clearly, resulting in better student understanding of the concepts being taught. However, they are not ends in themselves but they are means to an end (Ng'etich & Chemwei, 2015). More so, the importance of these instructional resources cannot be underscored. This has been emphasized by some scholars. Lockheed (1991 as cited in(Ng'etich & Chemwei, 2015) articulates that instructional materials are critical ingredients in learning and that the curriculum could not be easily implemented without them. Indisputably, the use of instructional materials has yielded better results in learning especially in vocational studies, thus their widely proclaimed use(Alkali *et al.*, 2016). Consequently, the research on resource availability in the teaching of agricultural science in secondary schools is the spirit of sustainable agricultural development.

Agricultural science is one of the vocational studies in which instructional resources and facilities are provided to implement the teaching of agriculture practically with a mission to transform and promote the development of society (Bennell, 2007; Maxwell, 1965;(Alkali et al., 2016). Nwabuisi (1993) in a study on resources for teaching and learning agriculture science in Lagos State Junior secondary schools reported a low teacher/student ratio of 1:60. Amadi (2011) also reported a low teacher/student ratio of 1:158, which is just a marginal improvement on Nwabuisi (1993). Though as reported by Amadi (2011)

there are more qualified teachers of agriculture these days in Nigeria. In another study, Kabugi (2013) found that school farms, agricultural tools, and agriculture classes were inadequate. The study further found that livestock units/tools and agricultural laboratories were not available in most of the schools. From the findings of the study, it can be said that the inadequacy of teaching and learning resources in secondary schools in the Kakuyuni division poses a challenge to the teaching and learning of agriculture. The findings are in line with the findings of a study done by Temu and Kitalyi (2002) who found that teachers a poorly equipped to deal with some of the challenges that the system poses such as the reality of large class size, unavailability of didactic materials and gender disparities. Kabugi (2013) further found that inadequacy of resources such as school farms, agricultural tools, and agriculture classrooms posed challenges to teaching and learning of agriculture. Some topics such as agriculture economics, farm power, and types of machinery seemed very difficult to the learners.

Ultimately, instructional resources can make agricultural science more accessible and engaging for students. Owino *et al.* (2015) posit that the availability of instructional resources enhances the effectiveness of schools as these are the basic things that can bring about good academic performance in students. According to Cheplogoi (2011), the level of availability of agricultural science facilities in the school has a significant influence on students' attitudes towards the subject. Mutai (2006) asserts that learning is strengthened when there are enough reference materials such as textbooks, exercise books, teaching aids, and classrooms. Lack of required resources as observed in the senior secondary schools could have a great toll on the students' performance in agricultural science. On this note, this study sought to assess the instructional resources for teaching agricultural science in senior secondary schools in the Maiduguri metropolitan council of Borno State.

Statement of the Problem

Agricultural science being a practical subject needs to be made more realistic and meaningful through the use of instructional aids for effective teaching of the subject. Rather, what is obtainable in our senior secondary schools is more of a theoretical teaching of agricultural science. Many studies have identified that inadequate instructional resources are contributing to the poor performances of students and also affect their attitude and interest in studying agricultural sciences. Furthermore, some studies have identified that some of the few available resources are outdated and the poor attitude of agricultural science teachers as regards the use of instructional resources is among the factors that are affecting the use of these resources. The uniqueness of this subject resulted from the variety of materials and experiments necessary for its effective teaching and learning. Teachers' ability to carefully select and skillfully handle the instructional resources in teaching makes learning more effective and interesting. On this basis, the present study thus investigates the effectiveness of instructional resources in teaching agricultural sciences in senior secondary schools in the Maiduguri metropolitan council of Borno state.

Aims and Objectives of the study

This study aimed to assess the instructional resources in teaching agricultural science in senior secondary schools in the Maiduguri metropolitan council of Borno State. Specifically, the study:

i. Investigate the relevance of instructional aids in teaching and learning of agricultural science in senior secondary schools in Maiduguri metropolitan council in Borno state.
ii. Investigate the availability of instructional resources for teaching agricultural science in senior secondary schools in the Maiduguri metropolitan council of Borno State.
iii. Investigate the difficulties faced by the agricultural science teacher using instructional resources for teaching the subject in Maiduguri metropolitan council of Borno State.

Research Questions

The following research questions were raised to guide the study

i. What are the Agricultural science teachers' perceptions on the relevance of instructional resources in teaching agricultural science in senior secondary schools in Maiduguri metropolitan council of Borno State?
ii. What is the availability of instructional resources for teaching agricultural science in senior secondary schools in the Maiduguri metropolitan council of Borno State?
iii. What are the difficulties faced by the agricultural science teacher using instructional resources for teaching the subject in the Maiduguri metropolitan council of Borno State?**Methodology**

The study is a survey-based descriptive research design. A total of 10 agricultural science teachers were chosen with care using a random sampling method from five purposeful selected secondary schools in Maiduguri metropolitan council. The selected schools were Government Day Senior Secondary School Maiduguri, Government College Maiduguri, Yerwa Girls Secondary Schools Maiduguri, Government Girls College Maiduguri, and Shehu Sanda Kyarimi Government Day Senior Secondary School Maiduguri. The study's instrument was a structured questionnaire titled Agricultural Science Teachers Questionnaire. Demographic information of the respondents were all elicited in Section A relevance of instructional resources in Section B, and availability of the instructional resources in Section C. In Section D, respondents were asked their thoughts on the difficulties encountered while using the instructional resources in teaching agricultural sciences. The information gathered was analyzed using descriptive statistics of frequency and percentage.

Result and Discussion

Relevance of instructional resources in teaching agricultural science in senior secondary schools in Maiduguri metropolitan council of Borno State

Table 1: indicates the teachers' responses on the relevance of using instructional resources in teaching agricultural science

S/N	Items	Frequency	Percentage (%)
1	Instructional resources make teaching agricultural science lessons interesting	3	30%
2	Instructional resources help facilitate the students' understanding	-	-
3	Instructional resources help capture the student's interest in learning agricultural science	2	20%
4	All of the above	5	50%
	Total	**10**	**100%**

Table 1 above shows the agricultural science teachers' responses on the relevance of using instructional resources in teaching the subject. The table revealed that 30% of the respondents agreed that the use of instructional resources in teaching agricultural science subject in senior secondary school make the lessons more interesting. 20% of the respondents believed that the use of instructional resources in teaching agricultural science arouses the interest of the students in learning the subjects while 50% of the respondents believed that the use of instructional resources not only makes lessons more interesting or captures the students interest but also facilitate the students understanding of the concepts. Therefore, the study agreed that the use of instructional resources is more relevant in teaching agricultural science in senior secondary schools in the Maiduguri metropolitan council.

Table 2: indicates the teachers' responses on the availability of instructional resources in teaching agricultural science

S/N	Items	Frequency	Percentage (%)
1	Yes	6	60%
2	No	4	40%
	Total	**10**	**100%**

Table 2 revealed the teachers' responses on the availability of instructional resources in teaching agricultural science in senior secondary schools in the Maiduguri metropolitan council. It shows that 60% of the teachers agree that there are available instructional resources for teaching agricultural science in their schools while 40% of the teachers did not agree to have instructional resources for the teaching of the subject in their schools. Table 3 below shows the identified instructional resources for teaching agricultural sciences in the selected schools of Maiduguri metropolitan council of Borno state.

Table 3: Teachers Responses on available instructional Resources for Teaching Agricultural Science

S/N	Items	Remark
1	Chemicals	Available
2	Textbooks	Available
3	Specimens of Agricultural produce	Available
4	Agricultural Laboratory	Available
5	Farm Machines and equipment	Not Available
6	Forest products	Available
7	pH meter litmus paper	Available
8	Rock and soil samples	Available
9	School Farm	Not Available
10	Sample of Animal feeds	Available
11	Specimens of insect pests	Available
12	Weeds Specimen/album	Available
13	Charts and Pictures	Available
14	Fishing trap	Available
15	Specimen of endo-parasite and eco-parasite	Available
16	Specimen of monocotyledonous & dicotyledonous seeds	Not Available
17	Multi-media projector	Available
18	Simple farm tools	Available
19	Specimens of ornamental plants	Not Available

Note: Not Available = 0 – 49% Available = 50 – 100%

Table 3 shows the available instructional resources for teaching Agricultural Science in senior secondary schools. The available instructional resources for teaching Agricultural Science include chemicals, an Agricultural Science laboratory, rock and soil and samples, specimens of agricultural produce, pH meter litmus paper, simple farm tools, samples of animal feeds, specimens of insect pests, weeds specimen/weeds album, charts and pictures, Fishing tools, laboratory apparatus, Specimens of endo-parasites and ectoparasites, forest products, and textbooks.

Table 4: Teachers Responses on Difficulties faced while using the Instructional Resources in Teaching Agricultural Science

S/N	Items	Frequency	Percentage (%)
1	Yes	2	20%
2	No	8	80%
	Total	**10**	**100%**

Table 4 revealed the teachers' responses on the difficulties faced while using the instructional resources in teaching agricultural science in senior secondary schools in Maiduguri metropolitan council. It shows that 20% of the teachers agree that they were facing some difficulties in using some of the instructional resources available for teaching agricultural science in their schools while 80% of the teachers did not agree to facing any difficulties while using the available instructional resources for teaching agricultural science in their schools.

Table 5: Teachers Responses on the identified challenges associated with the difficulties faced while using the Instructional Resources in Teaching Agricultural Science

S/N	Items	Frequency	Percentage (%)
1	Obsolete nature of the resources	2	20%
2	Lack of School farm	6	60%
3	Inadequate farm animals in the school farm	2	20%
	Total	**10**	**100%**

Table 5 revealed the teachers' responses on the major challenges associated with the difficulties faced while using the instructional resources in teaching agricultural science in senior secondary schools in

Maiduguri metropolitan council. It shows that 20% of the teachers agree that the obsolete nature of the resources contributed to the difficulties encountered while using the resources, 60% of the teachers agreed that lack of school farms contributed to the difficulties faced while using the resources, and lastly, 20% of the teachers agreed to the fact that inadequate live farm animals in the school farm contributed to some of the difficulties encountered while using some of the instructional resources available for teaching agricultural science in their schools.

Discussion of the Result

This study assessed the relevance of instructional resources for teaching Agricultural Science in Senior Secondary Schools in Maiduguri Metropolitan Council, Borno State. The result showed that the instructional resources for teaching Agricultural Science in senior secondary schools are relevant to the progress of the agricultural science students. This result supported the earlier findings of (Aholi *et al*., 2018 & Alkali *et al*., 2016) that the use of instructional resources in teaching agricultural science helps build the creativity of the students and also widens the opportunity to create more jobs.

The result also shows that instructional resources are available for teaching agricultural science in the selected senior secondary schools in Maiduguri metropolitan council. This result corroborates the findings of Kofo et al (2021) and Kochar (2011) that instructional resources are available for teaching agricultural science in secondary schools. It is evident from the findings of this study that chemicals, Agricultural Science laboratory, rock and soil and samples, specimens of agricultural produce, pH meter litmus paper, simple farm tools, samples of animal feeds, specimens of insect pests, weeds specimen/weeds album, charts and pictures, Fishing tools, laboratory apparatus, Specimens of endo-parasites and ectoparasites, forest products, and textbooks were all available while school farm, specimen of ornamental plants, Specimen of monocotyledonous & dicotyledonous seeds, and farm machine and equipment were not available in the study. this finding corroborates the result of Aholi *et al.* (2018) on the available instructional resources for agricultural science in secondary schools.

The result of this study also revealed that the majority of agricultural science teachers are not facing any difficulties in terms of using the available instructional resources for teaching the subjects but some of these teachers testified to the fact that some of the available resources are obsolete, while absent of school farms in various secondary schools is one of the factors affecting the utilization of these resources.

Conclusion

According to the findings of this study, instructional resources are relevant in teaching agricultural science subjects in senior secondary schools. Available instructional resources for teaching agricultural science in senior secondary schools were employed in the teaching and learning processes of the subject. Agricultural science teachers agreed not to face any difficulties in using the resources while they identified that some of the available resources are obsolete.

Recommendations

The following recommendations are given in light of the findings of this study.

1. The government and school officials need to work together as a team to ensure that obsolete resources are rebranded or changed.
2. The unavailable resources should be made available to students to enhance the teaching and learning of agricultural science in secondary schools.
3. Teachers should be encouraged and motivated to make appropriate use of available resources to enhance effective teaching and learning of agricultural science in secondary schools.

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AWARENESS AND ADOPTION OF BIM AMONG ARCHITECTS AND BUILDERS IN MANAGEMENT OF BUILDING PROJECTS IN ABUJA, NIGERIA

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Abstract
This study investigated the awareness and adoption of Building Information Modelling (BIM) among architects and builders in the management of building projects in Abuja, Nigeria. The population of the study comprised of 2,890 registered architects and builders, made up of 1,680 architects registered with the Abuja chapter of Nigeria Institute of Architects and 1,210 Builders registered with the Abuja chapter of Nigeria Institute of Builders (NIOB). A proportional stratified random sampling technique was employed to draw 10% of the total population resulting in a sample size of 289 comprising of 168 architects and 121 builders. The instrument was tested for reliability using Cronbach alpha and a reliability coefficient was determined to be 0.81. The questionnaires were then administered to 289 respondents out of which 277 were correctly filled and returned. The collected data was analyzed using mean and standard deviation to answer the research questions. The result from the study revealed that the level of awareness and adoption of BIM tools was poor with mean scores of 2.08 and 1.52 respectively. It was recommended that BIM should be introduced into academic curriculum in tertiary institutions while training and seminars on BIM should be conducted by government and construction firms to employees.

Keywords: BIM, Building Information Modelling, Construction, Awareness, Adoption

Introduction

Building Information Modelling (BIM) is an innovative digital technology that is transforming the construction industry by revolutionizing the way buildings are designed, constructed, and managed. BIM has been recognized by the Architectural, Engineering and Construction (AEC) industries as a powerful design and management tool with significant advantages stretching from areas of building life cycle, building design, to include construction management (Yan & Damian, 2008). BIM has been defined in a number of ways, with different industry professionals having varying understanding of what it is. BIM has been described as a process of drawing and design, construction of a building by using technology approach, and it involves a procedure in the Architecture, Engineering, Construction and Operations (AECO) (Abdullah, 2018).

The uses of BIM in construction management are numerous because of its wide area of application throughout a project's life cycle. This benefit ranges from planning, design, and construction and operation stages. BIM plays different important roles in each of these phases. It uses extends from field capturing or existing conditions modelling, cost estimation or quantity take-off, phase planning, site utilization planning, 3D coordination and clash detection, virtual mock-up or construction system design, digital fabrication, digital layout, field tracking as well as record modelling. The benefits of BIM as identified by Eastman *et al*., (2011) and Succar (2009) can be summarised to include significant reduction in the number of construction errors, cost saving, improved collaboration, reduced design errors and omissions, improved scheduling and coordination, and improved communication among project team members. However, the overall objective of BIM use remains same which is to create a shared pool of data to increase collaboration among all project stakeholders, and as a result, achieve better productivity. According to Kreider & Messner (2013) a BIM use is "a method of applying Building Information Modelling during a project's lifecycle to achieve one or more specific objectives."

The adoption of BIM in Nigeria is still at a nascent stage. According to a study conducted by Oluwole *et al*. (2020), only 17.5% of construction firms in Nigeria use BIM. The low adoption rate can be attributed to several factors, such as the lack of awareness, inadequate government support, and the high

cost of implementing BIM. The study also revealed that most construction firms in Nigeria still rely on traditional methods of construction.

The adoption of BIM in Nigeria faces several challenges. One of the major challenges is the lack of awareness and education among stakeholders. According to Akinade *et al*. (2015), there is a lack of understanding among stakeholders about the benefits of BIM, which leads to resistance towards its adoption. Another challenge is the lack of government support and policies that encourage the use of BIM. The high cost of implementing BIM is also a significant challenge faced by stakeholders, especially small and medium-sized construction firms. Implementing policies and regulations mandating the use of BIM in public sector projects, increasing BIM training and education programs, and raising awareness of the benefits of BIM are strategies the Nigerian government can adopt. This will not only improve project delivery and reduce costs but also position Nigeria to compete with other countries in the global construction industry.

However, in spite of all these benefits of BIM, it was observed that there are reluctancy to the use of BIM in Abuja construction industries as cases of abandoned projects, poor resource management, poor communication and information sharing between construction professionals are still witnessed. Furthermore, the identification of poor designs, poor construction as well as non-adherence to approved building plans as major issues facing the industry are indications that the professionals responsible for carrying out these tasks are either lacking in skills, unaware, incapable or reluctant to adopt more sophisticated and productivity proven tool like the BIM.
With the growing incidences of abandoned building project and other related problems in building construction, this may suggest that there is low level of awareness and adoption of BIM in the building construction industry. Hence, the study seeks to investigate the level of awareness and adoption of BIM among architects and builders in the management of building projects in Nigeria.

Aim and Objectives of the Study
The study aimed to determine the awareness and adoption of BIM among architects and builders in the management of building projects in Nigeria. Specifically, the study:

1. Determined the level of awareness of BIM tools among architects and builders for the management of building projects in Abuja.
2. Identified the level of adoption of BIM tools among architects and builders for the management of building projects in Abuja.

Research Questions

1. What is the level of awareness of BIM tools among architects and builders for the management of building projects in Abuja?
2. What is the level of adoption of BIM tools among architects and builders for the management of building projects in Abuja?

Methodology
The study was conducted in Abuja, Nigeria. A descriptive research design was adopted for this study, where a total population of 2,890, comprised of 1,680 architects registered with the Abuja Chapter of the Nigerian Institute of Architects (NIA) and the 1,210 builders registered with the Abuja Chapter of the Nigeria Institute of Builders (NIOB) was used. A sample size of 289 comprised of 168 architects and 121 builders was calculated through the adoption of a proportional stratified random sampling technique to draw 10% of the total population of the registered members of the National Institutes of Architects (NIA) and National Institute of Builders (NIOB) in Abuja, Nigeria. Structured questionnaire was adopted as instrument for data collection while mean statistics and standard deviation were adopted as method for data analysis. The questionnaire was deemed reliable when tested with Cronbach alpha reliability test with a score of 0.81.

Results and Discussions
Research Question 1.
Data for answering research question 1 is shown in table 1

Table 1: Awareness of BIM tool among architects and builders in Abuja

S/No	Items	$\bar{X}_a$	SD_a	$\bar{X}_b$	SD_b	$\bar{X}_t$	SD_t	Rank	Remark
1.	Revit Architecture	3.98	0.78	3.14	0.85	3.56	0.82	1	Very Aware
2.	Autodesk BIM 36(	3.97	0.99	2.25	1.05	3.11	1.02	3	Aware
3.	ArchiCAD	3.96	0.96	2.22	1.01	3.09	0.99	4	Aware
4.	VectorWorks	1.96	1.03	2.44	0.99	2.20	1.01	11	Unaware
5.	DProfiler	1.25	1.1	2.14	0.88	1.70	0.99	17	Unaware
6.	SketchUp Pro	2.91	0.97	2.91	0.61	2.91	0.79	6	Aware
7.	Tekla BIM Sight	2.99	0.81	2.41	0.95	2.70	0.88	7	Aware
8.	Affinity	1.77	0.88	1.25	0.82	1.51	0.85	20	Unaware
9.	Vico Office	3.25	1.05	2.15	1.03	2.70	1.04	7	Aware
10.	Navisworks Mana	3.89	0.87	3.14	1.04	3.52	0.96	2	VeryAware
11.	Sychro Profession	2.11	0.98	1.69	0.89	1.90	0.94	15	Unaware
12.	Constructware	1.14	1.03	1.88	0.89	1.51	0.96	21	Unaware
13.	Cbim	1.11	0.98	2.35	0.78	1.73	0.88	16	Unaware
14.	4BIM	1.23	0.74	1.1	0.88	1.17	0.81	27	VeryUnaware
15.	BIM server	1.33	0.95	1.01	1.03	1.17	0.99	26	VeryUnaware
16.	Bantley BIM Suite	3.51	1	2.34	0.92	2.93	0.96	5	Aware
17.	ArchiFM	1.12	0.91	1.01	1.03	1.07	0.97	28	VeryUnaware
18.	Green Building St	1.52	0.99	1.45	1.07	1.49	1.03	22	VeryUnaware
19.	Power Civil	2.69	0.87	2.36	0.99	2.53	0.93	9	Aware
20.	Digital Project	2.81	0.98	2.02	0.98	2.42	0.98	10	Unaware
21.	Edificius	3.01	1.04	1.25	1.12	2.13	1.08	14	Unaware
22.	Buildertrend	1.25	0.97	1.89	1.02	1.57	1.00	18	Unaware
23.	BricsCAD BIM	1.11	1.01	1.25	0.93	1.18	0.97	25	VeryUnaware
24.	Allplan Architectu	1.45	0.99	1.48	0.99	1.47	0.99	23	VeryUnaware
25.	Cinema-4D	1.47	0.97	1.02	0.89	1.25	0.93	24	VeryUnaware
26.	AECOsim Bui Designer	1.58	0.84	1.45	0.88	1.52	0.86	19	Unaware
27.	Solibri Model Vie	2.14	0.65	2.14	0.98	2.14	0.82	13	Unaware
28.	Navigator	2.02	1.02	2.33	0.95	2.18	0.99	12	Unaware
Total		2.23	0.94	1.93	0.94	2.08	0.94		Unaware

Key: $\bar{X}_t$ = Average mean; $\bar{X}_a$ = Average mean of architects**;** $\bar{X}_b$ = Average mean of builders SD_t = Average Standard Deviation**;** SD_a = Average Standard Deviation of Architects; SD_b = Average Standard Deviation of builders

The level of awareness of BIM tools among architects were generally poor with a mean score of 2.08 implying low level of awareness of BIM among architects and builders. The architects had a higher level of BIM awareness with a total mean score of 2.23 than builders with mean score 1.94. From Table 1, result showed that the respondents were mostly unaware of BIM tools like DProfiler, Affinity, Sychro Professional, Constructware, Cbim, Digital Project, Edificius, Buildertrend, AECOsim Building Designer, Solibri Model Viewer, Navigator. The respondents were 'Aware' of BIM Tools Autodesk BIM 360, ArchiCAD, SketchUp Pro, Tekla BIM Sight, Vico Office, Bantley BIM Suite, Power Civil while they were 'Very Aware' of BIM tool like Revit Architecture and Navisworks Manage ranking first and second respectively. The standard deviation of the responses ranged from 0.79 -1.08 signifying they closely clustered around the mean suggesting same response. The result indicated that the level of BIM tools awareness among architects and builders in Abuja was low.

Research Question 2

Data for answering research question 2 is shown in table 2.

Table 2: Adoption of BIM tool among architects and builders in Abuja

S/No	Items	$\bar{X}_a$	SD_a	$\bar{X}_b$	SD_b	$\bar{X}_t$	SD_t	Rank	Remark
1.	Revit Architecture	3.12	0.65	1.54	0.92	2.33	0.79	2	RO
2.	Autodesk BIM 360	3.11	0.79	1.35	0.61	2.23	0.70	4	RO
3.	ArchiCAD	2.92	1.06	1.84	0.97	2.38	1.02	1	RO
4.	VectorWorks	2.99	0.9	1.57	0.9	2.28	0.90	3	RO
5.	DProfiler	1	0.89	1.1	0.88	1.05	0.89	25	NA
6.	SketchUp Pro	2.14	0.88	1.14	1	1.64	0.94	11	RO
7.	Tekla BIM Sight	2.21	0.94	1.05	0.99	1.63	0.97	12	RO
8.	Affinity	1.11	0.77	1.11	0.87	1.11	0.82	18	NA
9.	Vico Office	1.12	0.87	1.04	1.05	1.08	0.96	20	NA
10.	Navisworks Manage	2.99	0.87	1.08	0.99	2.04	0.93	6	RO
11.	Sychro Professional	2.01	0.95	1.21	0.93	1.61	0.94	13	RO
12.	Constructware	1.04	1.06	1.12	0.89	1.08	0.98	20	NA
13.	Cbim	1	0.85	1.98	0.96	1.49	0.91	14	NA
14.	4BIM	1.01	0.6	1.1	0.83	1.06	0.72	24	NA
15.	BIM server	1.04	0.78	1	0.84	1.02	0.81	27	NA
16.	Bantley BIM Suite	2.57	0.91	1.78	0.94	2.18	0.93	5	RO
17.	ArchiFM	1.02	0.93	1	1.03	1.01	0.98	28	NA
18.	Green Building Stuc	1	0.89	1.45	0.97	1.23	0.93	16	NA
19.	Power Civil	2.31	0.89	1.52	0.87	1.92	0.88	7	RO
20.	Digital Project	1.89	0.98	1.01	0.87	1.45	0.93	15	NA
21.	Edificius	2.54	1.04	1.11	1.04	1.83	1.04	8	RO
22.	Buildertrend	1.02	0.99	1.42	1.1	1.22	1.05	17	NA
23.	BricsCAD BIM	1.11	0.87	1.02	0.91	1.07	0.89	23	NA
24.	Allplan Architecture	1.04	0.99	1.14	0.77	1.09	0.88	19	NA
25.	Cinema-4D	1.07	0.81	1	0.93	1.04	0.87	26	NA
26.	AECOsim Bui Designer	1.02	0.69	1.14	0.9	1.08	0.80	20	NA
27.	Solibri Model View	1.89	0.96	1.66	0.99	1.78	0.98	9	RO
28.	Navigator	1.74	0.83	1.58	0.96	1.66	0.90	10	RO
Total		1.75	0.88	1.29	0.93	1.52	0.90		RO

Key: RO = rarely often adopted; **NA** = Not adopted

The level of adoption of BIM among architects and builders was very poor with a mean score of 1.52. While the architects performed a little better than the builders with a mean score of 1.75 against the builders' score of 1.29, the performances were way below average. From Table 2, BIM tools DProfiler, Affinity, Vico Office, Constructware, Cbim, 4BIM, BIM server, ArchiFM, Green Building Studio, Digital Project, Buildertrend, BricsCAD BIM, Allplan Architecture, Cinema-4D, AECOsim Building Designer were mostly 'Not Adopted', while BIM tools Revit Architecture, Autodesk BIM 360, ArchiCAD, VectorWork, SketchUp Pro, Tekla BIM Sight, Navisworks Manage, Sychro Professional, Bantley BIM Suite, Power Civil, Edificius, Solibri Model Viewer, Navigator were 'Rarely Often' adopted. From the ranking presented in the table, it was discovered that archicad and revit architecture were the most adopted BIM tools among architects and builders. The standard deviation ranged between 0.79 and 1.0, indicating a closely clustered response. This result indicated a very low level of BIM adoption among architects and builders in Abuja while the standard deviation suggests that the responses of the respondents were mostly the same.

Discussion of Findings

Findings on the level of awareness of BIM among architects and builders revealed that tools like Revit architecture, Autodesk BIM 360, ArchiCAD, Vector Works, SketchUp Pro, Tekla BIM, Bantley BIM suite, Digital Project, Power civil, Navisworks manage, Edificius, Solibri Model Viewer and Navigator known or moderately known to architects and builders. This is in agreement with studies by Abdulmumin *et al.*, (2020) and Olanrewaju *et al.* (2020) who identified these tools as tools with higher level of BIM awareness among construction professionals. While the level of awareness of BIM among architects and builders was discovered to be high, the level of awareness of BIM among architects was

higher than builders. The reason for the difference in level of awareness could be tied to the fact that architects are usually exposed to BIM tools at early stages of learning in institutions than builders. Architects therefore have a higher chance of understanding the complexity of BIM tools and features than most builders. The result on the level of awareness although more promising that of the level of availability, the level is still too low for a country like Nigeria and especially for Abuja its capital. With low level of awareness, there will be a corresponding lower level of adoption. The low level of awareness can be in different categories, those who know nothing about BIM tools, features and usage; those who know about the tools but lack knowledge of their features; those who know about the tools and their features but lack the technical know-how or ability to apply those tools and features. This therefore is an indication of lack of adequate training and knowledge acquisition strategies on the part of the government, academic institutions and construction firms.

Findings on the level of adoption of BIM tools used among Architects and Builders for management of building project in Abuja, Nigeria revealed that there was a very low level of BIM adoption. The level of adoption of BIM was generally low but it was discovered that unlike AchiFM, Cinema-4D which were rarely adopted, tools with higher level of awareness such as Revit, ArchiCAD, Autodesk 360 enjoyed higher level of BIM adoption among architects and builders. Another factor that might have influenced the increased adoption of the tools was the fact that the tools were readily accessible, easier to use with a user-friendly interface. This result is not surprising as a tool cannot be adopted without first having prior knowledge or being aware of its use and features. This finding is also in line with the findings of Abdulmumin et al. (2020) and Onungwa et al., (2017) who stated that tools with higher level of awareness also enjoyed higher level of adoption. The tools that enjoyed higher level of adoption were Revit, ArchiCad and Autodesk 360. The difference in the level of adoption between architect and builders might arise from the fact that architects tend to utilize BIM for design which is one of the first stages of design while builders implement the already designed models. When BIM created design models are unavailable, it becomes difficult for a builder to adopt BIM. This finding is in line with the findings of Olanrewaju et al., (2020) who posited that BIM is mostly adopted within the design stage of a project than in other stages. Consequently, a low level of BIM adoption is an indication of low demand for BIM usage on the parts of the project owners, lack of technical knowhow and expertise, lack of awareness of the benefits of BIM tools or high cost of acquisition and usage.

Conclusion

Based on the results of this study, it is concluded that the state of BIM in Abuja is poor as the level of awareness BIM tools as well as the level of adoption by architects and builders is below average. The implication of this study is that the industry will continue to witness poor project delivery in terms of timeline and quality associated with proper timely management of needed information. It is therefore, necessary that the level of awareness and adoption of BIM is improved on so as to enhance and promote BIM usage while also exposing the professionals and relevant stakeholders to the benefits of BIM.

Recommendations

The following recommendations are made based on the findings of this study:

1. In order to improve the level of awareness of BIM among architects and builders in the construction industries in Abuja, it is recommended that BIM related knowledge is included as a core course in educational syllabuses of higher institutions. Construction organisations with support of government should endeavour to conduct trainings and workshops on the uses and benefits of BIM and the technical knowhow.
2. In order to boost the level of BIM adoption among architects and builders, it is recommended that government relevant policies that mandates the use of BIM in construction of projects in Abuja and other major town in Nigeria.

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ASSESSMENT OF PROJECT MANAGEMENT TOOLS ON BUILDING PROJECTS BY CONSTRUCTION PROFESSIONALS IN NIGER STATE AND FEDERAL CAPITAL TERRITORY, ABUJA

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Abstract
The research was carried out using descriptive survey research design. The study was carried out in Niger State and Federal Capital Territory (FCT), Abuja. A purposive sampling technique was used to select 182 registered construction professionals as respondents for the study in construction industries in Niger State and Federal Capital Territory, Abuja. A 44-items structured questionnaire titled "Questionnaire on the Assessment of Project Management Tools on Building Projects by Construction Professionals (QAPMTBPCP)" was used for data collection. The instrument was validated by three experts in the Department of Industrial and Technology Education, School of Science and Technology Education, Federal University of Technology, Minna. The reliability of the instrument was tested using the Cronbach Alpha statistic and a coefficient of 0.84 was obtained. The data collected for the study was analyzed using mean and standard deviation for answering the research questions. While t-test statistics was used to test the hypotheses at 0.05 level of significance. The findings of the study revealed that construction professional are aware of the different types of project management tools adopted on the building projects and also the finding further revealed that the construction professional do not adopt some project management tools on the building projects. Based on the findings it was recommended that construction professionals should diverse a means of keeping abreast to the current trend in the management of building project with project management tools for effective delivery and construction industries should organize a workshop, seminar or conference in order to avails different types of project management tools for both old and young professional in the construction work.

Keywords: Assessment, Project Management Tools, Building Projects, Construction Professionals

Introduction

Project Management Tools (PMTs) are today gaining popularity and are highly discussed area in the construction industries. PMTs are techniques which generally help to effectively plan towards the successful completion of building projects (Ayodele & Alabi, 2015). However, projects within the construction industries are managed has not changed significantly during the last decade in Nigeria. Mattias (2012) explained that in the construction market, the number of different actors and the way the projects management are procured today has however changed in some developed countries.

The Project Management (PM) processes are common to most building projects and they include elements such as: project initiation, planning, execution, monitoring, controlling and the project closure (Project Management Institute (PMI), 2016). The PMI explained that PM is to ensure an efficient flow of project all through its life cycle. While project oriented processes involve the creation of PM process and specification. The processes are defined by the life cycle of the project and they differ by area of application and the stage of product life cycle (PMI, 2016). In these processes it is difficult to define a project scope without adequate knowledge of how to establish a specified product. For instance, in construction project, several tools and techniques are needed at each phase or to be taken into account when carrying out construction project (Olateju *et al.,* 2011). The PMI (2016) divided the process of project management into five group and these include the following: initiation, planning, execution, control/monitor and closing. Project managers employ these processes in their project, especially in large projects such as construction project where there are a lot of work packages such as purchasing, safety, subcontract, brick laying, roofing, forecasting scaffolding and equipment requirements (PMI,

2017). The phases in the projects overlap each other indicating that some stages in project life cycle are undertaken concurrently in the construction industries.

The construction industry is made up of professionals such as architect, builders, quantity surveyor, structural engineering, and others whose various disciplines are to ensure that construction work is completed as appropriate (Olateju, 2017). Architect is the person who directly communicates with the client and the first professional who is contacted by the client for the translation of his desire or need into drawings and specification. The architect overall responsibility is to design the construction project in accordance with the client's specification. The architect also performs the following roles; ensures the buildability of the design, responsible for the selection of contractors and subcontractors, responsible for contract administration, responsible for project coordination and coordination of other project team members by visiting the construction site on a regular basis as is necessary to determine the work is in progress (Olatunji, *et al.,* 2014).

Another construction professional is the Quantity Surveyor (QS). According to Obadan and Uga, (1996), The QS is professional trained, qualified and experienced personnel in dealing with problems relating to construction cost, management and communication in the construction industry. The QS is one of a number of professionals involved in the construction processes and has specific responsibility for project cost control not only through the construction phase but for the whole life of the building. Traditionally quantity Surveying is concerned with contracts and costs on construction projects and quantity surveyors control construction costs by accurate measurement of the work required. This role is achieved by performing the following activities: Conducting feasibility studies to estimate materials, time and labour costs, preparing, negotiating and analysing costs for tenders and contracts, coordination of work effort, advising on a range of legal and contractual issues, valuing completed work and arranging for payments. Also a builder is not left out as a major player in the construction industry.

A builder is an individual who engages in the planning, developing and coordinating of activities which coincide with the building of structures Olateju et al., (2014). Olateju explained that the general responsibilities of a builder as an individual is planning and carrying through any and all pertinent activities relating to the construction of a dwelling, building or other structure. The builder carries out his/her duties by: Supervising employees, planning how the project will be carried out and completing the project in a manner which coincides with all laws, rules and regulations which may be in existence and correlate with construction, implementing a plan in which to carry out the construction project. This extends anywhere from hiring workers to developing a step-by-step timeline that the project will follow from start to finish, the builder is responsible for hiring, supervising and, at times, firing employees who work on the specific project with the contractor.

Building construction project needs flexible management. Gould and Joyce (2009) observed that building construction projects can be very unpredictable and management needs to be able to cope with daily changes. Furthermore, the construction projects are instigated in a complex environment resulting in a situation of high risk and uncertainty, which are intensify by arduous time constraints (Grant & Pennypacker, 2006). Building construction project goes through the different phases and has therefore a continuously changing workflow and different cultural settings. Management needs to adapt to these changes and at the same time keep the home office updated with the progress of the project through the use of project tools.

In adoption of project management tools into the construction industry, construction project management must take into cognizant of methods, techniques, planning, co-ordination and control of a project from conception to completion (including commissioning) on behalf of a client requiring the identification of the client's objectives in terms of utility, function, quality, time and cost, and the establishment of relationships between resources, integrating, monitoring and controlling the contributors to the project and their output, and evaluating and selecting alternatives in pursuit of the client's satisfaction with the project outcome (Goedert & Meadati, 2008). In Nigeria today, there are constant news and reports of collapse of buildings and delay which when walk around urban areas shows a lot of abandoned building projects that have been marked by regulatory bodies to be demolished

because of the danger it pose. Therefore, there is a need to carry out an assessment of the adoption of project management tools.

Assessment as defined by Odu, (2011) as the process of gathering data and fashioning them into interpretable form for decision making. It often involves collection and collating of data obtained from an assessment process with a view to making valuable judgment concerning the situation or quality of an object or event. Assessment is not concerned with the explanation of the underlying reasons and does not proffer recommendations for action. Although, there may be some implied judgment as the adequacy or otherwise of the situation (Odu, 2011). Hence, the study is to assess the adoption of project management tools on building project delivery by construction professionals in Niger State and Federal Capital Territory, Abuja

Purpose of the Study

The purposes of the study are to:

1. Determine the construction professional awareness of the different types of project management tools adopted on the building projects in Niger State and Federal Capital Territory, Abuja
2. Find out whether the construction professional adopt the different types of project management tools on the building project in Niger State and Federal Capital Territory, Abuja

Research Questions

The following research questions were raised to guide the study:

1. Does the construction professional aware of the different types of project management tools adopted on the building projects in Niger State and Federal Capital Territory, Abuja?
2. Does the construction professional adopt the different types of project management tools on the building project in Niger State and Federal Capital Territory, Abuja?

Methodology

The research was carried out using descriptive survey research design. The study was carried out in Niger State and Federal Capital Territory (FCT), Abuja. Purposive sampling techniques will be used to select 182 registered construction professionals as respondents for the study in construction industries in Niger State and Federal Capital Territory, Abuja. A 44-items structured questionnaire titled "Questionnaire on the Assessment of Project Management Tools on Building Projects by Construction Professionals (QAPMTBPCP)" was used for data collection. The questionnaire items were assigned five points rating scale of Very Aware (VA) / Highly Adopted (HA) with 5 points, Aware (A) / Adopted (A) with 4 points, Unaware (U) / Moderately Adopted (MA) with 3 points, Very Unaware (VU) / Not Adopted (NA) with 2 point and Undecided with 1 point. The instrument was validated by three experts in the Department of Industrial and Technology Education, School of Science and Technology Education, Federal University of Technology, Minna. The reliability of the instrument was tested using the Cronbach Alpha statistic and a coefficient of 0.84 was obtained. The data collected for the study was analyzed using mean and standard deviation for answering the research questions. While t-test statistics was used to test the hypotheses at 0.05 level of significance. Real Upper and lower limit of numbers was used in order to determine the decision of the respondents to each items. Also, p-value is greater than alpha value at 0.05 level of significance, the hypotheses was accepted and if otherwise rejected.

Results

Research Question One

Does the construction professional aware of the different types of project management tools adopted on the building projects in Niger State and Federal Capital Territory, Abuja?

Data for answering research questions one is presented in Table 1.

Table 1: Mean and Standard Deviation of Construction Professional Aware of the Different Types of Project Management Tools Adopted on the Building Projects in Niger State and Federal Capital Territory, Abuja

S/NO.	Awareness of different types of Project Management Tools	X	SD	RMK
1	Critical Path Method	4.12	0.45	Aware
2	Gantt Chart	3.45	0.52	Aware
3	Project Network Diagrams	3.22	0.81	Aware
4	Work Breakdown Structure (WBS)	3.76	0.28	Aware
5	Benchmark Job Technique	2.44	0.55	Unaware
6	Earned Value Management	3.15	0.35	Aware
7	Modular Approach	2.14	0.92	Unaware
8	Expert Judgment	2.55	0.65	Unaware
9	Parametric Techniques	3.45	0.46	Aware
10	Project Stakeholder Management	3.56	0.76	Aware
11	Linked Bar Chart	4.28	0.84	Aware
12	Project Risk Management	3.28	0.27	Aware
13	Line of Balance	2.53	0.62	Unaware
14	Business Care	2.89	0.39	Aware
15	Cost of Quality	3.76	0.77	Aware
16	Agile Tools	3.77	0.28	Aware
17	Flow- charting	3.91	0.74	Aware
18	Decomposition	2.33	0.88	Unaware
19	Use of Spreadsheets e.g. Excel	3.25	0.19	Aware
20	Use of Simulation/ Statistical Tools	3.54	0.57	Aware
21	Benefit/ Cost	3.12	0.53	Aware
22	Benchmarking	2.19	0.61	Unaware
	Grand Mean	**3.21**	**0.56**	**Aware**

Table 1 revealed the mean responses of construction professional awareness on the different types of project management tools adopted on the building projects in Niger State and Federal Capital Territory, Abuja with majority of the item agreed to be aware ranging from 3.12 – 4.28, while some few of the items were unaware. However, the grand mean of 3.21 implies that the respondents jointly agreed with almost all the items. The standard deviation of the items ranges from 0.27-0.92 which further indicates that the respondents were not too far from the mean and were closed to one another in their responses. This closeness of the respondents adds value to the reliability of the mean. Hence the construction professional are aware of the different types of project management tools adopted on the building projects.

Research Question Two

Does the construction professional adopt the different types of project management tools on the building project in Niger State and Federal Capital Territory, Abuja?

Data for answering research questions one is presented in Table 2.

Table 2: Mean and Standard Deviation of construction professional adopt the different types of project management tools on the building project in Niger State and Federal Capital Territory, Abuja

S/NO.	Adoption of different types of Project Management Tools	X	SD	RMK
1	Critical Path Method	2.88	0.46	Moderately Adopted
2	Gantt Chart	3.51	0.38	Adopted
3	Project Network Diagrams	3.22	0.29	Adopted

4	Work Breakdown Structure (WBS)	2.33	0.44	Not Adopted
5	Benchmark Job Technique	2.45	0.36	Not Adopted
6	Earned Value Management	2.38	0.29	Not Adopted
7	Modular Approach	2.86	0.77	Moderately Adopted
8	Expert Judgment	2.11	0.83	Not Adopted
9	Parametric Techniques	2.44	0.47	Not Adopted
10	Project Stakeholder Management	3.66	0.24	Adopted
11	Linked Bar Chart	3.19	0.39	Adopted
12	Project Risk Management	2.13	0.22	Not Adopted
13	Line of Balance	2.48	0.31	Not Adopted
14	Business Care	2.17	0.63	Not Adopted
15	Cost of Quality	2.66	0.82	Moderately Adopted
16	Agile Tools	2.09	0.49	Not Adopted
17	Flow- charting	3.67	0.38	Adopted
18	Decomposition	2.14	0.64	Not Adopted
19	Use of Spreadsheets e.g. Excel	3.66	0.55	Adopted
20	Use of Simulation/ Statistical Tools	2.17	0.92	Not Adopted
21	Benefit/ Cost	2.91	0.84	Moderately Adopted
22	Benchmarking	2.25	0.73	Not Adopted
	Grand Mean	**2.69**	**0.52**	**Not Adopted**

Table 2 revealed the mean responses of construction professional adoption of the different types of project management tools on the building project in Niger State and Federal Capital Territory, Abuja with majority of the item not adopted ranging from 2.09 – 2.48, while some few of the items were adopted. However, the grand mean of 2. 69 implies that the respondents jointly agreed with maj ority not been adopted. The standard deviation of the items ranges from 0.22-0.92 which further indicates that the respondents were not too far from the mean and were closed to one another in their responses. This closeness of the respondents adds value to the reliability of the mean. Hence the construction professional do not adopt the different types of project management tools on the building projects.

Finding of the Study

1. The construction professional are aware of the different types of project management tools adopted on the building projects.
2. The construction professional do not adopt the different types of project management tools on the building projects.

Discussion of Findings

The finding revealed that construction professionals are aware of the different types of project management tools adopted on the building projects. In support of the this finding Okoye *et al.,* (2016) that pointed out that lack of awareness has hindered most of the construction companies from adopting a management tool as they do not have prior knowledge of its outcome. This statement buttresses Ofori-Kuragu *et al.,* (2016) who affirmed that the creation of awareness is significant to the adoption of PMT; they also stated that if people are completely aware of the advantage derived from PMT implementation, there is the possibility that they will take full part in adoption of PMT. A comment from the case study asserts that, the technological infrastructure aspect of this organisation persists as the key challenge hindering PMT implementation as well as the related issues, including awareness. This is in collaboration with Ofori-Kuragu *et al.* (2016) opinion that the creation of awareness is one of the key factors for improving PMTT in construction organisations.

The findings also revealed that the construction professional do not adopt the different types of project management tools on the building projects. In agreement with the findings is Chaves, *et al*. (2016) assert that the use of PMT in construction companies in Nigeria is less effective; this is attributed to economic factors that hinder adoption. Also in support of the finding Baptista, *et al.,* (2016) that funding project, foreign investment and foreign exchange rates influence the successful adoption of PMT in various ways. This could be associated with changes in regulation requiring changes in the adoption of new

approaches to business and competition between construction companies. In addition, Nunan, *et al.*, (2015) assert that economic factors are contributing factors to the performance of an economy, and that directly influences a construction company and has extensive effects on the adoption of PMT. For instance, an increase in the inflation rate of an economy would definitely influence the way construction companies adopt new business approaches. Like other factors, this factor is presented in the framework as one of the key factors influencing the adoption of PMT. This factor includes: cost of investment, lack of funds, poverty rate and unstable economy.

Conclusion

Based on the findings of the study it was concluded that the construction professional are aware of the different types of project management tools adopted on the building projects but very few among them are adopted. It was also concluded that the construction professional do not adopt the different types of project management tools on the building projects due to political and economic factors which hinder adoption for successful building project delivery in construction industries in Niger State and Federal Capital Territory, Abuja

Recommendation

Based on the findings of the study it was recommended that;

1. Construction professionals should diverse a means of keeping abreast to the current trend in the management of building project with project management tools for effective delivery
2. Construction industries should organize a workshop, seminar or conference in order to avails different types of project management tools for both old and young professional in the construction work
3. Government should also assist the construction professional by making it mandatory and also encouraging any practicing construction professional to adopt the use of project management tools compare to conventional management due to the trend in the construction field.

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RELATIONSHIP BETWEEN ENTREPRENEURIAL COGNITIVE ATTITUDES OF STUDENTS AND THEIR COMPETENCIES IN MACHINE WOODWORKING IN COLLEGES OF EDUCATION IN NORTH-WEST, NIGERIA

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Abstract
The study established the relationship between entrepreneurial attitudes and competence in machine woodworking among woodwork technology education students in colleges of education in North-West, Nigeria. Three research questions were raised and answered as well as three null hypotheses were formulated and tested at 0.05 level of significance. Correlational research design was adopted for the study. The targeted population for the study was 70 Nigeria Certificate in Education (NCE) III technical education students from five Colleges of Education offering woodwork technology education in North-West Nigeria. The study was carried out on the whole population. The instruments used for data collection includes: Entrepreneurial Attitude Inventory (EAI) and Competence on Machine Woodworking Inventory (CMWI). The reliability of the instruments were established using Cronbach's Alpha statistics and yielded overall reliability coefficient of 0.924 and 0.816 respectively. The data collected were analyzed using Kendall's tau-b to answer all the research questions and to test the hypotheses at .05 level of significance. Findings from the study revealed among others strong positive relationship between: entrepreneurial cognitive attitudes and knowledge (.827), skills (.856) and attitudes (.873) towards machine woodworking among woodwork technology education students in colleges of education in North-West, Nigeria. Based on the findings, the study recommended among others that: conferences, workshops, seminars and other capacity building programmes should be organized by the Federal and State ministries of education in order to enhance the competence in machine woodworking lecturers which will positively reflect on the competence of the students and consequently improve their positive entrepreneurial cognitive attitudes.

Key words: Entrepreneurial, Cognitive Attitudes, Competencies, Machine Woodworking

Introduction

In Nigeria today, government is making effort in a bid to see that students at all level of education irrespective of their programmes are economically empowered through entrepreneurship education. According to Nabi and Holden (2008), the aim of entrepreneurship education is to serve as a primary source of economic growth that creates business opportunities, reduces unemployment and offers better prospects for students. Uzo-Okonkwo (2013) opined that, in spite of the good aim of entrepreneurship education, students of woodwork technology education express poor entrepreneurial cognitive attitudes. The cognitive component of entrepreneurial attitudes is the set of information, ideas, facts and knowledge about entrepreneurship. It is the opinion or belief segment of an attitude which is related in general knowledge of a person on entrepreneurship (Zampetakis, 2009). Cognitive component of entrepreneurial attitudes relates to thoughts, beliefs and knowledge that students have about entrepreneurship that shapes their attitudes and behaviours. Katane (2016) believed that the cognitive component of entrepreneurial attitudes sets the stage for the more critical part of attitude which is the affective component.

Moreover, it is clearly indicated that, the components of entrepreneurial attitudes largely affect students' desire to start and maintain a business after graduation. Thus, poor entrepreneurial attitude amongst students kills the desire to start and maintain a business after graduation from school. Abimbola (2017) attributed the high rate of unemployment among graduates of technical education programmes including woodwork technology education in developing countries like Nigeria to poor entrepreneurial attitudes and competence in machine woodwork.

Competence in machine woodworking refers to the abilities of woodwork technology education students to operate portable power tools, perform advance woodworking machines operations, and carry out mass production of various items by using woodworking machines to succeed in the world of work. Ugwu *et al.* (2015) described competency in technical education and specifically in woodwork technology education to comprise three basic components that include attitude, skill and knowledge.

Knowledge means familiarity, awareness, or understanding of someone or something, such as facts, information, descriptions, or skills, which is acquired through experience or education by perceiving, discovering, or learning. Roberts and Dyer (2014) noted that, knowledge can be implicit or explicit. Knowledge of machine woodworking is highly required in order to succeed in the world of work. According to Selvi (2016), lack of theoretical or practical knowledge of a subject matter such as machine woodworking among woodwork technology education students translates into insufficient skill.

Skill in Machine Woodworking refers to the ability of students to perform operations using wood machineries such as tenoning, mortising, and moulding, surface planing, wood turning, thicknessing, and wood boring, sanding and finishing among others. Okeke (2012) stated that, lack of competence sufficient skills among woodwork technology education students which will trigger their entrepreneurial attitude is an issue of national discourse in Nigeria. Abimbola (2017) confirmed that, the lack of skills among technical education students attributed to several factors among which is students' entrepreneurial attitude. Hence, lack of skills of woodwork technology education students especially machining due to technology advancement can lead them to negative attitudinal change.
Attitude in this study could be seen as the mind-set of woodwork technology education students towards machine woodworking. Owino *et al*. (2015) reported that students' poor attitude towards a course such as machine woodworking may negatively affect students' competence in machines operation. This implied that positive attitude towards machine woodworking may positively influence woodwork technology education students' competence and increase their chances of venturing into entrepreneurship and becoming self-employed. Nabi and Holdeni (2008) argued that Colleges of Education graduates of woodwork technology education hardly setup their workshops due to poor technical skills that include machine woodworking. Hence, it is against this backdrop that this study sought to establish the relationship between entrepreneurial cognitive attitudes of students and their competencies in machine woodworking in colleges of education in North-West, Nigeria.

Statement of the Research Problem

Machine woodworking is aimed at equipping woodwork technology education students with the technical skills in the use of machines to develop wood products such as furniture, doors, window frames and sills among others. Although, several efforts have been put in place in equipping students with the needed technical skills in machine woodworking, the competencies of students in the course is not encouraging. Nuffi (2018) revealed that the demonstrated competencies of woodwork technology education students in machine woodworking are low. The lack of competence by students in machine woodworking practically translates into lack of sufficient competency to function effectively in the world of work after graduation.

Several studies such as Okwori (2017), Samuel (2018) and Muhammad *et al.* (2020) attempted to address the lack of sufficient competence among students that led to consequent unemployment of technical education graduates. Despite these attempts, Salami (2019) revealed that competence of students in practical oriented courses such as machine woodworking and unemployment level among graduates remain discouraging. This entails that negative entrepreneurial cognitive attitudes could influence the lack of competences among woodwork technology education students in machine woodworking. Hence, this study sought to establish whether entrepreneurial cognitive attitudes influence students' competence in machine woodworking.

Aim and Objectives of the Study

The aim of the study was to determine the relationship between entrepreneurial cognitive attitudes and competence in machine woodworking among students of woodwork technology education in colleges of education in North-West, Nigeria. Specifically, the study determined the relationship between:

1. Students' cognitive entrepreneurial attitudes and knowledge in machine woodworking
2. Students' cognitive entrepreneurial attitudes and skills in machine woodworking
3. Students' cognitive entrepreneurial attitudes and their attitudes toward machine woodworking

Research Questions

The study sought answers to the following research questions:

1. What is the relationship between students' cognitive entrepreneurial attitudes and knowledge in machine woodworking?
2. What is the relationship between students' cognitive entrepreneurial attitudes and skills in machine woodworking?
3. What is the relationship between students' cognitive entrepreneurial attitudes and their attitudes toward machine woodworking?

Hypotheses

The following null hypotheses were formulated to guide the study and were tested at .05 level of significance:

Ho_1: There is no significant relationship between students' cognitive entrepreneurial attitudes and knowledge in machine woodworking

Ho_2: There is no significant relationship between students' cognitive entrepreneurial attitudes and skills in machine woodworking

Ho_3: There is no significant relationship between students' cognitive entrepreneurial attitudes and their attitudes toward machine woodworking?

Methodology

Correlational research design was used for this study. According to Adi (2019), correlational research is a type of non-experimental research method in which a researcher measures two variables, understands and assess the statistical relationship between them with no influence from extraneous variable. The study was conducted in North-West, Nigeria. The population of the study was 70 Nigeria Certificate in Education (NCE) III technical education students from Five Colleges of Education offering woodwork technology education in North-West Nigeria. The Colleges of Education include Federal College of Education (Technical) Gusau, Shehu Shagari College of Education, Sokoto, College of Education, Kafanchan, Federal College of Education, Bichi and Isah Kaita College of Education, Katsina. The study utilized the whole population due to its manageable size. Hence, there was no sampling in the study.

Two instruments were developed by the researcher and were used for data collection that includes Entrepreneurial Attitude Inventory (EAI) and Competence on Machine Woodworking Inventory (CMWI). The instruments were face validated by three experts for construct and content validity. Cronbach's Alpha formular was used to determine the overall reliability coefficient values for EAI and CMWI were found to be 0.924 and 0.816 respectively. The study employed the use of Kendall's τb to answer all the research questions and to test the null hypotheses at .05 level of significance. Decision regarding the interpretation of Kendall's tau-b to test the null hypotheses was based on comparing the Sig. two tailed value with p-value of 0.05. If the Sig. two tailed value attained is above the p-value of (<0.05), it means there is no significant relationship and the null hypotheses was upheld, where otherwise, it indicates there is significant relationship; consequently, the null hypothesis was rejected.

Results:

Research Question 1

What is the relationship between students' cognitive entrepreneurial attitudes and knowledge in machine woodworking? The result showing the relationship between students' cognitive entrepreneurial attitudes and knowledge in machine woodworking is presented in Table 1.

Table 1: Kendall's tau_b coefficient of concordance for the test of relationship between students' cognitive entrepreneurial attitudes and knowledge in machine woodworking

Variables		Cognitive	Knowledge
Cognitive	Correlation Coefficient	1.000	.827**
	N	70	70
Knowledge	Correlation Coefficient	.827**	1.000
	N	70	70

Table 1 shows that the correlation coefficient between students' cognitive entrepreneurial attitudes and knowledge in machine woodworking is .827. The correlation coefficient value signifies strong positive relationship between students' cognitive entrepreneurial attitudes and knowledge in machine woodworking.

Research Question 2

What is the relationship between students' cognitive entrepreneurial attitudes and skills in machine woodworking? The result showing the relationship between students' cognitive entrepreneurial attitudes and skills in machine woodworking is presented in Table 2.

Table 2: Kendall's taub coefficient of concordance for the test of relationship between students' cognitive entrepreneurial attitudes and skills in machine woodworking

Variables		Cognitive	Skills
Cognitive	Correlation Coefficient	1.000	.856**
	N	70	70
Skills	Correlation Coefficient	.856**	1.000
	N	70	70

Table 2 shows the correlation coefficient value of .856 for the relationship between students' cognitive entrepreneurial attitudes and skills in machine woodworking. The correlation coefficient value signifies strong positive relationship between students' cognitive entrepreneurial attitudes and skills in machine woodworking.

Research Question 3

What is the relationship between students' cognitive entrepreneurial attitudes and their attitudes toward machine woodworking? The result showing the relationship between students' cognitive entrepreneurial attitudes and their attitudes toward machine woodworking is contained in Table 3.

Table 3: Kendall's tau_b coefficient of concordance for the test of relationship between students' cognitive entrepreneurial attitudes and their attitudes toward machine woodworking

Variables		Cognitive	Attitude
Cognitive	Correlation Coefficient	1.000	.873**
	N	70	70
Attitude	Correlation Coefficient	.873**	1.000
	N	70	70

Table 3 shows the correlation coefficient between cognitive entrepreneurial attitudes and their attitudes toward machine woodworking is .873. The correlation coefficient value signifies strong positive relationship between cognitive entrepreneurial attitudes and their attitudes toward machine woodworking.

Hypothesis One

There is no significant relationship between students' cognitive entrepreneurial attitudes and knowledge in machine woodworking. The result for testing the significant relationship between students' cognitive entrepreneurial attitudes and knowledge in machine woodworking is contained in Table 4.

Table 4: Kendall's tau_b coefficient of concordance for the test of significant relationship between students' cognitive entrepreneurial attitudes and knowledge in machine woodworking

Variables		Cognitive	Knowledge
Cognitive	Sig. (2-tailed)		.000
	N	70	70
Knowledge	Sig. (2-tailed)	.000	
	N	70	70

**. Correlation is significant at the <0.05 level (2-tailed).

Table 4 shows the significant (2-tailed) value of **.**000 which is less than 0**.**05. The result indicated that there is significant relationship between students' cognitive entrepreneurial attitudes and knowledge in machine woodworking. Thus, the null hypothesis is rejected.

Hypothesis Two

There is no significant relationship between students' cognitive entrepreneurial attitudes and skills in machine woodworking. The result for testing the significant relationship between students' cognitive entrepreneurial attitudes and skills in machine woodworking is contained in Table 5.

Table 5: Kendall's tau_b coefficient of concordance for the test of significant relationship between students' cognitive entrepreneurial attitudes and skills in machine woodworking

Variables		Cognitive	Skills
Cognitive	Sig. (2-tailed)		.000
	N	70	70
Skills	Sig. (2-tailed)	.000	
	N	70	70

**. Correlation is significant at the <0.05 level (2-tailed).

Table 5 shows the significant (2-tailed) value of **.**000 which is less than 0**.**05.. Since the **.**000 is less than the stated level of significant (0.05), the test result implied that there is significant relationship between students' cognitive entrepreneurial attitudes and skills in machine woodworking. Therefore, the null hypothesis is rejected.

Hypothesis Three

There is no significant relationship between students' cognitive entrepreneurial attitudes and their attitudes toward machine woodworking. The result for the test of significant relationship between students' cognitive entrepreneurial attitudes and their attitudes toward machine woodworking is shown in Table 6.

Table 6: Kendall's tau_b coefficient of concordance for the test of significant relationship between students' cognitive entrepreneurial attitudes and their attitudes toward machine woodworking

Variables		Cognitive	Attitude
Cognitive	Sig. (2-tailed)	.	.000
	N	70	70
Attitude	Sig. (2-tailed)	.000	.
	N	70	70

**. Correlation is significant at the <0.05 level (2-tailed).

Table 6. The result shows the significant (2-tailed) value of **.**000 which is less than the stated level of significant (0.05). This indicated that there is significant relationship between students' cognitive

entrepreneurial attitudes and their attitudes toward machine woodworking. Consequently, the null hypothesis is rejected.

Findings

1. There was strong positive relationship between students' cognitive entrepreneurial attitudes and knowledge in machine woodworking.
2. There was strong positive relationship between students' cognitive entrepreneurial attitudes and skills in machine woodworking.
3. There was strong positive relationship between students' cognitive entrepreneurial attitudes and their attitudes toward machine woodworking.
4. The relationship between students' cognitive entrepreneurial attitudes and knowledge in machine woodworking was significant.
5. The relationship between students' cognitive entrepreneurial attitudes and skills in machine woodworking was significant.
6. The relationship between students' cognitive entrepreneurial attitudes and their attitudes toward machine woodworking was significant.

Discussion of Findings

The finding on the relationship between students' cognitive entrepreneurial attitudes and knowledge in machine woodworking revealed strong positive relationship. The finding implied that the cognitive component of entrepreneurial attitudes is directly affected by students' knowledge in machine woodworking. This finding is in agreement with Samuel (2018) whose finding produced strong positive relationship between students' cognitive entrepreneurial attitudes and knowledge in socioeconomic adjustment of primary school teachers. However, since students with high knowledge in machine woodworking tends to have high cognitive level of entrepreneurial activities, it is therefore logical to conclude that positive attitudes towards engaging in entrepreneurial activities after graduation is determined by the level of knowledge acquired in machine woodworking.

However, the finding on the test for significant relationship between students' cognitive entrepreneurial attitudes and knowledge in machine woodworking revealed that the relationship was significant. The finding is related to the finding of Samuel (2018) which showed a substantial positive relationship between entrepreneurship attitude and socioeconomic adjustment (related to entrepreneurial and vocational activities) of primary school teachers in Benue State, Nigeria. The finding clearly pointed out those students that are knowledgeable in machine woodworking tend to be more experienced professionals in entrepreneurship. Thus, giving them an edge over their counterparts that are not knowledgeable in machine woodworking. Hence, the relationship between students' cognitive entrepreneurial attitudes and knowledge in machine woodworking was not by chance.

The finding on the relationship between students' cognitive entrepreneurial attitudes and skills in machine woodworking revealed there was strong positive relationship. This is a sign that students with high skills in machine woodworking tends to have high cognitive level of entrepreneurial activities. This finding is anticipated as researcher works like Samuel (2018) made alike findings that displayed strong positive relationship between students' cognitive entrepreneurial attitudes and skills in a particular subject matter. However, since students with high skills in machine woodworking tends to have high cognitive level of entrepreneurial activities, it is therefore rational to make conclusion that positive attitudes towards engaging in entrepreneurial activities after graduation is determined by the level of skills in machine woodworking acquired.

In similar vein, the finding on the test for significant relationship between students' cognitive entrepreneurial attitudes and skills in machine woodworking revealed that the relationship was significant. The finding is linked to the finding of Samuel (2018) that shown a substantial positive relationship between entrepreneurship attitude and socioeconomic adjustment of primary school teachers in Benue State, Nigeria. However, the finding clearly pointed it out that students whom are skilled in machine woodworking tends to more experienced professionals in entrepreneurship. Thus, this will give them an advantage over their counterparts whom are not skilled in machine woodworking.

Hence, the relationship between students' cognitive entrepreneurial attitudes and skills in machine woodworking was not by chance.

The finding on the relationship between students' cognitive entrepreneurial attitudes and attitudes toward machine woodworking revealed there was strong positive relationship. This is an indication that students with high cognitive level of entrepreneurial activities are bound to have high attitudes toward machine woodworking. This finding is expected as Samuel (2018) made a similar finding that shows strong positive relationship between students' cognitive entrepreneurial attitudes and attitudes towards a particular subject matter. Logically, since students with high attitudes toward machine woodworking tends to have high cognitive level of entrepreneurial activities, it is therefore rational to conclude that students who exhibit positive attitudes towards machine woodworking are more likely to engage in entrepreneurial activities after graduation than students with negative attitudes.

On the other hand, the finding on the test for significant relationship between students' cognitive entrepreneurial attitudes and attitudes toward machine woodworking revealed that the relationship was significant. The finding of Samuel (2018) is related to this finding as it revealed a substantial positive relationship between entrepreneurship attitude and socioeconomic adjustment of primary school teachers in Benue State, Nigeria. The finding clearly pointed it out those students that possessed positive attitudes towards machine woodworking tend to be more experienced entrepreneurs. Thus, give them an edge over their counterparts with lesser attitudes toward machine woodworking. Hence, the relationship between students' cognitive entrepreneurial attitudes and attitudes toward machine woodworking was not by chance.

Conclusion

The study found a positive and significant relationship between entrepreneurial cognitive attitudes and competence in machine woodworking among students of woodwork technology education in Colleges of Education in North-West, Nigeria. In essence, the cognitive, components of entrepreneurial attitudes are determined by the knowledge, skills and attitudes that students acquired in machine woodworking. This implied that students with entrepreneurial mind-set are likely to bring innovation, risk-taking, and business growth opportunities to the field of machine woodworking. Hence, it is concluded that the entrepreneurial cognitive attitudes of woodwork technology education students could be enhanced with the appropriate knowledge, skills and attitudes of machine woodworking acquired in schools.

Recommendations

Based on the findings of the research, the following recommendations were made:

1. Conferences, workshops, seminars and other capacity building programmes should be organized by the Federal and State Ministries of Education in order to enhance the knowledge of machine woodworking lecturers which will positively reflect on the knowledge of the students and consequently improve their positive entrepreneurial cognitive attitudes.
2. The Federal and State Ministries of Education should ensure the availability of adequate human and material resources for teaching and learning woodwork technology education that can guarantee skills acquisition in machine woodworking among students and also boast their entrepreneurial cognitive attitudes.
3. The Federal and State Ministries of Education should improve on the existing funding to ensure the availability of adequate human and material resources in woodwork technology education which will enhance the process of teaching and learning, promote positive attitudes towards machine woodworking and consequently, improve positive entrepreneurial cognitive attitudes among students.

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APPLICATION OF MULTIMEDIA AND HYPERMEDIA TECHNOLOGIES IN TEACHING METALWORK TECHNOLOGY IN COLLEGES OF EDUCATION NORTH-CENTRAL, NIGERIA

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Abstract
This study investigated the application of multimedia and hypermedia technologies in teaching metalwork technology in Colleges of Education in North Central, Nigeria. Two research questions and two null hypotheses guided the study. A ddescriptive survey research design was adopted for the study. The study was carried out in all the Colleges of Education that offer metalwork technology education programme in North-Central Nigeria. The targeted population for the study was 38 respondents consisting of 24 highly experienced metalwork technology lecturers and 14 moderately experienced metalwork technology lecturers from seven Colleges of Education in the study area. A 38-item structured questionnaire developed by the researcher and validated by three experts was used for collection for the study. The reliability coefficient of the instrument was .083 using Cronbach's Alpha statistics. Mean and standard deviations were used to answer the research questions; while z-test statistics was used to test the null hypotheses at .05 level of significance. Statistical Package Social Science (SPSS) version 23 was used for the data analysis. The findings of the study among others revealed that lecturers rarely apply multimedia technologies in teaching metalwork technology. It was also revealed that lecturers do not use hypermedia technologies in teaching of metalwork technology. Based on the findings it was recommended that Government and curriculum planners should make policies that would mandate the application of multimedia and hypermedia technologies by the lecturers in teaching and learning of metalwork technology programme in colleges of education in North-Central Nigeria.

Keywords: Multimedia and hypermedia technologies, metalwork technology and Colleges of Education

Introduction

Colleges of Education are an all-round academic institution of learning established to meet up with an increasing demand for qualified teachers in Nigeria. College of education is a teacher training institution or a professional training college for teachers (Mbuthia, 2021). It has the primary role of training teachers who will be awarded the minimum teaching qualification of Nigerian Certificate of Education (NCE). Colleges of Education in Nigeria are categorised based on programmes they offered to include general Colleges of Education and Colleges of Education (Technical). General Colleges of Education accommodate educational programmes in art, social sciences, sciences and technical education courses, while Colleges of Education (Technical) offered major technical education programmes, leading to award of Nigeria Certificate in Education (Technical). Although some few conventional Colleges of Education also offered course in technical education program. The goal of NCE (Technical) program is to provide technical teachers with the intellectual and professional background adequate for teaching technical subjects and to make them adaptable to any changing situation in technological development not only in the country but also in the world at large. Orji and Ogbuanya (2018) identified technology education programmes offered in colleges of education in Nigeria to include: automobile technology, building technology, electrical/electronic, woodwork technology, and metalwork technology.

Metalwork technology Education is a component of technical education offered in the colleges of education in Nigeria with focus on the activity of making objects/product out of metal. Bello and Abdulrahman (2019) referred metalwork technology program as the study of all aspects of metalworking such as bench, sheet, art metal, Jewry, metal finishing, forging, casting, machine, heat treatment, metal testing, welding and other fastening methods in metal manufacturing. The goals of the metalwork technology programme in colleges of education as contained in the National Commission for Colleges of Education (NCCE) (2012) include: to produce qualified Technical Teachers and Practitioners of technology capable of teaching basic technology in the Junior Secondary Schools (JSS),

to produce metalwork NCE teachers who will be able to inculcate Scientific and technological development right from Nigeria school and to prepare metalwork teachers so as to qualify them for a POST – NCE degree program in technical Education. The realization of these laudable goals may be influenced through the application of these multimedia and hypermedia technologies.

Application is the act of bringing something to bear; using it for a particular purpose or the action of putting something into operation. Application in the context of this study refer to the extent to which lecturers applies the multimedia and hypermedia technologies in teaching and learning of metalwork technology. Application of multimedia and hypermedia technologies in teaching and learning is apparently one of the highest thrilling developments that have brought about fundamental transformation to education. In the opinion of James (2018) the application of new technologies has advanced the developments of communication and multimedia equipment that are capable of accepting data, processing data into information and storing both the data and information for future use and reference purposes. Enemali (2015) also corroborated that technology has provided new ideal shifts in the way we work, live, read, teach, and learn and this new idea has brought development to our society and change in individual attitude on how a task is be perform. Therefore, one form of these new technologies that can be adopt to attain these is multimedia.

Multimedia are instructional programmes that can be highly interactive and feature combination of sound, animation, video, graphics, and text. Vin-Mbah (2016) defined multimedia as a tele-service concept that provides integrated and simultaneous services of more than one telecommunication services, namely voice world, video-world and data-world. According to Sudarman, *et al.* (2019) Multimedia means "multiple media" or "a combination of media". The media can be still graphics and photographs, sound, motion video, animation, and/or text items combined in a product whose purpose is to communicate the information in multiple ways. Hypermedia on the other hand refers to media like text, graphics images, sound and video with property of nonlinearity (Vin-mbah, 2016). According to Fabos (2011) the hypermedia is a revolution in learning because hypermedia not only consist of text, graphics, video and audio, but also provide network to be accessed by students. Hypermedia is an emergent of multimedia and text that are integrated in one united system with nonlinear information access (El Janati, *et al*, 2018). The potential point of hypermedia as learning resources is its high flexibility and similarity with human brain work systems. This condition gives benefit for learning, because it can increase the awareness, cautions, learning styles, and learning motivation for students (Nwokolo-Ojo, *et al.*, 2015).

Furthermore, integrating technologies in teaching / learning situations has been shown to promote lecturers and student's performance and motivation. Literature has also shown that these technologies does not only have the potentials to create high quality environment but also helps the students to take better control of the classroom especially when the class size is large (Ojo and Shitmi,2017). However, in spite of these potential inherent in the use of multimedia and hypermedia technologies in the process of educational development, its use for teaching and learning in schools such as colleges of education is abysmally low. This might pose a serious threat to the graduates of metalwork technology in the area of skill acquisitions and employment opportunities. Thus, it is against this backdrop that the study sought to investigate the application of multimedia and hypermedia technologies in teaching of metalwork technology in colleges of education North-Central, Nigeria.

Statement of the Problem

The aim of metalwork technology education programme in Nigeria colleges of education is not only to produce qualified metalwork teachers and practitioners of technology capable of teaching basic technology in junior secondary schools, but also to produce competent skilled graduates with sound theoretical knowledge on how to operate equipment and perform other metalwork skills like welding, foundry, casting, metal forming and fabrication for production purposes in private practices or in the industries. Application of the ICT facilities such as multimedia and hypermedia technologies is relevant in the attainment of the objectives of metalwork technology education programme at NCE level. Enemali (2015) pointed out that multimedia and hypermedia technologies have been proven to the teaching and learning of skill related subjects positively. This suggest that metal work technology students taught with multimedia and hypermedia technologies are most likely to achieve higher

cognition as well as acquire 21st century practical skills in metal work technology needed for today's industry.

However, in spite of the benefits of the application of multimedia and hypermedia technologies in teaching, evidence in literature suggest that most metalwork technology lecturers do not apply these technologies in teaching (Almekhlafi, & Almegdedi, 2010, Hutchchison, & Reinking, 2011 and Chen, 2008). The graduates of metalwork technology from colleges of education are pre-service teachers that need to acquire effective skills, knowledge and values in order to be useful in the world of work. Studies have shown that many graduates of metalwork technology from colleges of education are not employable and cannot even be self-reliant due to lack of adequate skill acquisition during their training (Obi, 2018). This suggest that multimedia and hypermedia technologies may not have been adequately applied in teaching and learning in colleges of Education in the study area. Hence, the study sought to investigate the application of multimedia and hypermedia technologies in teaching of metalwork technology education in COEs in North-Central Nigeria.

Aim and objectives of the study

The main aim of this study is to determine the application of multimedia and hypermedia technologies in the teaching and learning of metalwork technology in colleges of education, North Central, Nigeria. Specifically, the study determined the following objectives:

1. Identify the extent to which lecturers apply multimedia technologies in the teaching of metalwork technology education.
2. Find out the extent to which lecturers apply hypermedia technologies in the teaching of metalwork technology education.

Research Questions

The following research questions guided the study:

1. To what extent do lecturers apply multimedia technologies in the teaching of metalwork technology education?
2. To what extent do lecturers apply hypermedia technologies in the teaching of metalwork technology education?

Hypotheses

The following null hypotheses were formulated and tested at .05 level of significance to guide the study

$H0_1$: There is no significant difference in the mean responses of highly experienced and moderately experienced metalwork technology lecturers on the extent to which lecturers apply multimedia technologies in the teaching of metalwork technology.

HO_2: There is no significant difference in the mean responses of highly experienced and moderately experienced metalwork technology lecturers on the extent to which lecturers apply hypermedia technologies in the teaching of metalwork technology.

Methodology

The study adopted a descriptive survey research design. This study was carried out in all the Colleges of Education that offered metalwork technology in North-Central Nigeria. The targeted population for the study was 38 respondents comprising of 24 highly experienced and 14 moderately experienced metalwork technology lecturers from all Colleges of Education in North Central States, Nigeria that offers metalwork technology. Due to smaller number of the population involved in the study, the entire population was used for the study. Therefore, no sampling techniques was used. A 38-item structured questionnaire developed by the researcher was used for collection for the study. Three experts, that is two experts from Department of Industrial and Technology Education, Federal University of Technology Minna and one expert from the Department of Science Education also from Federal University of Technology, Minna validated the instrument. All sections of the research questions were structured on five-point rating scale with corresponding weighing values of Very High Extent (VHE) (5); High Extent (HE) (4); Low Extent (LE) (3); Rarely Extent (RE) (2) and and Not Used (NU) (1). The concept of real limit of number was assigned to each response option. They are as follow: Very

High Extent (VHE) = 5.00-4.49; High Extent (HE) = 3.50-4.49; Low Extent (LE) = 2.50-3.49; Rarely Extent (RE) = 1.50-2.49 and Not Used (NU) = 1.00-1.49. The reliability coefficient of the instrument was .083 using Cronbach's Alpha statistics. Mean and standard deviations were used to answer the research questions; while z-test statistics was used to test the null hypotheses at .05 level of significance. Statistical Package Social Science (SPSS) version 23 was used for the data analysis. The decision for each research question was based on the resulting mean scores interpreted relative to the concept of real lower and upper limits of numbers as indicated above; while decision on the hypotheses formulated for study was based on comparing the significant value with (p< .05) level of significance, where the significant value is less than (p< .05) the hypothesis was rejected, while equal or greater than (p< .05) the hypothesis was upheld or accepted.

Results

Research Question 1

To what extent do lecturers apply multimedia technologies in the teaching of metalwork technology education?

Table 1: Mean Responses of Lecturers on the extent of application of multimedia technologies in teaching metalwork technology education.

S/N	**Items**	**X**	**SD**	**RMK**
1	Camcorders	1.47	.83	NU
2	Apple's Keynote	1.43	.81	NU
3	CD/DVD readable/record-able drives	2.41	.71	RE
4	DVD players	2.43	.68	RE
5	Digital cameras	1.10	.97	NU
6	Digital probes	1.12	.88	NU
7	Email	1.94	1.02	RE
8	Electronic chalkboards	1.30	.88	NU
9	Flash drives	2.45	1.05	RE
10	External hard drive	2.49	1.16	NU
11	Flat Screen monitors	1.23	1.43	NU
12	Headset	1.45	1.05	NU
13	Interactive TV	1.21	.96	NU
14	Internet Access	3.21	.90	LE
15	LCD Projectors	2.30	.98	RE
16	Microsoft's PowerPoint	2.38	1.04	RE
17	Mobile Telephony	1.04	.67	NU
18	Video conferencing	1.13	.92	NU
19	Digital Microscopes	1.10	.87	NU
	Grand Mean/SD	**1.75**	**.91**	**RE**

KEY: X **=** Mean of Respondents; SD = Standard Deviation of Respondents; Very High Extent =VHE; High Extent = HE; Low Extent = LE; Rarely Extent = RE; Not Used= NU; Remark = RMK.

The results in Table 1 shows the mean responses of the respondents on 19 items posed to determine the extent to which lecturers apply multimedia technologies in the teaching of metalwork technology with a grand mean of 1.75. This means that lecturers rarely apply multimedia technologies in teaching metalwork technology. The Standard deviation of the items ranging from 1.43-0.67 indicating that each of the 19 items had their standard deviation less than showing that 1.96 signifying that the respondents were not too far from the mean and were close to one another in their responses. This closeness of the respondents adds value to the reliability of the mean.

Research Question 2

To what extent do lecturers apply hypermedia technologies in the teaching of metalwork technology education?

Table 2: Mean Responses of Lecturers on the extent of application of hypermedia technologies in teaching metalwork technology education.

S/N	Items	X	SD	RMK
1	Blogging Tools	1.31	1.03	NU
2	Web Browses	3.53	.97	HU
3	Yahoo Messenger	2.41	1.14	RE
4	Clipboard	1.43	.81	NU
5	Electronic portfolios	1.14	.69	NU
6	Glossary	1.13	.71	NU
7	Hyper studio	1.12	.94	NU
8	Hyper card stacks	1.21	.81	NU
9	Hypertext	1.15	.92	NU
10	Interactive videodisc system	1.29	.78	NU
11	Micro worlds project builder	1.13	1.01	NU
12	Multimedia slideshow	1.16	1.12	NU
13	Multimedia tool book	1.14	1.06	NU
14	Paging	1.13	1.01	NU
15	Facebook	1.30	1.08	NU
16	WhatsApp	1.18	1.14	NU
17	Zoom	1.08	.88	NU
18	Goggle meet	1.14	.84	NU
19	Instagram	1.25	.92	NU
	Grand Mean/SD	**1.38**	**.94**	**NU**

KEY: **X =** Mean of Respondents; SD = Standard Deviation of Respondents; VHE = Very High Extent; HE = High Extent; LE = Low Extent; RE = Rarely Extent; NU = Not Used; RMK = Remark.

The analysis in Table 2 shows the mean responses of the respondents on 19 items posed to determine the extent to which lecturers apply hypermedia technologies in the teaching of metalwork technology with a grand mean of 1.38. This implies that lecturers do not use hypermedia technologies in teaching of metalwork technology. The Standard deviation of the items ranging from 1.14-0.69 indicating that each of the 19 items had their standard deviation less than showing that 1.96 signifying that the respondents were not too far from the mean and were close to one another in their responses. This closeness of the respondents adds value to the reliability of the mean.

Hypotheses Testing

Hypothesis One

$H0_1$: There is no significant difference in the mean responses of highly experienced and moderately experienced metalwork technology lecturers on the extent to which lecturers apply multimedia technologies in the teaching of metalwork technology ($P<.05$).

The result of the z-test on the significant difference between the mean responses of highly experienced metalwork lecturers and moderately experienced metalwork lecturers on the extent of application of multimedia technologies in the teaching and learning of metalwork technology education courses is shown in Table 3.

Table 3: Independent Samples z-test Results of Responses of Highly Experienced and Moderately Experienced Metalwork Lecturers on the Extent of Application of Multimedia Technologies in the Teaching and Learning of Metalwork Technology Education Courses.

GROUPS	N	Df	Mean	SD	Sig.(2-tailed)	Remark
Highly Experienced	24	36	1.76	0.71	0.02	S
Moderately Experienced	14		1.48	0.84		

N= No. of Respondents, DF= Degree of Freedom and SD= Standard Deviation

Table 3 showed that there were significant differences (P<.05) between the mean response of highly experience and moderately experience metalwork lecturers on the extent of application of multimedia technologies in the teaching and learning of metalwork technology education. These data support the hypothesis with df = 36, and 2-tail = 0.02. The mean and standard deviation for highly experience metalwork lecturers are 1.78 and 0.71 respectively while the mean and standard deviation for moderately experienced metalwork lecturers are 1.48 and 0.84 respectively. Hence, hypothesis one was rejected, which means that level of experience can affect the perception of lecturers on the extent of application of multimedia technologies in the teaching and learning of metalwork technology education courses**.**

Hypothesis Two

HO_2: There is no significant difference in the mean responses of highly experienced and moderately experienced metalwork technology lecturers on the extent to which lecturers apply hypermedia technologies in the teaching of metalwork technology (P<.05).

The result of the z-test on the significant difference between the mean responses of highly experienced and moderately experienced metalwork lecturers on the extent of application of hypermedia technologies in the teaching and learning of metalwork technology courses is shown in Table 4.

Table 4: Independent Samples z-test Results of Responses of Highly Experienced and Moderately Experienced Metalwork Lecturers on the Extent of Application of Hypermedia Technologies in the Teaching and Learning of Metalwork Technology Courses

GROUPS	N	Df	Mean	SD	Sig.(2-tailed)	Remark
Highly Experienced	24	36	1.61	0.76	0.01	S
Moderately Experienced	14		1.48	0.73		

N= No. of Respondents, DF= Degree of Freedom and SD= Standard Deviation

Table 4 showed that there was significant difference (P<.05) between the mean response of highly experienced and moderately experience metalwork lecturers on the extent of application of hypermedia technologies in the teaching and learning of metalwork technology courses. These data support the hypothesis with df = 36, and 2-tail = 0.01. The mean and standard deviation for highly experience metalwork lecturers is 1.61 and 0.76 respectively while the mean and standard deviation for moderately experienced metalwork lecturers are 1.48 and 0.73 respectively. Hence, hypothesis two was rejected which means that level of experience can affect the perception of lecturers on the extent of application of hypermedia technologies in the teaching and learning of metalwork technology education courses**.**

Discussion of Findings

The findings of research question one revealed the extent to which lecturers apply multimedia technologies in the teaching of metalwork technology education. The findings indicate that 12 multimedia technologies such as: Camcorders, Apple's Keynote, Digital probes, Digital microscopes and many others were not utilized in the teaching of metalwork technology education. This is because the aforementioned multimedia technologies are not available for the lecturers to use in teaching of

metalwork technology education courses. On the other hand, seven multimedia technologies such as CD/DVD readable/recordable drives, DVD player, Email among others were rarely used. Consequently, the benefits of utilizing multimedia technologies in teaching metal work technology was not maximally achieved. This is in line with the study conducted by Efuwape, *et al.* (2018), it was observed that certain multimedia technologies, such as camcorders, Apple's Keynote, digital cameras, digital probes, flat screen monitors, headset, interactive TV, mobile telephony, video conferencing, and digital microscopes, were not employed by the lecturers in their instructional practices.

The findings of research question two shows that lecturers (metalwork technology education) in the north central region of Nigeria do not utilize hypermedia technologies in teaching metalwork technology education. However, web browser and yahoo messenger are highly utilized and rarely utilized respectively. The lecturers lack proficiency in using some of the hypermedia technologies and inadequate facilities has limited the extent of utilization of others. According to this finding, all hypermedia technologies received low mean scores, indicating that they are not used, while web browsers and yahoo messenger stood out as an exception, being employed to a reasonable extent in teaching of metalwork technology education. These findings are in line with a study conducted by Ibrahim and Aliyu, (2021) who found that items such as blogging tools, clipboard, electronic portfolios, glossary, HyperStudio, HyperCard stacks, hypertext, interactive videodisc system, MicroWorlds project builder, multimedia slideshow, multimedia tool book, paging, Facebook, WhatsApp, Zoom, Google Meet, and Instagram all received low mean scores, suggesting that they were not used by the lecturers in their instructional practices.

Conclusion

The investigated the application of multimedia and hypermedia technologies in the teaching and learning of metalwork technology in colleges of education, North Central, Nigeria. The findings of the study serve as the basis for making the following conclusion: that multimedia technologies such as camcoders, apple keynotes, DVD players, email and headsets were rarely apply by lecturers in teaching metalwork technology. It was further concluded that: hypermedia technologies such as hypertext, clipboard, paging, zoom, facebook and whatsapp are not being apply by lecturers in teaching metalwork technology.

Recommendations

The following recommendations were made in line with the findings:

1. Government and metalwork technology education curriculum planners should make policies that mandate the application of multimedia technologies in teaching and learning of metalwork technology education programme in colleges of education.
2. Adequate efforts should be made by the administrators of metalwork technology education programme to map out pedagogical methodologies that encourage the application of hypermedia technologies in the teaching and learning process.

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EFFECT OF SELF-DIRECTED LEARNING BASED ON STUDENTS' ACHIEVEMENT AND INTEREST IN BASIC TECHNOLOGY FOR SUSTAINABLE DEVELOPMENT

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Abstract

The study adopted quasi-experimental design. The study was carried out in technical colleges in Niger State. The population of the study consists of seven technical colleges in Niger State. The sample of study was two hundred and forty seven (247) NTC II, Basic Technology students in technical colleges in Niger State. Basic Technology Achievement Test (BTAT) and Basic Technology Interest Scale (BTIS) were used as the instrument. The two instruments were validated by three experts from the Department of Industrial and Technology Education, Federal University of Technology, Minna. Pearson Product Moment Correlation Coefficient was used to compute results of the trial testing after test re-test instrument administration and the results indicated positive correlation coefficients of 0.85 and 0.88 for BTAT and BTIS respectively. The researcher administered the instrument with the help of two research assistants. Data for the study were collected through pre-test and posttest using the Basic Technology Achievement Test (BTAT) and the Basic Technology Interest Scale (BTIS). Data collected were analyzed using Mean and Standard Deviation to answer the two research questions while Analysis of Co-variance (ANCOVA) was used to test the two null hypotheses at 0.05 level of significance. From the findings, the study revealed that self-directed learning enhances students' achievement in Basic Technology in technical schools more than the lecture method. The finding also revealed that self-directed learning promotes students' interest in Basic Technology in technical schools more than the lecture method among others. The study therefore concluded that students' poor achievement and interest in Basic Technology informed the need for the study on the effect of self-directed learning on students' achievement and interest in Basic Technology in Technical Colleges in Niger state.

Keywords: self-directed learning, students, Basic Technology, achievement, interest

Introduction

Technical colleges are specialized institutions of learning where learners acquire knowledge, skills and attitudes necessary for the world of work. Technical college's according to Umar *et al.* (2020) are integral part of the total educational system in Nigeria that contributes towards the development of good citizenship by developing the physical, social, civic, cultural and economic competencies of the individual. The goals of technical colleges, as stated by Federal Republic of Nigeria, FRN, (2013) 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 requisite skills to individuals who shall be self-reliant economically.

Basic technology is aimed at exposing students to career awareness by exploring usable options in the world of work and enabling youth to have an intelligent understanding of the increasing complexity of technology. (Adodo, 2013) it is meant to provide the technical knowledge and vocational skills necessary for self- reliance. Basic technology is a three year programmes of preparatory instruction in manipulative skills, mathematics, sciences, communicative abilities and leadership skills which prepares individual for self- employment. Some of the instructional programmes of basic technology are; wood work, metal work, electrical/electronic, building architecture/technical drawing. (Federal Republic of Nigeria, 2013).

Basic technology, stresses the preparatory aspect of pre-vocational training offered to student at Junior Secondary School level to introduce them into the world of technology and have an appreciation of technology towards interest arousal and choice of a vocation at the end of Junior Secondary School and professionalism later in life.

As a result of this focus, Adodo (2013) states that, these are components of the general education curriculum which introduces pupils to the elements of technology in order to acquaint them with the role of technology in a contemporary life and permits them to develop basic practical skills in the manipulation of simple tools and materials. This element is also designed for information and guidance purposes for eventual educational and occupational choice. Federal Republic of Nigeria, (2013) refers to those aspects of the educational processes involving the study of technologies and related sciences, and the acquisition of practical skills, attitude, and knowledge relating to occupation in various sectors of economic and social life. Okorie, (2009) perceives vocational education as any form of education whose primary purpose is to prepare persons for employment in a recognize occupation.

Rocser, (2011) is of the view that, education consists of two components input and output. Input consists of human and material resources while outputs are the goal and philosophy of the educational process. Both the input and output form a dynamic organic whole and if one wants to investigate and assess the educational system in order to improve its performance, effects of one component on the other. Instructional materials are those materials that teachers need to incorporate in the teaching learning processes, to help the pupils benefit maximally from the learning experiences (Keshav, 2020).

Self-Directed Learning is a learning process for which students take their role and initiatives to learn independently without the help of other persons. The activities that are performed by students in this SDL include diagnosis of the necessity needed in the learning activity, formulating learning objectives, identifying learning source, choosing and performing learning strategy and evaluating learning achievement. Harsono (2008) states that SDL is one of the educational learning strategies of equality which is done either individually or group outside of lecturing or tutorial. It needs to be well managed by the manager of instruction through well planning.

SDL is considered to be one of the learning methods that is performed by a person for self-interest. SDL can be conducted in classrooms and in classroom environments that are individual or group who need limited assistance to orderly conduct in activities (Nur, 2017). Knowles' theory of SDL as cited by Malison & Thammakoranonta (2018) state that SDL is as a study process in which students need help or without the help of others, assessing their learning, formulating goals with appropriate strategies and evaluate learning outcome. SDL can be viewed as learners' effort of performing learning activity independently or with the help of others concerning their motivation to master learning material or to achieve a particular competency. Students in SDL are usually more actively participating in learning assignments as they read online learning material, completing class assignments, planning and evaluating learning outcomes (Geng *et al*., 2019). With the implementation of self-directed learning might improve student academic achievement.

Student Academic achievement has to do with the successful accomplishment of goals, measured by the extent to which instructional objectives are achieved. According to Eze and Osuyi, (2018), academic achievement is a measure of the degree of success in performing specific tasks in a subject area or area of study by students after a learning experience. Whereas Ahmad and Ombuguhim, (2020) defined achievement as the scholastic standing of a student at a given moment in learning both theoretical and practical skills in Basic technology therefore, is essential to students' progress in the changing world of technology. In this regard, effective instructional approach must be developed to improve skills achievement and to maintain acquired skills at a functional level over a period of time. With adoption of design-thinking learning strategies, students' interest might increase. When students' interests are piqued, their performance improves.

Student interest according to Duru *et al.* (2021) is defined as a content-specific, person-object relationship that emerges from an individual's interaction with the environment. According to the authors, interest is an important variable in the school context, as it can influence students' level of

participation in learning, Self-efficacy of their learning experience as well as their level of performance. The study therefore poised to find out the effect of self-directed learning on students' achievement and interest in basic technology for sustainable development.

Statement of the Problem

Basic technology is one of the trade programme offered at the Technical Colleges which is meant to prepare students with the requisite skills that can make them to be self-reliant after graduation. Such skills include but not limited to demonstration of basic knowledge in theory and practical skill content (NBTE, 2017). The National Examinations Council (NECO) reports show the persistent records of the students' low performance in Basic technology and this has been attributed to teachers' inappropriate pedagogical approaches. Study Mbonyiryivuze, *et al.* (2019) had shown that students' poor academic achievement is as a result of teaching methods employed by teachers. Similarly, Researchers such as Duhu and Ibanga, (2020) and Lawal *et al.*, (2020) also identified several factors responsible for students' poor performance in subjects such as Basic technology to be specific, and they classified these factors as students-related factors, teacher related factors, society-related factors and government–related factors. Among other things that form the teacher-related factors is the teaching methods adopted by teacher like conventional teaching method. These learning methods adopted by teacher`s' in the technical colleges according Ayonmike, (2020) results to students' abseentism during lesson thereby paving way for students poor learning outcome.

Various methods of improving the poor performance of students have been neglected, hence there is the need to look for more proactive methods that will incorporate individual differences of learners and make them learn in a more profitable way. To search for more efficient methods that will improve students' academic performance call for the trial of another individualized approach such as design-thinking teaching methods. Therefore, the study, seeks to investigate effect of self-directed learning on students' achievement and interest in basic technology for sustainable development in Niger State.

Research Questions

The following research questions guided the study:

1. What are the mean achievement scores of students taught Basic technology using self-directed learning and those taught using lecture method for sustainable development?
2. What are the mean interest scores of students taught Basic technology using self-directed learning and those taught using lecture method for sustainable development?

Hypotheses

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

Ho_1: There is no significant difference in the mean achievement scores of students taught Basic technology using self-directed learning and those taught using lecture method for sustainable development.

Ho_2: There is no significant difference in the mean interest scores of students taught Basic technology using self-directed learning and those taught using lecture method for sustainable development.

Methodology

The study adopted quasi-experimental design. The study was carried out in technical colleges in Niger State. The population of the study consists of seven technical colleges in Niger State. The sample of study was two hundred and forty-seven (247) NTC II, Basic technology students in technical colleges in Niger State. Basic technology Achievement Test (BTAT) and Basic Technology Interest Scale (BTIS) were used as the instrument. The two instruments were validated by three experts from the Department of Industrial and Technology Education, Federal University of Technology, Minna. Pearson Product Moment Correlation Coefficient was used to compute results of the trial testing after test re-test instrument administration and the results indicated positive correlation coefficients of 0.85 and 0.88 for BTAT and BTIS respectively. The researcher administered the instrument with the help of two research assistants. Data for the study were collected through pre-test and posttest using the Basic Technology Achievement Test (BTAT) and the Basic Technology Interest Scale (BTIS). After the pre-test, items of the BTAT were reshuffled before re-administration for posttest. The essence of reshuffling the items was to ensure that students do not memorise all the contents of the BTAT. Data collected from the two tests (pre-test and post-test) were used for data analysis. Data collected were analyzed using

Mean and Standard Deviation to answer the two research questions while Analysis of Co-variance (ANCOVA) was used to test the two null hypotheses at 0.05 level of significance. The ANCOVA was preferred because of its power to take care of the initial lack of equivalence (differences) in the experimental and control groups since intact classes were used for the study. The pretest served as covariate to the post-test and this justifies more the use of ANCOVA for testing the null hypotheses.

Results

Research Question 1: What are the mean achievement scores of students taught Basic technology using self-directed learning and those taught using lecture method?

Table 1: Mean Achievement Scores of Students taught Basic technology using Self-directed learning and those taught using Lecture Method

Teaching Methods	N	Pre-test		Post-test		Mean Gain Score
		Mean	SD	Mean	SD	
Self-directed learning	126	33.28	10.32	79.08	8.80	42.80
Lecture Method	121	33.62	6.20	37.77	7.25	4.15
Total	**247**	**33.45**	**8.26**	**58.43**	**8.03**	**23.48**

Table 1 showed that students taught Basic technology in technical schools using Self-directed learning had a mean and standard deviation achievement score of 33.28 (10.32) in pre-test while students taught with lecture method had pretest mean and standard deviation achievement score of 33.62 (6.20) respectively. This suggests that at pretest level students in both design thinking based and lecture methods almost had the same achievement. The post-test mean and standard deviation achievement of students taught Basic technology in technical schools using the design thinking based and lecture methods are 79.08 (8.80) and 37.77 (7.25) respectively. This implies that students taught Basic technology in technical schools with design thinking based had better achievement than their counterparts taught using the lecture method. Thus, the Self-directed learning enhances students' achievement in Basic technology in technical schools more than the lecture method.

Research Question 2: What are the mean interest scores of students taught Basic technology using self-directed learning and those taught using lecture method?

Table 2: Mean Interest Scores of students taught Basic technology using Self-directed learning and those taught using lecture method

Teaching Methods	N	Pre-test		Post-test		Mean Gain Score
		Mean	SD	Mean	SD	
Self-directed learning	126	1.69	0.80	3.39	0.68	1.70
Lecture Method	121	1.55	0.62	1.76	0.75	0.21
Total	**247**	**1.62**	**0.71**	**2.58**	**0.72**	**0.95**

Table 2 revealed that students taught Basic technology in technical schools using Self-directed learning had a mean and standard deviation interest score of 1.69 (0.80) in pre-test while students taught with lecture method had pretest mean and standard deviation interest score of 1.55 (0.62) respectively. This suggests that at pretest level students in both Self-directed learning and lecture method almost had the same interest level. The post-test mean and standard deviation interest of students taught Basic technology in technical schools using the design thinking based and lecture methods are 3.39 (0.68) and 1.76 (0.75) respectively. This implies that students taught Basic technology in technical schools with design thinking based had higher interest in Basic technology than their counterparts taught using the lecture method. Thus, the Self-directed learning promotes students' interest in Basic technology in technical schools more than the lecture method.

Ho$_1$: There is no significant difference in the mean achievement scores of students taught Basic technology using self-directed learning and those taught using lecture method.

Table 3: ANCOVA Summary Table of the difference in the mean (x) achievement scores of students taught Basic technology using Self-directed learning and those taught using lecture method

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	109046.255[a]	2	54523.128	1081.545	.000
Intercept	28358.581	1	28358.581	562.534	.000
Pretest	3708.140	1	3708.140	73.556	.000
Method	**106104.674**	**1**	**106104.674**	**2104.740**	**.000**
Error	12300.587	244	50.412		
Total	976558.000	247			
Corrected Total	121346.842	246			

Table 3 shows the F value as 2104.74 and the probability value as .000. The probability value of .000 of this finding is less than the alpha value of 0.05. Therefore, the null hypothesis is rejected and thus, there is significant difference in the mean achievement scores of students taught Basic technology using Self-directed learning and those taught using lecture method in favour of the Self-directed learning. This implies that students taught Basic technology with Self-directed learning had better achievement compared with their counterparts taught with the lecture strategy.

Ho$_2$: There is no significant difference in the mean interest scores of students taught Basic technology using self-directed learning and those taught using lecture method.

Table 4: ANCOVA Summary Table of the difference in the mean (x) interest scores of students taught Basic technology using Self-directed learning and those taught using lecture method

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	165.925[a]	2	82.963	163.546	.000
Intercept	313.734	1	313.734	618.469	.000
Pre-Interest	2.219	1	2.219	4.374	.038
Method	**165.854**	**1**	**165.854**	**326.950**	**.000**
Error	123.775	244	.507		
Total	1948.000	247			
Corrected Total	289.700	246			

Table 4 showed the F value as 326.95 and the probability value as .000. Since the probability value of .000 of this finding is less than the alpha value of 0.05. Therefore, the null hypothesis is rejected and thus, there is a significant difference in the mean interest scores of students taught Basic technology using Self-directed learning and those taught using lecture method in favour of the Self-directed learning. This suggests that students taught Basic technology with the Self-directed learning had higher interest in the subject compared to their counterparts taught with the lecture method.

Discussion of Results

The data presented in Table 1 and Table 3 revealed that students taught Basic technology in technical schools with design thinking based learning had better achievement than their counterparts taught using the lecture method. There is significant difference in the mean achievement scores of students taught Basic technology using Self-directed learning and those taught using lecture method. This implies that students taught Basic technology with Self-directed learning had better achievement compared with their counterparts taught with the lecture method. This finding is expected as students' direct involvement in the teaching and learning processes enhances students' achievement more than teacher-dominated instruction. The finding of this study is coherent with that of Fabiano *et al.* (2021) who

found that Self-directed learning was very effective in promoting students' academic performance and retention in children.

The data presented in Table 2 answered research question 2 while the data presented in Table 4 answered hypothesis 2. The result of the analysis revealed that students taught Basic technology in technical schools with Self-directed learning had higher interest in Basic technology than their counterparts taught using the lecture method. There is a significant difference in the mean interest scores of students taught Basic technology using Self-directed learning and those taught using lecture method in favour of the Self-directed learning. This suggests that students taught Basic technology with the Self-directed learning had higher interest in the subject compared to their counterparts taught with the lecture method. This finding is expected as students' active participation in teaching and learning process rekindles their interests and deactivates boredom and day dreaming. In line with the findings of this study Cereja *et al.* (2018) found out that students taught using design thinking exhibited higher interest in the subject Technical Drawing, than those taught by their teachers using the lecture method.

Conclusions

Students' poor achievement and interest in Basic technology informed the need for the study on the effect of self-directed learning on students' achievement and interest in Basic technology in Technical Colleges in Niger state. The study indicated that self-directed learning enhances students' achievement and interest in Basic technology more than the lecture method. Basically, there was significant difference in the mean achievement and interest scores of students taught Basic technology using Self-directed learning and those taught using lecture method in favour of the Self-directed learning. It was concluded that appropriate use of self-directed learning in teaching Basic technology would facilitate students' achievement and interest in Basic technology.

Recommendations

Based on the findings of the study, the following recommendations were made.

1. Basic technology teachers should be encouraged by the government through its relevant ministries to adopt self-directed learning in teaching and learning Basic technology for better academic achievement of the students in the subject.
2. The Government through its relevant ministries of education should organize seminars, workshops and symposia for the in-service teachers on the use of self-directed learning for effective teaching and learning of Basic technology in technical schools.

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STEM AND TECHNICAL VOCATIONAL EDUCATION AND TRAINING (TVET) FOR QUALITY EDUCATION

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Abstract
Technical Vocational Education and Training (TVET) is widely recognized as a vital driving force for the socio-economic growth and technological development of nations. In achieving the goals and objectives of TVET in Nigeria, the quality of the programme needs to be improved and sustained. The purpose of this study is to ascertain the challenges and improvement strategies of attaining quality TVET programmes in Nigerian tertiary institutions. Two research questions were raised to guide the study and two null hypotheses were tested at 0.05 level of significance using z-test statistics. The survey research design was used and a total 130 Government Technical College, Ilorin participated in the study. The instrument of data collection was a questionnaire (CSQTCE) and data were collected by the researchers. The study revealed the following factors as challenges of attaining quality TVET programmes in Nigeria tertiary institutions: lack of required TVET facilities, poor funding of TVET programmes; poor teaching methods employed by teachers; and poor assessment of TVET students' competency. Also, the study showed that adequate funding; training and retraining of TVET teachers; provision of required TVET facilities; adequate internal and external supervision; and public private partnership are improvement strategies for quality TVET programmes in Nigeria. Thus, it was recommended that the government, stakeholders, policy makers and TVET providers in Nigeria should focus on TVET quality assurance best practices that have worked in countries around the world.

Keywords: TVET, quality, quality assurance, challenges & strategies

Introduction

Skills and knowledge are the engines of economic growth and social development of any nation (Goel, 2021), And Technical Vocational Education and Training (TVET) holds the key to training the skilled and entrepreneurial workforce needed for the changing technological workforce (Afeti, 2010). Technical Vocational Education and Training (TVET) is used as a comprehensive term referring to those aspects of the educational process involving in addition to general education, the study of technologies and related sciences, and the acquisition of practical skill, attitudes, understanding and knowledge relating to occupations in various sectors of economic and social life (UNESCO, 2010). According to Mclean and David (2019) TVET is concerned with the acquisition of knowledge and skills for the world of work to increase opportunities for productive empowerment and socio-economic development in knowledge economics and rapidly changing work environment. TVET thus equips people not only with technical and vocational skills, but with a broad range of knowledge, skills and attitudes that are now recognized as indispensable for meaningful participation in work and life.

TVET has numerous goals which vary from countries to countries. In Nigeria, TVET is part of the formal education system incorporated in the three levels of education primary, secondary and tertiary) with a view to meeting the nation's need for skilled manpower and support the economic state of individual and the nation in general. As qualitative TVET is increasingly recognized as the bedrock of every development, quality assurance therefore is an indispensable process for achieving the national goals in TVET which will in turn lead to the production of qualitative human capital for sustainable national development.

STEM Education for TVET and training

UNESCO (2004) defined TVET as "those aspects 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 relating to occupation in various sectors of economic life". Given the fact that vocational education, technical education, career-vocational technical education,

TVET are used interchangeably, this study adopted and used 'TVET and training' (Gordon, 2019; Tripney and Hombrados, 2018). The rapidly changing global demands of the 21st century draw increasing attention to STEM education practices and related funding needs within the context of TVET (Wilkin and Welty, 2014). According to the recent employment growth and productivity trends, job creation efforts fall short of the demands of the expanding growth of the labor force (International Labour Organization, 2019). The role of TVET should be prioritized to support innovative individuals in the society who can produce solutions for cultivating the economy (Castellano et al., 2018). STEM education leads to improvement in TVET students in academic achievement, self-efficacy, and interest toward STEM careers (Akgunduz and Mesutoglu, 2020; Chang et al., 2015; Dougherty and Macdonald, 2020; Oran et al., 2018; Reeve, 2016; Wu et al., 2019). TVET is a critical contributor to students' acquirement of skills valuable for successful employment (Jou et al., 2014; OECD, 2019).

A rich learning environment is part of successful STEM education which can be attained through the physical and technical infrastructure of TVET (Reeve, 2018; Wilkin and Welty, 2019). The use of mathematics, science, and technology content in technical branches (e.g., industrial automation, mechatronics) of TVET create an ideal context for STEM education (Dixon and Hutton, 2016). Vocational and technical education should embrace the vision of innovation, meaningful application of knowledge of multiple disciplines and should prioritize collaboration with the industry and education politicians to equip students with the necessary skills to meet the demands of the workforce (Watters and Christensen, 2019).

Purpose of the study

TVET high school students need support on developing high order thinking skills such as creative thinking, reasoning, problem-solving, and abstract thinking (Uzmanoglu et al., 2010; Watters and Christensen, 2014). For students to acquire these skills as they work on 21st-century problems, one critical factor is to have competent teachers in STEM education who have positive perceptions toward STEM teaching (Corlu et al., 2019; OECD, 2015; Vennix et al., 2021). TVET should reform its educational practices to better adapt to the STEM education movement and contribute to students' 21st-century skills development (Fletcher and Gordon, 2017). Important enablers of accomplishing this goal are (a) PD programs to support teachers and to understand the challenges teachers face in implementing STEM education practices, and (b) collaborations between TVET, policymakers and the industry (Ayonmike and Okeke, 2020; Holmlund et al., 2018; Shernoff *et al.*, 2017; Uzmanoglu et al., 2010). In overcoming the barrier of TVET teachers' limited competencies concerning the needs of the business world, educators should consider conducting scientific studies within the context of teacher PD programs (Hoekstra et al., 2018; Nadelson et al., 2018; Tripney and Hombrados, 2013).

In TVET, quality is directly related to the achievement of the learning outcomes (knowledge, skills and competence achieved at the end of the learning process) that fulfils the key stakeholders' expectations: - students, parents, employers and community in general. Continuous enhancement of the quality of TVET system is a key priority to any nation that desires to reap the benefits of this all important aspect of education system. In order to ensure quality in TVET, it is essential to establish quality assurance (QA) frameworks applying to all aspect of TVET. Globally, the focus today is on strengthening quality assurance at all levels. There is currently a strong move in many countries towards having rigorous, internationally recognized TVET quality assurance process. Many countries have initiated steps for establishment of quality assurance mechanisms keeping in view the provision of TVET. This initiative is tied to the reforms in TVET sweeping round the globe (Kingombe,2018) Quality Assurance (QA) is a generic term that can mean different things in different national and regional contexts. In a broad sense, Maajumdar, *et al* (2020) described quality assurance as the process of verifying or determining whether products or services meet or exceed customer expectations. This involves a coordinated quality assurance system, which should be systematic; provide fundamentals of practice; be manageable so that its people will use it; be integrated; and allow scope for individual initiative and professional judgment (Kirkpatrick, 2005).

Quality assurance as applied in education refer to all forms of internal and external quality monitoring, evaluation or review or the systematic review of educational programmes to ensure that acceptable standards of education, scholarship and infrastructure are being maintained (African Union, 2007).

According to Tuck (2007) quality assurance in education is the process and procedures for ensuring that qualifications, assessment and programme delivery meet certain standards. Quality assurance in TVET is the systematic management and assessment procedures adopted by an educational institution or system to monitor performance and to ensure achievement of quality outputs or improved quality (Majumdar et al., 2010). The main actors to quality assurance in TVET are; teachers, the commission for quality assurance and evaluation, school management, school inspectorate, and community. It can be simply put that any activity that is concerned with assessing and improving the merit or the worth of an intervention in the field of TVET or its compliance with given standards constitutes quality assurance.

In Nigeria educational system, the quality assurance agencies for TVET include the National University Commission (NUC), and National Board for Technical Education (NBTE), National Business and Technical Examination Board (NABTEB). The NUC's roles include the accreditation, monitoring, and evaluation of universities programmes, infrastructural facilities, teaching and non-teaching staff, and instructional materials. On the other hand, the NBTE performed similar task as that of NUC to polytechnics, technical colleges, and other certificate awarding TVET providers.

Statement of the Problem

Technical vocational education and training (TVET) programmes are designed for people who can profit and progress by it (Okoye & Okwelle, 2019). In order to accomplish these outcomes, quality must be the watchword. Quality assurance is a key component of successful internalization, mechanism for building institutional reputation in a competitive local and global arena and necessary foundation for consumer protection (National University Commission, 2007). However, over the years Nigerian TVET programmes are bedeviled with numerous challenges that have been affecting the quality of TVET programmes both in output and input (Afred & Kayoma, 2017; ganwu, 2011; Okoye & Okwelle, 2019; Onyesom & Ashibogwu (2013); Uwaifo & U.I Uwaifo, 2012). According to these authors, these challenges include inadequate funding of TVET; inadequate infrastructures; poor power supply; vortage of qualified TVET teachers/ instructors; poor supervision of TVET programmes; inadequate curriculum planning and implementation. Various strategies have been put in place to tackle the challenges of quality assurance in TVET in different countries in the World. This cannot be said of Nigeria where quality of TVET is reported to have been marred by several challenges. Quality Assurance is aimed at remedying all aspects of educational programme which include; facilities, instructional materials, teaching and learning processes, examination, school environment and human resources. A situation where indicators and indices of quality assurance may pose as obstacles, need to be addressed. This has therefore informed this study.

The purpose of this study is to examine the challenges and strategies of attaining quality TVET programmes in Nigeria. The following research questions were raised to guide the study:

1) What are the students' factors that act as challenges of attaining quality TVET programmes in Nigerian tertiary institutions?
2) What are the schools' factors that posed as challenges of attaining quality TVET programmes in Nigerian tertiary institutions?

The following research hypotheses were tested at 0.05 level of significance:

1) There is no significant difference in he mean response of male and female GTC members on students 'factors that act as challenges of attaining quality TVET programmes in Nigerian tertiary institutions.
2) There is no significant difference in the mean response of male and female GTC members on schools' factors that act as challenges of attaining quality TVET programmes in Nigerian tertiary institutions.

Methodology

The descriptive survey research design was used in this study. The researchers considered this design appropriate since no variable was manipulated in this study. The population comprised 130 (100 males and 30 females) of Government Technical College, Ilorin. (GTC). No sampling was done, rather all the 130 GTC Ilorin were used for the study since the population size was considered manageable. Data

were collected using a structured questionnaire titled "Challenges and Strategies for Quality Technical College Education" (CSQTCE) developed by the researchers. The CSQTCE was divided into two parts. The first part sought information on selected personal data of the respondents. The second part had sections A, B C and D consisting of 41- items relevant for answering research questions posed in the study. The response format of CSQTCD sections were based on a four-point Likert scale pattern of Strongly Agree (SA=4), Agree (A=3), Disagree (D-2) and Strongly Disagree (SD-).

The instrument was content and face validated by three experts in GTC Ilorin. As a result of the experts' comments, some items were restructured to produce the final instrument. To determine the reliability of the instrument, twenty (15) copies of the questionnaire were administered twice with an interval of three weeks to vocational educators who were not part of the sample of this study. The test retest method was used to ascertain the reliability of the instrument using Cronbach's Alpha reliability method. The reliability coefficient obtained was 0.89 which was high and above the recommended acceptable value of 0.7 for good reliability (Adeyemi, 2019). Therefore, the instrument was regarded as reliable enough for use in data collection for the study.

The researchers administered the questionnaires to the 130 GTC Ilorin and 120 questionnaires were returned (male = 120 and female= 30) which recorded 94% return rate. The mean was used to analyze the research questions, while the z-test was used to test the hypothesis at 0.05 level of significance. Mean values of 2.50 and above were accepted while mean values below 2.50 were rejected. Also, it was decided that where the Z-calculated value was equal or greater than the table Z-value, it indicates significant difference; the null hypothesis is rejected but if otherwise, the null hypothesis is accepted. All statistical analyses were performed with statistical package for social sciences (SPSS) software.

Results

Research Question 1

What are the students' factors that act as challenges of attaining quality TVET programmes in Nigerian tertiary institutions?

Table 1. Mean responses on students' factors as challenges of quality TVET in Nigeria

Students Factors as Challenges of Attaining Quality in Vocational Technical Education Programme in	**Male Mean**	**GTC S.D**	**Member Remark**	**Female Mean**	**GTC Ilorin S.D**	**Member Remark**
Poor interest to learn	3.63	0.80	Agree	3.33	1.06	Agree
Poor entry qualification for TVET Programmes	3.13	0,42	Agree	3.24	0.83	Agree
Poor reading culture	3.41	1.05	Agree	3.02	1.11	Agree
Lack of required learning material such as Textbooks	3.53	1.49	Agree	2.80	1.09	Agree
Poor parental background	3.55	0.64	Agree	3.40	0.80	Agree

Peer group influence	3.50	0.81	Agree	3.33	0.98	Agree
Lack of self confidence	3.48	0.81	Agree	3.30	0.10	
Disobedience to school regulation and rules	2.43	0.85	Disagree	2.33	1.47	Disagree

The result shown in Table 1 revealed that the male and female teachers accepted nine items but rejected one (item 9) as students' factors that act as challenges of attaining quality TVET programmes in Nigerian tertiary institutions. his is in line with the view of Anyanwu (2009) who stated that students can make or mar quality in teaching depending on their attitude to learning. Also, Onachuna and Nwachukwu (2012) agreed with the findings of this study when they reported that the militating factors to quality assurance included examination malpractice and cultism.

3.2 Research Question 2

What are the schools' factors that act as challenges of attaining quality TVET programmes in Nigerian tertiary institutions?

Table 2. Mean responses on school factors as challenges of quality TVET in Nigeria

Students Factors as Challenges of Attaining Quality in Vocational Technical Education Programme in	Male Mean	GTC S.D	Member Remark	Female Mean	GTC S.D	Member Remark
Poor Teaching Method by Teachers	3.84	0.58	Agree	3.50	0.90	Agree
Teachers lack interest to teach.	3.73	0.70	Agree	3.52	0.83	Agree
Poor Research Attitude of Teachers	3.67	0.81	Agree	2.41	0.86	Agree
Negligence of Duties	3.40		Disagree	3.53	o.73	Agree
Poor preparation of Lesson by Teachers	2.82	1.21	Agree	0.27	1.27	Agree
Poor Students-Teacher Relationship	2.50	1.36	Agree	3.50	3.52	Agree
Inadequate Classroom Blocks	3.37	1.05	Agree	3.45	0.97	Agree
Inadequate Electricity Supply	3.68	2.58	Agree	3.33	0.91	Agree
Inadequate workshop space	3.73	0.67	Agree	3.47	0.97	Agree
Lack of TVET Machine and Tools	3.42	0.82	Agree	3.57	0.86	Agree

Table 2 revealed that both male and female respondents agreed with all the items as government factors that act as challenges of attaining quality TVET programmes in Nigerian tertiary institutions. This finding is consistent with those of Okoye and Okwelle, (2013), Onachuna and Nwachukwu (2012),

Singer (2012), Uwaifo and U.I Uwaifo (2009) who reported among others that poor provision of facilities and equipment's; inadequate personnel; poor incentives; poor funding; defect in curriculum content selection, organization, and delivery system; poor implementation of government policy are challenges to the attainment of quality TVET in Nigeria institutions.

Hypothesis 1

There is no significant difference in the mean response of male and female GTC members on students' factors
that act as challenges of attaining quality TVET programmes in Nigerian tertiary institutions.

Table 3 Analysis of mean response of male and female NVA members on students' factors challenges of attaining quality TVET programmes in Nigerian tertiary institutions

Group	N	Mean	Std	Df	Zcal	Zcrit	Decision
Male GTC Member	120	3.28	0.48	1.48	0.689	1.645	Accept
Female GTC Member	30	3.15	0.37				

N =150, df=148, p<0.05 * Accept

The results in Table 3 show that the calculated z-value (0.689) is less than the critical value (1.645) at 0.05 percent level of significance. The null hypothesis was therefore accepted. This implies that there is no significant difference between the mean response of male and female NVA members on students' factors that act as challenges of attaining quality TVET programmes in Nigerian tertiary institutions.

Hypothesis 2

There is no significant difference in the mean response of male and female GTC on schools' factors that act as challenges of attaining quality TVET programmes in Nigerian tertiary institutions.

Table 4. Analysis of mean response of male and female GTC on school factors challenges of attaining quality TVET programmes in Nigerian tertiary institutions

Group	N	Mean	Std	Df	Zcal	Zcrit	Decision
Male GTC Member	120	3.26	0.40	1.48	0.545	1.959	Accept
Female GTC Member	30	3.02	0.26				

N =150, df=148, p<0.05 *Accept

Table 4 shows that the calculated. z-value (0.545) is less than the critical value (1.959) at 0.05 percent level of Significance, indicating that there is no significant difference between the mean response of male and female GTC members on school factors that act as challenges of attaining quality TVET programmes in Nigerian tertiary institutions. The second null hypothesis was therefore accepted.

Conclusion

TVET is the bedrock to national development. In order to provide TVET programmes that can create impact in the development of human resources who can be the driving force for technological and economic growth of the nation, quality and standard will have to be created. Various factors (students'; school; and government) have been identified as the challenges of attaining quality TVET programmes in Nigeria tertiary institutions. Also strategies for addressing the challenges of attaining quality TVET were identified in this study. As a way forward, a workable quality assurance mechanism and system that will help to foster quality and standard in every aspect (such as input, process, and output) of TVET programmes in Nigeria tertiary institutions is advocated.

Recommendations

To further develop TVET and STEM competencies, the total amount of time spared for face-to face training and online training can be increased to longer hours. More time devoted to the Industry competencies; robotics programming, the Internet of things, virtual and augmented reality and mobile programming training can further develop the competencies of these components. Competencies to create STEM education lesson plan might be improved by addressing more exemplary practices and increased feedback during the training programs. It should be ensured that the knowledge and experience of the pedagogical concepts are increased. Special training can be organized for the development of the teachers to bring together the achievements related to different disciplines and to address them within the scope of a common subject or problem. This in fact suggests the need to stress the value of technical branch teachers in TVET education to be able to fully address Industry components and engineering design process steps

Based on the findings of the study, it was recommended that

1) The government, stakeholders, policy makers and TVET providers in Nigeria should focus on TVET quality assurance best practices that have worked in countries around the world.
2) The government should adequately fund, plan, implement, and manage TVET programmes in tertiary institutions in Nigeria.
3) The quality of input TVET programmes must be considered. This can be achieved through the provision of adequate facilities, equipments, consumable materials, and hand tools; provision of qualified TVET personnel; adequate provision of instructional materials; provision of in service training for TVET personnel.
4) Provision of scholarship/grants for TVET teachers/ instructors; proper supervision and monitoring of the implementation of TVET programmes by government.
5) The introduction of competency based TVET programmes in Nigerian tertiary institutions.

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ASSESSING THE EXTENT OF NCE MATHEMATICS EDUCATION NEW MINIMUM STANDARD IMPLEMENTATION IN COLLEGES OF EDUCATION IN NIGER STATE, NIGERIA

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Abstract
The study seeks to assess the extent to which NCE Mathematics new minimum standard is been implemented in colleges of education in Niger state, Nigeria. Two objectives with corresponding research question guided the study. The study adopts mixed-methods research design. A purposive sampling technique was employed to select a total of 17 lecturers from two colleges. To gather data, two instruments were utilized: the NCE Mathematics Programme Implementation Questionnaire (NCEMPIQ) and an interview protocol to capture the perspectives of lecturers regarding the extent of Minimum Standard implementation. Experts validated the questionnaire, and its internal consistency was evaluated using Cronbach Alpha, yielding a reliability coefficient of 0.79. Mean and standard deviation were employed for data analysis, with a criterion mean of 2.5 serving as the basis for assessment. Hence, it was recommended among others that National commission for Colleges of Education should Establish a monitoring and evaluation framework to track the progress of curriculum implementation and address challenges promptly.

Keywords: Assessing, College of education, minimum standard, NCE Mathematics, Implementation

Introduction

Nigeria, with its diverse population and rapidly growing economy, recognizes the pivotal role that mathematics education plays in preparing a skilled workforce, fostering technological innovation, and addressing socioeconomic disparities (Aliyu, 2023). To this end, the Nigerian government has embarked on a series of educational reforms aimed at improving the quality of education, with specific emphasis on mathematics education.

The National Certificate in Education (NCE) program is central to these efforts, as it is responsible for training the majority of teachers who will go on to educate future generations. The introduction of new minimum standards for NCE programs by the NCCE represents a significant step forward in this endeavor (Magaji, & Nayaya, 2022; Bulama, 2014). These standards emphasize curriculum reforms, innovative teaching methodologies, and effective assessment strategies, all designed to enhance the preparation of mathematics educators.

Despite these well-intentioned reforms, Alumode and Onuma (2016) stress that there is a pressing need to assess the extent to which these new minimum standards have been effectively implemented in Colleges of Education. This assessment is vital for several reasons among which are: Quality Improvement, Alignment with Global Trends, Economic Competitiveness, Addressing Teacher Shortages and Enhancing Equity (De Wit & Altbach, 2021).

Thus, the minimum standards hold great promise for advancing mathematics education in Nigeria, questions remain regarding the extent to which they have been effectively implemented at the grassroots level, particularly in Colleges of Education in Niger State. The successful implementation of educational reforms requires careful planning, allocation of resources, faculty development, and a supportive institutional culture (Shibankova, Ignatieva, Beloko n, Kargapoltsev, Ganaeva, Beroeva & Kozlova 2019). Therefore, it is essential to critically examine the challenges, successes, and barriers encountered during the implementation of these standards, as well as their impact on mathematics teacher education in the state.

Hence, this research aims to address these critical issues by assessing the extent of the implementation of the NCE mathematics education new minimum standards in Colleges of Education in Niger State, Nigeria. Through rigorous examination, it seeks to identify both successful practices and areas that

require improvement, ultimately contributing to the ongoing efforts to enhance mathematics education in the state and the nation as a whole.

Aim and objectives of the study

The aim of this study is to Assessing the Extent of NCE Mathematics Education New Minimum Standard Implementation in Colleges of Education in Niger State, Nigeria. Specifically, the research objectives are stated to:

1. Assess the extent of the implementation of the National Certificate in Education (NCE) mathematics education new minimum standards in Colleges of Education in Niger State, Nigeria.
2. Identify the strengths and successes in the implementation of the new minimum standards for NCE mathematics education in Colleges of Education in Niger State.

Research Questions:

1. To what extent have the National Certificate in Education (NCE) mathematics education new minim.um standards been implemented in Colleges of Education in Niger State, Nigeria?
2. What are the strengths and successful practices observed in the implementation of the new minimum standards for NCE mathematics education in Colleges of Education in Niger State?

Research Methodology

This study utilizes a mixed-methods research design, incorporating both quantitative and qualitative research approaches. Harrison, Reilly, and Creswell (2020) and Dawadi, Shrestha, and Giri (2021) have endorsed the mixed-methods approach for its capacity to offer a comprehensive assessment of research studies. The study focuses on lecturers in Colleges of Education in Niger State as the population of interest. A purposive sampling technique was employed to select a total of 17 lecturers from two colleges. To gather data, two instruments were utilized: the NCE Mathematics Programme Implementation Questionnaire (NCEMPIQ) in a structured format and an interview protocol to capture the perspectives of lecturers regarding the extent of Minimum Standard implementation. Experts validated the questionnaire, and its internal consistency was evaluated using Cronbach Alpha, yielding a reliability coefficient of 0.79. Mean and standard deviation were employed for data analysis, with a criterion mean of 2.5 serving as the basis for assessment. For the interview protocol, data collected during interviews were meticulously recorded, transcribed manually, and then organized and coded to identify emerging themes. The following methodological steps were followed:

Step 1: The recorded data were transcribed and coded by highlighting and extracting pattern themes to create an initial group of similarities. This process aimed to identify recurring responses and common items within each group of questions (pattern themes/similarities). The objective was to break down the data and categorize them into subsequent groups to facilitate comparisons between responses (pattern themes/similarities) (Drake, Pytlarz & Patel, 2018).

Step 2: In this stage, the initially extracted pattern themes in the first category were refined to describe the participants' concepts and beliefs more precisely. This involved creating a verified or theoretically-based classification, which is more accurate in describing the data and brings it closer to the final stage of thematic classification. This step aimed to streamline the first group, making it smaller and more precise, as part of a theoretical or thematic strategy for concept refinement.

Step 3: This phase represents the researcher's synthesis of extracted subthemes and pattern themes, making it a more theoretical stage in the formation of themes that represent stages 1 and 2 of qualitative data analysis (Bernard, Wutich, & Ryan, 2016).

Findings

In this section, Table 1 is presented with its interpretations tailored towards providing answers to the research questions one raised.

Sno		N	Mean	SD	Decision
1	I'm aware of the new minimum standard for NCE mathematics education in Nigeria.	17	2.82	1.13	Agreed
2	I adopt the new minimum standard.	17	2.59	1.06	Agreed
3	I became uncomfortable using the new NCE minimum standard.	17	2.18	1.01	Disagree
4	All aspects of the new minimum standard were effectively implemented	17	3.06	0.89	Agreed
5	I face challenges which hindered the successful implementation of the new minimum standard	17	2.12	0.99	Agreed
6	I integrated the new minimum standard into my mathematics teaching practices?	17	2.88	0.99	Agreed
7	I noticed many changes in student performance or engagement since the implementation of the new minimum standard	17	2.88	1.05	Disagree
8	I received many professional development related to the new minimum standard	17	1.82	0.95	Disagree
	Grand mean		**2.54**		

Table 1: Mean and standard deviation of the extent of the implementation of the National Certificate in Education (NCE) mathematics education new minimum standards in Colleges of Education in Niger State, Nigeria.

Decision mean 2.50

Table 1 shows the. mean and standard deviations of respondents on the extent of the implementation of the National Certificate in Education (NCE) mathematics education new minimum standards in Colleges of Education in Niger State, Nigeria. The result obtained show that items 1 - 8 had mean ratings of 2.82, 2.59, 2.18, 3.06, 2.12, 2.88, 2.88 and 1.82 with standard deviations of 1.13, 1.06, 1.01, 0.89, 0.99, 0.99, 1.05 and 0.95 respectively. The table reveals further that, the grand mean score of responses to the 8 items is 2.54 which was greater than the decision mean score of 2.50 This implies that National Certificate in Education (NCE) mathematics education new minimum standards in Colleges of Education in Niger State, Nigeria were successfully implemented.

Research question 2: What are the strengths and successful practices observed in the implementation of the new minimum standards for NCE mathematics education in Colleges of Education in Niger State?

The entire responses of lecturers on the strengths, weakness and corresponding suggestions successful on implementation of the new minimum standards for NCE mathematics education in Colleges of Education in Niger State were alighted. Two strengths, six weaknesses and corresponding suggestions to improve the weaknesses were identified. The strengths identified are: the new minimum standards is accountable, and good for quality assurance. Contrary to this, it is not consistence, too rigid, narrow focus, lack of update, inequity and lack of teacher input. It was in view of this that it was suggested that to improve the weaknesses identified, Minimum standards should be consistence. When it is consistence with the previous once, it becomes easier to assess the performance of teacher candidates and the quality of programs.

Minimum standards should not be too rigid, leaving room for innovation and adaptation to local contexts. This rigidity may stifle creativity and hinder the development of effective teaching practices. Minimum standard should not be too narrow on specific content overlooking important aspects, such as credit Units allocated to each course.

It should always reflect the latest and best practices. It should always be updated to incorporate new ideas. Lecturers should have sufficient input into the development and revision of standards. Their expertise and insights are critical for designing effective mathematics education programs.

Discussion of Findings

The study's findings indicate that the implementation of the new minimum standards for National Certificate in Education (NCE) mathematics education in Colleges of Education in Niger State, Nigeria was successful. This aligns with previous research conducted by Muhammed, Garbs, and Mutapha (2018), which showed significant coverage of the NCE Hausa curriculum. Similarly, Ibrahim (2017) discovered that the biology core curriculum for senior secondary education in Nigeria was adequately covered by biology teachers. It is possible that the mandate outlined in the National Policy on Education blueprint (NPE, 2004) influenced the biology lecturers' adherence to the recommended course content specified in the minimum standards for implementing the NCE biology curriculum.

Therefore, the compliance of biology lecturers with the stipulated course content in the minimum standards for the NCE biology curriculum is aimed at achieving the aforementioned goals and ensuring that they produce biology student-teachers with comprehensive knowledge of both content and pedagogical skills necessary for effective biology instruction at all educational levels.

Additionally, the study revealed two strengths and five weaknesses, along with corresponding suggestions for addressing these weaknesses. The identified strengths include the accountability and quality assurance provided by the new minimum standards. In contrast, the weaknesses include inconsistency, excessive rigidity, a narrow focus, lack of updates, inequity, and insufficient teacher input. To enhance the identified weaknesses, it is recommended that: Minimum standards should be consistent with previous versions to facilitate assessment, it should avoid excessive rigidity to allow for innovation and adaptation to local contexts, promoting creativity and effective teaching practices. Minimum standards should not focus too narrowly on specific content, considering aspects like credit units allocated to each course. Minimum standards should always reflect the latest and best practices and be regularly updated to incorporate new ideas and finally, Lecturers should have a substantial role in the development and revision of standards, as their expertise and insights are vital for designing effective mathematics education programs. The results of the study correspond to that of Atu (2010) who indicate that NCCE is achieving its objectives. The findings of the study are also in line with that of Shehu (2009) who reported that teachers had performed better in the implementation of NCE programme if necessary recommendation from previous studies are adequately addressed.

Conclusion

In spite of the weaknesses observed, researcher concludes that new minimum standards for NCE mathematics education in Colleges of Education in Niger State is found to be successfully implemented. While obstacles exist, there are also promising practices that demonstrate the potential for successful curriculum alignment. By addressing the identified challenges and adopting the recommended strategies, Colleges of Education can effectively equip students with the mathematical knowledge and skills needed for their future endeavours. This will contribute to the overall advancement of mathematics education in Niger State and Nigeria as a whole.

Recommendations

The following recommendation was made based on the findings and conclusion of this study.

1. The National Commission for Colleges of Education should include evaluation techniques on the minimum standard for NCE Mathematics curriculum so as to provide uniform standard on which the student-teachers academic performance will be assessed.
2. National Commission for Colleges of Education should regularly organize seminars and workshops for the Mathematics lecturers on the need to use all the evaluation technique without exceptions as they are all vital instrument in teaching and learning process as well as essential for effective implementation of the curriculum planned.
3. Foster partnerships between Colleges of Education, government bodies, and industry experts to provide relevant resources and support.
4. Establish a monitoring and evaluation framework to track the progress of curriculum implementation and address challenges promptly.
5. Create platforms for continuous feedback from students, instructors, and administrators to ensure ongoing improvement.

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NEGLIGENCE OF TECHNICAL AND VOCATIONAL EDUCATION; A THREAT TO NATIONAL SECURITY FOR SUSTAINABLE DEVELOPMENT

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Abstract

This paper focused on Negligence of Technical and Vocational Education as a Threat to National Security for sustainable Development. The study adopted a descriptive survey research design Three research questions guided the study. The population for the study comprised of 205 Technical Teachers, 19 questionnaires items were used for the study while 3 experts were engaged to face validated the instrument. Pearson Product Moment Correlation method was used to determine the reliability of the instrument at 0.68

Key words: Negligence, Technical and Vocational Education, Threat, National Security, Sustainable Development.

Introduction

Vocational and Technical Education had been neglected for a long, time because of the negative perception of those who should project it and nurture it to maturity. The negative perception held by society that Vocational and Technical Education is for "drop out" or those who cannot think must change if this country is to benefit from the constant development in Technology and Engineering. This would change the orientation of parents and students who now shift into Social Science based programs because they are convinced that these are the only viable courses to pursue in the in institutions of learning Simply put, Waziri (2014) opined that the reward system is skewed in such a way that nobody cares nowadays how to produce money through industry and hard work. What they perceive as ready money makers is more attractive to them than even the traditional noble profession such as Medicine, Law and Engineering. Nigeria has been described as a Nation in a hurry; she must therefore be prepared to pay the price. After all, the Nupe adage has it that "whoever want to eat honey inside the rock must not worry about what happened to the blade of his axes" if we must make positive Technological breakthrough in our society.

The United Nations Educational, Scientific and Cultural Organization (UNESCO, 2016) viewed (TVET) as learning, aims at developing skills in the practice of certain trades, as well as learning, aims at preparing students for entry into the labour market in general. The organization maintained that in both cases. Learning may be geared towards direct access to the labour market or lay the foundation for access to higher education and training with joining specific trades in view. The organization added that TVET encompasses programs that provide participants with skills, knowledge and aptitudes that enable them to engage in productive work, adapt to rapidly changing labour markets and economies, and participate as responsible citizens in their respective societies. Indeed, various contemporary definitions of the term Technical, Vocational Education and Training (TVET) are evolving to reflect the fundamental changes in the scope of the programs worldwide. Most recently, the Federal Republic of Nigeria (FRN, 2013) defined (TVET) as a comprehensive term referring to those aspects of educational process involving. the study of technologies and related sciences, the acquisition of practical skills, attitudes, understanding, and knowledge relating to occupations in various sectors of economic and social life in addition to general education FRN (2013) listed the goals of (TVET) to include among others: provision of trained manpower in the areas of applied sciences, technology, business, advanced craft as well as providing training and related skills for self-reliant and employment. Indeed, (TVET) is a potent means for fast-tracking technological progress, citizens capacities, economic growth and

national development (Akhuemonkhan & Raimi, 2013) It is designed to train skilled and entrepreneurial workforces that are needed to create wealth that would help reduce the menace of poverty and unemployment (Maigida, 2014). According to Ogundele (2013), (TVET) is classified into three categories: formal, non-formal and informal TVET. Formal TVET refers to organized vocational education programs provided within an approved public or private educational or training institution and it is structured (in terms of curriculum, learning objectives and learning time) in such a way that it constitutes a continuous adder where one level leads to the next and finally leads to certification In a nutshell, formal TVET covers vocational education programs provided within an approved public institution, It is intentional from the learner's perspective, it is school based. It has a rigid curriculum, and the entry qualifications of trainees are fixed Moreover. Teachers in the formal TVET delivery system are required to be trained technical teachers with relevant vocational teacher's qualifications Non-formal TVET is the type of vocational education and training which takes place outside the formal school system either on a regular or intermittent basis. It has the advantage of a short-term training period, it is occupation-specific, and the main emphasis is on the acquisition of practical skills for self-reliance or direct employment in a related field. For this reason, skilled craftsmen with some pedagogical training may be engaged as Instructors.

Informal TVET is the type of vocational education that is provided by craftsmen of different trades in the informal sector of the economy. It is more appropriately often referred to as vocational training or experience based learning and is usually carried out in form of apprenticeship system. Thus, the informal TVET is characterized by the non-existence of any curriculum or structure as there is no well-designed scheme and the method of training is not always sequential The master craftsman decides out of his experience what the apprentice should learn Vocational and Technical Education is the acquisition of skills and techniques in chosen occupation or profession to enable an individual earn a living. Technical and Vocational Education is an integrate subject comprising of Metalwork, Building Technology, Auto Mechanic, Electrical /Electronics, Woodwork and Technical Drawing as matter of fact, Vocational and Technical Education is aimed at developing not only practical skills but also attitudes and habits that makes the recipient a creative, innovative and resourceful person in the society.

Education is a problem solving instrument for society and since society's problem according to Uduigwomen and Ozumba (2014) change over time so much education change as well Curriculum is the instrument whereby the educational system strives to attain its goals The Curriculum must also change in line with the dynamics of man's needs, noted by Eya (2006) This implies that although a good Curriculum may have been planned and developed, there may be need for changes, revision, reforms, improvements or even total overhauling of the entire curriculum. Ogben and Ugeh (2009) opined that our educational system (Vocational and Technical Education inclusive) has to show marked flexibility, if it has to be valuable to its recipients and the entire society. Undoubtedly, the political, social and economic changes in Nigeria today of a necessity, call for some degrees of rational adjustments There is now more need for a functional and utilitarian education than liberal education provided by Vocational and Technical Education. Graduates unemployment presently poses a serious danger not only to Nigeria but to the entire world. To ensure productivity increase there is need to reposition Vocational and Technical Education through reforming its curriculum.

In the view of Akin (2016) security refers to the situation that exists as a result of the establishment of measures for the protection of person's information and property against hostile persons. However, Gubak and Bulus (2018) stated that national security can be described as stability and continuity of livelihood (stable and steady income), predictability of daily life (knowing what to expect, protection from crime (feeling safe), and freedom from psychological harm (safety or protection from emotional stress) which results from the assurance of knowing that one is wanted, accepted. loved and protected in one's community or neighborhoods and by people around. It focuses on emotional and psychological sense of belonging to a social group, which can offer one protection.

The discovery of a problem they say is halfway to its solution. Finding the way forward for vocational education in Nigeria entails the correction of anomalies with the quality of Nigerian education system. Technical/Vocational Education (TVE) has been an integral part of national sustainable development strategies in many societies because of its impact on the security challenges of any country. Large

percentage of Nigerian youths are unemployed and have often been the ready tool in the hand of unscrupulous individuals or group to perpetuate a state of insecurity in the nation, and that Vocational and Technical Education is a more effective tool in the hand of any government of nation to curb the problems of unemployment and insecurity, Hence, it is important to consider how we can reform Vocational and Technical Education in Nigeria and use it effectively (Uwaito, 2001). According to Ayodele (2016) that the high rate of insecurity as exemplified in kidnapping. prostitution, and armed robbery has relationship with unemployment, poverty, illiteracy, and more especially lack of occupational skills that can be derived from vocational and technical education, which can be described as any form of education whose purpose is to prepare person(s) for employment in an occupation or group of occupations This implies that vocational and technical education has a major role to play for the sustenance of living in his period of security challenges in Nigeria. This is true in the sense that vocational and technical education can help one to be independent, autonomous, ambitious, and can take responsibility for their own future. It can help people learn skills to gain jobs and become self-reliant and most importantly. Candidates with vocational training can find work in several states and central government organizations, non-profit groups, academic institutions and sometimes even in private companies. Hence vocational and technical education gives individuals the skills to live, learn and work as a productive citizens in a global society.

It is an acceptable fact that National policy on Education (NPE 2013) present Technical and Vocational Education as a form of education for the acquisitions of practical skills. It also states the readiness and the responsibilities of the Government to enforce the implementation to meet up with the demands of skills. In 2013 the NPE was reviewed and the section was renamed as "Science Technical and Vocational Education". Also the responsibilities of all agencies at all levels were clearly stated. It is unfortunate to note that, no logical implementation strategies in place despite such splendid policies.

Technical and Vocational Education is a medium of acquiring skills that can be employed to obtain a useful and meaningful life. Shiba (2015) observed it as a medium of skills development and training to prepared people for work in the formal and informal sectors. The National policy on Education (NPE 2013) see Technical and Vocational Education as a medium of acquiring practical skills for self-reliance, attitude for moral living, understanding various ideas and building knowledge relating to occupation in different areas of life. Basically any skills acquired in Technical and Vocational Education assist the individual who acquired them towards the acquisition of self-employed jobs. The National Policy on Education (NPE 2013), stated that, graduate of trained Technical and Vocational Education should be able to be skillful enough to teach and work in their area of specialization. The following are vital skills to empower the Technical and Vocational programme: Communication Skill, Critical thinking Skill, Technical Skill, Entrepreneur Skill and Leadership Skill. All these are the require skills that makes an individual competent to occupy a substantial job specification in the work environment.

Purpose of Study

The purpose of this study is to determine the Negligence of Technical and Vocational Education as a threat to National Security and for sustainable Development. The study also aimed at determines the factors that can improve enrolment into Technical and Vocational Education programe.

Statement of the Problem

The sustainable development and security of any nation hinge on the social and economic contributions of her citizens but Vocational and Technical Education that can play a major role in promoting community and national development, including security sustenance has been neglected for a long time because of the negative perception of those who should project it and nurture it to maturity. Vocational and Technical Education can be described as any form of education whose purpose is to prepare person(s) for employment in an occupation or group of occupations. The level of infrastructural development and facilities provided by the government are affecting to a large extent, the level of skills acquisition in the country. The high rate of insecurity as exemplified in kidnapping. Prostitution, and armed robbery has a relationship with unemployment and poverty. Observation has shown that vocational and technical education gives individuals the skills to live, learn and Work as productive citizens in a global society, Therefore, the study aims at looking into the way of improving National

sustainable development and security through Technical and Vocational Education hence the following research questions are raised:

1. What are the factors that can improve enrolment into Technical and Vocational Education programe?
2. What are the availability and usability of machine and equipment needed in Technical and Vocational Education?
3. What are the required Skills necessary to empower Technical and Vocational Education programe?

Methodology

The descriptive survey design is adopted for the study. The population consisted of all Technical colleges teachers in Lagos State. The sample consists of the 205 Technical and Vocational Educational Teachers teaching Technical and Vocational subjects from the five State owned Technical Colleges in Lagos State. The instrument for the study was questionnaire which comprises of 19 items was divided into four sections A, B, C and D the first section consists of demographic data of the respondents while the section B takes care of enrolment, section C is on available Machines and equipment's, section D is on policies formulated and required skills necessary to empower TVE. A cut-off point of 3.50 was used for decision making any item whose Mean value is 3.50 or above was judged as agree or required, while any item whose Mean value is less than 3.50 was judged as Disagree or not required. Also, any item whose standard deviation is below 1.96 that is 95% confidence limits indicated that the respondents were close to the mean and not too far from one another in their responses while any item with standard deviation above 1.96 that is 95% confidence limits indicated that the respondents were far from the mean and from one another in their responses. The reliability of the instrument was ascertained through test-retest method using Pearson Product Moment Correlation and coefficient of 0.68 was obtained. The questionnaire was personally distributed with permission from the college authorities.

Result and Discussion

The results for the study were obtained from the research questions answered through the data collected and were analyzed.

Research Questions 1: What are the factors that can improve the level of enrolment into Technical and Vocational Education programme?

Table 1:Mean Responses of Technical Teachers on the factors that can improve the level of enrolment N=205

S/N	Factors that can improve the level of enrolment into VTE programme	X	S.D	Remarks
1.	The need to improve advocacy	4.24	0.75	Agree
2.	Clearly defined stated objective	3.90	0.89	Agree
3.	Abolishment of tuition fees for VTE programme	4.37	0.85	Agree
4.	Provision of stipends to the training	3.74	0.98	Agree
5.	Redefining curriculum to highlight societal needs	4.19	0.85	Agree

Keys: *X= Mean of Respondents, SD= Standard Deviation, A= Agree, N= Number of Respondents*

The data presented in Table 1 reveal 5 factors that can improve the level of enrolment into Technical and Vocational Education programme. The Means for the factors ranged from 3.74 to 4.37. Each Mean is above the cutoff of 3.50 indicating that all could be the factors that can improve the level of enrolment in to Technical and Vocational Education programme. The standard deviation values for the five specific factors ranged from 0.76 to 0.98 and were less that 1.96 that is 95% confidence limit. This showed that the respondents were not far from one another in their responses and that their responses were not far from the mean. This added some value to the reliability of the mean.

Research Questions 2: What are the availability and usability of machine and equipment needed in Vocational and Technical Education?

Data for answering research question two

S/N	Availability and usability of machine and equipment in VTE	X	S.D	Remarks
6.	Adequate provision of the furniture	4.18	0.79	Required
7.	Adequate financing	3.96	0.80	Required
8.	Provision of state of art equipment	4.41	0.76	Required
9.	Training and retraining of the Technical Teachers	3.77	0.87	Required
10.	Equipping the schools laboratory to the standard available in the industries	4.07	0.76	Required

Keys: *X= Mean of Respondents, SD= Standard Deviation, A= Agree, N= Number of Respondents*

The data presented in Table 2 reveal 5 factors that can improve the level of enrolment into Technical and Vocational Education programme. The means for the items ranged from 3.77 to 4.41. Each means is above the cutoff of 3.50 indicating that all could be the needed items that can improve the effectiveness of Technical and Vocational Education program. The standard deviation values for the five items ranged from 0.76 to 0.87 and were less than 1.96 that is 95% confidence limit. This showed that the respondents were not far from one another in their responses and their responses were not far from the mean. This added some value to the reliability of the mean.

Research Question 3: What are the required skills necessary to empower Technical and Vocational Education programme?
Data for answering research question three are presented in Table 3

Table 3: Mean Responses of Technical Teachers on the required skills necessary to empower VTE programme N=205

S/N	Required skills necessary to empower VTE programme	X	S.D	Remarks
11.	Communication skill	4.07	0.76	Agree
12.	Critical thinking skill	3.52	0.77	Agree
13.	Technical skill	4.20	0.86	Agree
14.	Entrepreneurial skill	3.76	0.83	Agree
15.	Leadership skill	3.97	0.79	Agree

Keys: *X= Mean of Respondents, SD= Standard Deviation, A= Agree, N= Number of Respondents*

The data presented in Table 3 reveal 5 required skills necessary for empower Technical and Vocational Education programme. The Mean for the factors ranged from 3.52 to 4.20. Each Mean is above the cutoff of 3.50 indicating that all could be the required skills necessary to empower Technical and Vocation Education programme. The standard deviation values for the five specific skills ranged from 0.76 to 0.86 and were less than 1.96 that is 95% confidence limit. This showed that the respondents were not far from one another in their responses and that their responses were not far from the mean. This added some value to the reliability of the mean.

Conclusion

Regenerating Technical and Vocational Education is critically for national security and for sustainable development is a common saying that an idle hand is a devil's workshop. If everyone is gainfully employed and is self-reliant, there will be no problem about poverty or unemployment, which are the key factors that ginger youths or young school leavers to go into dubious act or causing havoc to individuals, states etc. Vocational and Technical Education equips students with the right technical knowledge, skills and trained proficiency, it is the gateway to the nation's industrialization and security stability. It is high time a bigger premium is put on Vocational and Technical Education, because it is the key to national stability, security, political and economic growth and development.

Recommendations

1. Technical and vocational institutions curriculum planners should enhance the present curriculum to include present societal and industrial demands.
2. Technical and vocational programme and institutions should be governed and administered by technical educators' not general education educators.
3. For the purpose of technological advancement, any increase in the number of technical institutions in the country should go with a corresponding increase in the quality and adequacy of technical teachers as well as the students' intake.
4. Technical and vocational skills acquired graduates should on their own, provide capital via bank/community loans to establish small scale industries and discourage the over dependents on government for employment.

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COMPETENCIES REQUIRED BY MOTOR VEHICLE MECHANICS IN THE TROUBLESHOOTING AND MAINTENANCE OF AUTOTRONIC SYSTEMS IN KADUNA STATE, NIGERIA;

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Abstract
The study was designed to determine the competencies required by motor vehicle mechanics in the troubleshooting and maintenance of autotronic systems in Kaduna state, Nigeria. Two research questions and two null hypotheses guided the study. A descriptive survey research design was adopted for the study. The study was conducted in all the standard automobile workshops in Kaduna State. A total of 580 respondents consisting of 20 automobile lecturers and 560 motor vehicle mechanics were used as total respondents for the study. 35 items structured questionnaire, developed from the literature reviewed for the study was used to collect data from the respondents. The questionnaire items were face validated by three experts. The internal consistency of the questionnaire was determined to be 0.85 using Cronbach alpha method. Mean and standard deviation were used to answer the research questions while Z-test statistic was used to test the null hypotheses at 0.05 level of significance. The findings among others revealed that: the respondents agreed with the majority of the items for the troubleshooting and maintenance of transmission and braking systems. Based on findings, it was recommended that there should be appropriate autotronics retraining skills organized by the government through the social intervention programs where motor vehicle mechanics could be trained by experts to utilize the identified skills needed to improve their effectiveness in troubleshooting and maintenance of autotronics sub-systems.

Keywords: Motor vehicle mechanics**,** Competencies, Autotronics, Maintenance and troubleshooting

Introduction

Motor Vehicle Mechanics (MVM) is one of the vocational training programmes in Nigerian technical colleges. MVM involve the acquisition of scientific knowledge in design, selection of materials, construction, operation and maintenance of motor vehicles. The MVM trade at the technical college level consists of three components/subjects grouping as; Service Station Mechanic Work, Engine Maintenance and Refurbishing and Auto Electricity. The aim of MVM trade is generally to produce a competent MVM craftsmen and women for technological and industrial development (Baba *et al.* 2018). Abdulkadir *et al.* (2017) described motor vehicle mechanic as a person who, for compensation, engages in the diagnosis or repair of faulty motor vehicles components or system. In essence, according to National Board for Technical Education (NBTE) (2009) MVM work students are expected to upon completion of their training be able to test, diagnose, service and repair any fault relating to conventional automobile assembly main units and systems to manufacturer's specifications. This means that motor vehicle mechanics are responsible for the service and repair of motor vehicles including undertaking work on engine as well as autotronics systems.

Autotronic refer to the 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 (Haruna *et al.* 2015). Autotronics in the context of this study refers to modern technologies in the field of automobile engineering that describe an artificial word that combines automotive field and electronics contents applications in motor vehicles. Tanuja *et al.* (2016) identified the elements of autotronic 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 foregoing clearly revealed the incorporation of these autotronic systems as a result of rapid advancement in technology seems to have not only posed

serious threats to motor vehicle mechanics in the area of servicing and repairs but also in the aspect of troubleshooting.

Troubleshooting is a problem-solving process in which the troubleshooter attempts to isolate faults states in some mal-functional systems, sub system and once the fault is found, the parts are replaced or repaired (Ele *et al.,* 2016). Baba *et al. (*2018) further explained that it is a systematic and logical search for the root cause of a problem so that it can be rectified such that the components and systems can be restored back to it functional state. Troubleshooting autrotronic systems in modern vehicles implies identifying the symptoms of dysfunction, the likely causes and rectification of the notable causes. Autotronics troubleshooting in the words of Alabi, *et al.* (2019) requires the ability of MVM to adopt diagnostic tools in retrieving diagnostic trouble codes (DTCs) as well as the use of a scan tool that communicates with the vehicle's on-board computer to identify current or permanent fault. It is however worrisome to note that most MVM do not have the required troubleshooting competencies, rather rely heavily on try and error method. The problem according to Tanuja *et al.* (2016) may be pinned down to some critical factors, which might not have been properly addressed in the past due to irregular programme assessment. This situation posed serious consequences on the effective maintenance the modern automated vehicles.

Maintenance refers to repair activities carried out on modern automotive system and related machineries to keep them unaltered, and if altered, to restore them to their original state through short daily inspections, cleaning, lubricating, and making minor adjustments (Giri, 2015). Minor problems can be detected and corrected before they become a major problem that could shut down the entire vehicle system and subsystems (Mbah and Oluka 2021). However, maintenance in this study could either be preventive or corrective. Preventive maintenance according to Selin and Mahasin (2016) refers to regular routine maintenance where vehicles are inspected, repaired and maintained in such that defects are prevented from surfacing in the first place; while corrective maintenance is a maintenance task that could be planned and unplanned performed to identify, isolate and rectify a fault so that failed vehicle systems can be restored to proper working order (Mbah and Oluka 2021). The author further argued that the major aim of maintenance on vehicles is not only to ensures their safety and dependability but also to improve their overall efficiency. This means that for MVM to effectively undertake the troubleshooting and maintenance of autotronics systems and subsystems he/she must possessed certain competencies.

Competency refers to 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. Wagirna (2020). Competencies in the context of this study refer to new set of ability required by MVM for the troubleshooting of vehicle system autotronics according to the manufacturers' specifications. Mbah and Oluka (2021) observed that today's modern vehicles contain more embedded electronic components and controls that requires higher degree of sophistication for testing and servicing, as well as use of special On-Board Diagnostic (OBD) tools and testing instruments for troubleshooting and maintenance. Hence, one of the autotronic subsystem in modern vehicles requiring effective troubleshooting and maintenance on the part of MVM for its continuous operation is transmission system.

The main function of transmission system is to convey the power developed by the engine crankshaft to the driving road wheels. Transmission system is a key element in the power train that provides a link between the power unit and the vehicle wheels (Amadike, *et al*. 2017). Alabi, *et al.* (2015) claimed that, conventional transmission system consists of the following: clutch, gearbox, sliding joint, universal joint, propeller shaft, universal joint and differential units. The transmission system could be manually or automatically operated. However, Modern transmission system equipped with electronically controlled unit for gear selection as well as clutch control is made automatically by the ECU. Regrettably, the level of competency acquired by these MVM mechanics in transmission system maintenance, compared with the demands of the labour market and technological advancement, is nothing to talk about. This explains why most employers of labour in this nation and abroad believe that the products of technical colleges are half-baked and unusable without further training (Alabi, *et al.* 2019). Thus, system of mechanical arrangements that retards the energy of moving vehicle is braking system.

Brakes absorb the kinetic energy and dissipate or store it in some other form (usually heat or electricity). Conversion of kinetic energy into heat energy is a function of frictional force produced by the frictional contact between brake shoe and moving drum or disc of a braking system (Gbile, *et al.* 2021). The types of braking system according to Ogunmilade (2017) include mechanical, hydraulic, pneumatic. The author further classified modern brake systems to include; brake assist (power brakes), anti-lock braking system (ABS) as well as traction control system. The ABS prevents skids or tyre burst due to excessive friction during an emergency braking situation. However, traction control system (TCS) on the other hand prevent the drive wheels from wheel-spinning during starting off or acceleration on a wet or icy surface (Gbile, *et al.* 2021). The ABS is a complex and sophisticated unit of motor vehicle and this makes it so difficult for road side mechanic to maintain. The modern car owners hardly locate efficient automobile craftsmen who can service and repair mal-functional ABS. The qualified automobile maintenance industries who can handle anti-lock braking systems are few in number compare to number of vehicles in Kaduna State (Ogunmilade, 2017). Thus, troubleshooting and maintenance of the systems requires the intervention of experts such as automobile lectures

Automobile technology lecturers are experts with the required educational qualifications that influences to change his attitude and behaviour on the basis of new skills, knowledge, values, habit and practical skills in the area of both theory and the practical aspects of modern vehicles. Similarly, Alabi, *et al.* (2019) further opined that automobile technology lecturers are saddle with the responsibilities of developing course material, grading assignment, attending conference, consultant and inspiring meaningful discussion with automobile technology students who upon graduation impact knowledge to MVM student. Motor vehicle mechanic master craftsmen on the other hand 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 (Adamu, 2015). This means both automobile lecturers and motor vehicle mechanic craftsmen 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 automobile world of work.

The foregoing clearly revealed that modern automobiles are blend of 20th and 21st century technology. The designs of modern vehicles have advanced to a very sophisticated level. Indeed, almost every other function within the automobile is controlled by computerized electrical sensors. However, the MVM mechanics who are suppose to maintain these vehicles to the manufacturer's specification end up complicating the condition of the vehicle. Gbile, *et al.* (2021) further explained that, this trial and error work could leads to increase in cost of spending and time on the same fault by the vehicle owners. Hence, competency in using programming and diagnostic tools (OBD) for troubleshooting by the MVM craftsmen is required. This study is therefore design to identify the competencies required by Motor Vehicle Mechanics in the troubleshooting and maintenance of autotronic system in Kaduna State, Nigeria.

Statement of Problem

The job of motor vehicle mechanics in the automobile world of the work is to effectively undertake general services such as conduct of standard test procedures, fault diagnosis, rectification of faulty parts including troubleshooting and maintenance of both conventional vehicles and modern vehicles equipped with integrated electronic systems and computers (autotronic systems). Aduku (2019) pointed out that mechanics operate as paid employees in the automobile industry and other organizations or as self-employed in their workshops to fully undertake maintenance and repairs of modern vehicles. Modern vehicles are group of emerging technologies that offers fuel economy, safety, comfort that improves their overall performance.

However, the foregoing innovations which are in form of the incorporation of new technologies with new subsystems and system components into modern automobiles seems to have changed their configurations thereby complicating troubleshooting and maintenance process among motor vehicle mechanics. Aspects of autotronic systems in modern vehicle that required effective troubleshooting and

maintenance competencies for their smooth operation according to Bellisa (2015) include: transmission system, braking system, suspension system, ignition system and fuel supply system. Evidences from the literatures revealed that most automobiles with these new autotronic innovation systems either suffer disrepair or have the new system replaced by classical substitute systems that new ones were meant to improve upon; yet some are even completely grounded just barely before its expected service live span (Ogunmilade, 2017). The possible reasons here might be due to the lack of troubleshooting and maintenance competencies on the part of motor vehicle mechanics in Nigeria. For instance, Baba *et al*. (2018) identified one of the major challenges of motor vehicle mechanics to include lack of competent knowledge and skills of autotronic principles in which modern automotive system operate upon. Ogunmilade (2017) argued that majority of motor vehicle mechanics in Nigeria lack the required competencies to fix anything right on modern vehicles but rather relied heavily on trial and error basis. This negative development may lead to loss of job among these mechanics. The question here is: What are the competencies required by motor vehicle mechanics in the troubleshooting and maintenance of autotronic systems in Kaduna State, Nigeria?

Aim and Objectives of the Study

The aim of this study is to identify the competencies required by Motor Vehicle Mechanics in the troubleshooting and maintenance of autotronic system in Kaduna State, Nigeria; Specifically, the objectives of the study are to:

1. Determine the competencies required by motor vehicle mechanics in the troubleshooting and maintenance of transmission system.
2. Find out the competencies required by motor vehicle mechanics in the troubleshooting and maintenance of braking system.

Research Questions

The following research questions guided the study

1. What are the competencies required by motor vehicle mechanics in the troubleshooting and maintenance of transmission system?
2. What are the competencies required by motor vehicle mechanics in the troubleshooting and maintenance of braking system?

1.5 Hypotheses

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

Ho_1: There is no significant difference in the mean responses of automobile lecturers and motor vehicle mechanic craftsmen as regards the competencies required by motor vehicle mechanics in the troubleshooting and maintenance of transmission system.

Ho_2: There is no significant difference in the mean responses of automobile lecturers and motor vehicle mechanic craftsmen as regards the competencies required by motor vehicle mechanics in the troubleshooting and maintenance of braking system.

Methodology

A descriptive survey research design was employed for this study. The study was conducted in all the standard automobile workshops in Kaduna State. The targeted population for this study was 12,420 respondents consisting of 20 automobile technology lecturers in Kaduna State Polytechnic Zaria (2), Kaduna polytechnic (7), College of Education Gidan Way (5) and Air force institute of technology (6) in Kaduna State and 12,400 registered motor vehicle mechanic master craftsmen in Kaduna south, Kaduna north, Sabo-geri Zaria and Kafanchan in Kaduna State. A proportional stratified random sampling technique was employed to draw 5% of motor vehicle mechanic master craftsmen from Kaduna State, Nigeria. Number are said to be proportional if the second varies is in a direct relation arithmetically to the first. Nwana (2005) indicated that 5% sample size is smallest of a study population which ranges between 1,000 – 9,999 subjects. Hence 5% of 12,400 is 620 respectively. Furthermore, due to the relatively small size of population of automobile technology lecturers in Kaduna State, no sampling technique was employed for them. The instrument for data collection for the study were a

structured questionnaire titled: Autotronic System Competencies and Troubleshooting Maintenance Required Questionnaire (ASCTMRQ). The instrument was validated by the three experts. One expert from the Department of Technical Education Kaduna Polytechnic, one expert from Department of Mechanical Engineering Ahmadu Bello University and one expert from Department of Automotive Engineering Air Force Institute of Technology (AFIT), Kaduna, Kaduna State. The internal consistency of the instrument used for the data collection for the study was 0.84 through Conbach Alpha statistics. Mean and standard deviation were used to answer the research questions; While z-test statistics was used to test the null hypotheses at .05 level of significance. The decisions for research questions was based on the resulting mean scores interpreted relative to the concept of real lower and upper limits of numbers of 3.50-4.00; 2.50-3.49; 1.50-2.49 and 0.50-1.49. While the decisions on the null hypotheses formulated for the study was 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.

Research Question 1

What are the competencies required by motor vehicle mechanics in the troubleshooting and maintenance of transmission system?

Table 1.1: Mean and standard deviation of respondent on the competencies required by motor vehicle mechanics in the troubleshooting and maintenance of transmission system N=580

S/N	Items	$\bar{x}$	SD	Remark
1	Checking output shaft speed (OSS) sensor for irregular or interrupted rotation of the transmission output shaft.	3.45	0.59	R
2	Using the scan tool to identify possible cause of clutch pedal position switch trouble	2.75	0.81	R
3	Using the scan tool to test for voltage fluctuation in the Transmission Range sensor	3.30	0.64	R
4	Ability to diagnose voltage fluctuation in the clutch switch input circuit.	3.45	0.50	R
5	Ability to check the actuator supply voltage circuit for any interruption in transmission solenoid	3.15	0.62	R
6	Ability to retrieve and clear transmission system freeze data in the ECU	2.75	0.71	R
7	Testing Transmission Fluid Pressure to determine if it meet the minimum calibrated value	2.45	0.53	MR
8	Ability to detect open or short circuit	2.75	0.81	R
9	Ability to find out possible cause of voltage fluctuations in the Output Shaft Speed (OSS) Sensor	3.30	0.63	R
10	Ability to diagnose transmission control system malfunction and clear the freeze data from the ECU	3.45	0.59	R
11	Ability to test for functionality transmission system	3.15	0.75	R
12	Appropriateness of 4x4L when the switch is cycled on and off	2.75	0.71	R
13	Using the scan tool to test the Park/Neutral Position (PNP) switch for functionality	2.45	0.51	MR
14	Using the scan tool to diagnose intermittent malfunction signal in the Turbine Shaft Speed (TSS) Sensor	2.75	0.83	R
15	Using the scan tool to Diagnose possible cause of gear Shift Malfunction	3.30	0.63	R
	Grand Mean/SD	**3.01**	**0.65**	**R**

Note: N = Number of respondents; $\bar{x}$ = Mean SD = Standard Deviation; Highly Required (HR); Required (R); Moderately Required (MR); Not Required (NR)

Table 1 shows the mean responses of the respondents on fifteen (15) items posed to determine the competencies required by motor vehicle mechanics in the troubleshooting and maintenance of transmission system with grand mean of 3.01. This implies that motor vehicle mechanics requires the

competencies in troubleshooting and maintenance of transmission system. The standard deviation of the items ranges from 0.50-0.83 which is less than 1.96 meaning the respondents were not too far from the mean and were close to one another in their responses. This closeness of the respondents add value to the reliability of the mean.

Research Question 2

What are the competencies required by motor vehicle mechanics in the troubleshooting and maintenance of braking system?

Table 2: Mean and standard deviation of respondent on the competencies required by motor vehicle mechanics in the troubleshooting and maintenance of braking system

N=580

S/N	Items	$\bar{x}$	SD	Remark
1	Check the positions of the brake sensors	3.45	0.60	R
2	Identify the causes of ABS delay for rectification	3.15	0.76	R
3	Check the service manual for the voltage/resistance values on various pins and sensors	2.75	0.76	R
4	Top the brake fluid container as recommended by the manufacturers.	3.45	0.60	R
5	Change the brake lining if bad	2.75	0.81	R
6	Check the lines of the ABS for leakages and functionality	3.30	0.64	R
7	Remove the wheels in order to clean the brakes	3.45	0.58	R
8	Manually clean the brakes on the car	2.15	0.73	MR
9	Making sure that the TRAC OFF switch is in the enabled position.	2.75	0.74	R
10	Connection of the sub-harness leads directly to the battery terminals to operate the TRAC pump.	3.45	0.59	R
11	Recording the codes in the chart when scanning.	2.75	0.89	R
12	Indicating which light outputs with each code.	2.30	0.62	MR
13	Checking of the service manual for the voltage.	2.45	0.57	MR
14	Allowing the pump to run for 30 seconds after tightening the bleeder screw.	3.15	0.72	R
15	Making sure that the lift does not interfere with the rotating wheels when serving.	2.75	0.73	R
16	Carry out basic tests and repairs on traction control system using computer animation.	3.45	0.59	R
17	Identifying the on-board diagnostic port in vehicles.	2.85	0.81	R
18	Consult the service manual for a chart of specific values of components.	3.30	0.64	R
19	Identify the needed materials for servicing of ABS	3.55	0.59	HR
20	Replace the brake fluid as often as recommended by your vehicle's owner's manual	3.65	0.72	HR
	Grand Mean/SD	**3.04**	**0.68**	**R**

Note: N = Number of respondents, $\bar{x}$ = Mean, SD = Standard Deviation; Highly Required (HR); Required (R); Moderately Required (MR); Not Required (NR)

Table 2 shows the mean responses of the respondents on twenty (20) items posed to determine the competencies required by motor vehicle mechanics in the troubleshooting and maintenance of braking system with grand mean of 3.04. This implies that motor vehicle mechanics requires the competencies in troubleshooting and maintenance of braking system. The standard deviation of the items ranges from 0.57-0.81 which is less than 1.96 meaning the respondents were not too far from the mean and were

close to one another in their responses. This closeness of the respondents add value to the reliability of the mean.

Hypothesis 1
There is no significant difference in the mean responses of automobile lecturers and motor vehicle mechanic craftsmen as regards the competencies required by motor vehicle mechanics in the troubleshooting and maintenance of transmission system.

Table 3: Two Independent Samples Z-test Results (automobile lecturers and motor vehicle mechanic craftsmen as regards the competencies required by motor vehicle mechanics in the troubleshooting and maintenance of transmission system)

Groups	N	df	$\bar{x}$	SD	Sig. (2-tailed)	Remark
automobile technology lecturers	20	578	3.28	0.25		
motor vehicle mechanics craftsmen	560		3.15	0.22	1.00	NS

Significant at P>0.05 NS = No significant

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 = 578; 2-tail = 1.00. The mean and standard deviation for automobile technology lecturers were 3.28 and 0.25. The mean and standard deviation for motor vehicle mechanics craftsmen were 3.15 and 0.22 respectively. Hence, hypothesis one was retained. This mean, there was no significant difference in the mean achievement scores of automobile lecturers and motor vehicle mechanic craftsmen as regards the competencies required by motor vehicle mechanics in the troubleshooting and maintenance of transmission system.

Hypothesis 2
There is no significant difference in the mean responses of automobile lecturers and motor vehicle mechanic craftsmen as regards the competencies required by motor vehicle mechanics in the troubleshooting and maintenance of braking system.

Table 4: Two Independent Samples Z-test Results (automobile lecturers and motor vehicle mechanic craftsmen as regards the competencies required by motor vehicle mechanics in the troubleshooting and maintenance of braking system)

Groups	N	df	$\bar{x}$	SD	Sig. (2-tailed)	Remark
Automobile technology lecturers	20	578	3.15	0.22		
Motor vehicle mechanics craftsmen	560		3.25	0.21	0.83	NS

Significant at P>0.05 NS = No significant

Table 4 revealed that there was no significant difference (P<0.05) in the mean ratings of the respondents. These data supported the hypothesis, df = 578; 2-tail = 0.83. The mean and standard deviation for automobile technology lecturers were 3.15 and 0.22. The mean and standard deviation for motor vehicle mechanics craftsmen were 3.25 and 0.21 respectively. Hence, hypothesis two was retained. This mean, there was no significant difference in the mean achievement scores of automobile lecturers and motor vehicle mechanic craftsmen as regards the competencies required by motor vehicle mechanics in the troubleshooting and maintenance of braking system.

Discussion
The major finding of the study was discussed in the order of the research questions and hypothesis formulated for study. The analysis of Table 1 showed that respondents agreed with 13 out of 15 items. However, 2 items were disagreed by the respondent as regard troubleshooting and maintenance of transmission system. The findings is consistent with the assertion of Alabi, *et al.* (2019) who advocated that ability to check the actuator supply voltage circuit for any interruption in transmission solenoid and

checking output shaft speed (OSS) sensor for irregular or interrupted rotation of the transmission output shaft among others, were competencies required by motor vehicle mechanics in transmission system. However, it is then not surprising that even though some competencies were required by MVM craftsmen in troubleshooting and maintenance of transmission system, yet Tanuja, *et al.* (2016) noted that testing transmission fluid pressure to determine if it meet the minimum calibrated value and using the scan tool to test the Park/Neutral Position switch for functionality are still lacking behind, thus disagreed by the respondents as supported by the author.

$H0_1$:- It was found out that there was no significant difference in the mean achievement scores of the two groups of respondents (20 automobile lecturers and 560 motor vehicle mechanic craftsmen) as regards the competencies required by motor vehicle mechanics in the troubleshooting and maintenance of transmission system. The null hypothesis of no significant difference was therefore upheld for the two groups. The implication of this is that the respondents did not differ significantly in their opinions on the 15 items. Generally, the findings of the study on hypothesis one was in conformity with the findings of Gbile, *et al.* (2021) where it was found out that there was no significance difference in the mean ratings of the responses of automobile lecturers and motor vehicle mechanic craftsmen. The findings of Alabi, *et al.* (2019) gave credence to the findings of this study on hypothesis one.

The analysis of Table 2 showed that respondents agreed with 17 out of 20 items. However, 3 items were disagreed by the respondent as regard troubleshooting and maintenance of braking system. The findings is in conformity with the findings of Ogunmilade, (2017) who advocated that ability to replace brake fluid as often as recommended by the vehicle's owner's manual as well as identifying the needed materials for servicing of ABS among others, were competencies required by motor vehicle mechanics in braking system. The stand of the respondents could have stemmed from the findings of Giri, (2015) who opined that manual cleaning of brakes on the car and checking of the service manual for the voltage among other competencies were not required by motor vehicle mechanics in the troubleshooting and maintenance of braking system as supported by the researcher.

$H0_2$:- It was found out that there was no significant difference in the mean achievement scores of the two groups of respondents (20 automobile lecturers and 560 motor vehicle mechanic craftsmen) as regards the competencies required by motor vehicle mechanics in the troubleshooting and maintenance of braking system**.** The null hypothesis of no significant difference was therefore upheld for the two groups. The implication of this is that the respondents did not differ significantly in their opinions on the 20 items. Generally, the findings of the study is in assertion with the findings of Giri (2014) that there was no significance difference in the mean ratings of the responses of automobile lecturers and motor vehicle mechanic craftsmen. The findings of Ogunmilade (2017) gave credence to the findings of this study on hypothesis two.

Conclusion

The study is determined to ascertain the competencies required by Motor Vehicle Mechanics in the troubleshooting and maintenance of autotronic systems in Kaduna State, Nigeria. The finding of the study serves as the basis for making the following conclusion that: Motor Vehicle Mechanics require competencies in the troubleshooting and maintenance of transmission and braking systems in Kaduna State.

Recommendations

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

1. There should be appropriate autotronics retraining skills organized by the government through the social intervention programs where motor vehicle mechanics could be trained by experts to utilize the identified skills needed to improve their effectiveness in troubleshooting and maintenance of autotronics sub-systems.
2. Appropriate scan tool/equipment should be use by motor vehicle mechanics to diagnose intermittent malfunction signal in the turbine shaft speed (TSS) sensor based on present innovation in autotronics system to eliminate trial and error.

3. Motor vehicle mechanics should embrace self development by improving their skills through continuous education in testing and detecting defective reflector sensors. Hence almost all the modern component in automobile are electronics base.

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ENHANCING FEMALE PARTICIPATION IN TECHNICAL, VOCATIONAL EDUCATION AND TRAINING (TVET) IN NIGERIA

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Abstract
There is generally low enrolment of female students in Technical, Vocational Education and Training (TVET) in Nigeria. Despite the few progress made in the last decade in enhancing progress, equity, quality, opportunity rates and gender parity in education and Training in Nigeria, but Technical, Vocational, Education and Training (TVET) field continues to experience low female enrolment in Science, Technology, Engineering and Mathematics (STEM) based courses. This paper was carried out to focus on the present state of female participation in TVET and enumerate factors militating against effective contribution of female gender in all aspect of life in Nigeria. This study recommends fair and equal opportunities for both female and male to perform in TVET related subjects at schools so as to enable more female participation in TVET and STEM fields of study, and generally to the world at large. Educationists believe that no country can grow beyond is education, and for noticeable development to take place in Nigeria, there is need for good synergy between education and developments. This relationship can only have positive impact when women benefits more from the synergy because whoever educate a woman, educate a nation. This paper also recommends gender responsive approaches at all levels of education, such as having certain percentage of female being given admission for Science, Technology, Engineering and Mathematics (STEM) related courses, and encourage female enrolment in Vocational and Technical Education (VTE) based subjects at secondary school level of education, which will assist in changing their mind set towards choosing careers in Technical, Vocational and Education Training (TVET) in the Tertiary Institutions.

Keywords: Technical, Vocational Education and Training (TVET), Female Participation, Science, Technology, Engineering and Mathematics (STEM), Vocational and Technical Education (VTE).

Introduction

Destruction of any nation does not require war, conflict, violence and so on, but denial of it citizens of qualitative education in technology, most especially the female gender because education is a veritable tool for national development but it has illusion to female gender in Nigeria. It is observed that female gender are traditionally disadvantages with other associated problems and obstacles that hindered the right of female gender to Technical, Vocational Education and Training (TVET), which is designed to improve quality of life because it enables individual to become economically productive so as to escape poverty and marginalization when individuals are equipped with skills, they become entrepreneurs, employable and informed citizens thereby contributing to economic development of a nation (Anaele, Isiorhovoja, Dele & Asoluka, 2014). But it's a pity that majority of these individuals given opportunity of skill acquisition trades are male genders while female genders are faced out. The role of women's' education and empowerment cannot be underestimated, because it is said when a man is educated, you educate a person, but when a woman is educated, you educate a nation. The reason is not farfetched, education starts from home and mother is the first teacher. The belief that gender equality in the world has made reasonable progress is just fallacy, because there's still a noticeable gap in the educational sphere especially in Technical, Vocational Education and Training (TVET) in Nigeria.

Haman resources development through TVET not only contributes to economic development but also leads to enhancement of social participation. The greater percentage of human resources that contributed to economic development are female genders mostly in marketing, agriculture, cloth making, education and so on.

Gender is the state of being male or female with reference to socially and culturally defined characteristics of masculinity or feminist. Also gender is used to refer to the socially constructed relationship between women and men in particular society. Although gender role of men and women in one society may differ from those in another society. The concept of gender recognized that men and women are not in a homogeneous group. UNESCO (2010) refers to gender as those characteristics of men and women that are socially determined and are always distinguished from those that are generally or biologically determine (sex). Gender-differentiated performance implied that there are some activities or tasks in which males excel more than female.

Gender differences are social constructs inculcated based on a specific society's particular perception of the physical difference and the assured taste, tendencies and capabilities of men and women. Societies determine what resources when men and women will access jointly or separately, what work men and women shall perform and what rewards, what types of knowledge are appropriate for men and women and how and where this knowledge is acquired. Gender relationship differs based on culture, religion, ethnicity and classes that men and women belong, each institutions has its own gender culture, that is the relationships between women and men, for example, who hold more powerful position have position have access to more resources, and has a stronger network that can be used to their benefits.

It is estimated that women total to one half of the world's population, and they represent two thirds of the world's workers, but ironically earn one tenth of the world's income and own one hundreds of property (Adelakun, Oviawe *et al* 2015). According to the above data, women play effective roles in economics development of the world but they play little or minute roles in technological advancement. The inequality can be linked to unequal access to training opportunities. For example, a study conducted in Nigeria found out that females' participation in TVET and Science, Engineering and Technology (SET) show that female genders are still underutilized and occupy the middle or lower status, in spite of the recent steady progression from this status over time (Udeani & Ejikeme, 2001). This is confirmed by another study which reported that a large percentage of women are found mainly in poorly paid jobs and several others go into early marriages, prostitution and child labor (Adelakun, Oviawe *et al*2015). More so, a study by UNESCO (2010) concurs with this fact by pointing out that male students outnumber the female students in 91% of countries globally, despite increased in parity in enrolment in higher education and in Science Technology Engineering and Mathematics (STEM) disciplines.

Moreover, in the developed world, countries such as United Kingdom experience low rates of female participation in STEM related subjects and occupational choice (National Academics Press, 2007). This lacuna is attributed to gender inequality in the curriculum, classroom pedagogy and failure to offer support for development of self-esteem by the education system, confidence and aspiration of female learners at the formative stage (Johnson and Kendrick, 2005 cited in Watermeyer, and Stevenson, n.d). Female under representation in TVET is becoming an issue both in developed and developing countries, Nigeria included. According to the United Nations Human Development Report (2008 – 2009), Nigeria is classified as a low developed country in respect of equality in educational accessibility with Female Adult Literacy Rate (age 15 and above) of 55.1% against 73.2% male. United Nation (1979) in UNESCO (2010) noted that women alone constitute one half of the world's population, do two-thirds of the world's work, earn one tenth of the world's income and own one hundredth of the world's property including land. Institute for Women's Policy Research (IWPR, 2013) noted that women and girls are underrepresented in Career and Technical Education (CTE) programmes that prepare students for careers in high paying occupations like Science, Technology, Engineering and Mathematics (STEM), the skilled trades and other occupations traditionally done by men in highly skilled professions, it is necessary to carry women along in developmental programmes for self-sustenance. Oganwu (1996) cited by Owodunni and Igwe (2016) equally points out those Nigerian women and other African women have been denied and dishonoured by the belief that every woman is supposed to consider motherhood as their principal purpose in life. That is, women are created for producing children, cooking food, mending and washing clothes, taking care of men and children, submissive to male authority. In corroborating the above fact, the presidential speech made by former President Mohammed Buhari at his first inauguration on the 29th of May, 2015, he said that the role of the first lady (Aishat Buhari) is in the bedroom and kitchen but not in the First Lady's office. Also, the previous kidnapping of female students of Girls Secondary School, Chibok, BornoState on the 14th of April,

2014 and Dapchi School Girls, Yobe State on the 19th of February, 2018 and the recent kidnapping of female students of Federal University Gusau, Zamfara State to mention few has demonstrated that there's attempt to frustrate the female gender from obtaining qualitative education, which has become a mirage to the female students in the northern part of Nigeria. According to Omoregie and Ihensekien cited by Owodunni and Igwe (2016), there is still much gender inequality in Nigeria's education in spite of all steps taken by the Federal Government to give equal gender opportunity to education in Nigeria as a whole such as the provision of the Universal Free Primary Education (UPE) in 1976. But frequent attack of female student may truncate all efforts if drastic measures are not taken, Nigeria education will only be dominated by males and female will be relegated to farm, market, baby factory, prostitution and promote poverty level in the country.

In the study conducted by Eta (2000) on Dimension of Gender Crisis in Nigeria Education, it was observed that there is low enrollment of female students in Vocational and Technical Education (VTE) courses, such as Mechanical, Automobile, Building, Woodwork, Fine-Art, Agricultural Science etc. Which has shown that there's gender disparity and crises in this aspect of education. Also, Osideinde (1999) reported that the gender ratio in the educational system indicates that males are more educated than females in Technical and Vocational Education and Training (TVET). This report was supported by Okorie (1998) who stated that there is gender gap in access to education and that women receive less education than men. He stated further that despite increase in education enrolment at various levels fewer girls participate in technical and vocational courses. Further still, Mamba, Mwambu and Kameji (2002) and Nyerere (2009) agree that TVET delivers core entrepreneurial communication, financial and leadership skills which translate to increase wage and self-employment opportunities. TVET is essential to the world of work and is an effective means of empowering the society to engage in productive and sustainable livelihoods (Simiyu, 2009).

However, improving gender equality in TVET programmed is still riddled with many challenges, therefore it is pertinent to carry females along in developmental efforts for self-sustenance through Technical, Vocational Education and Training (TVET). This paper focuses on the concept of TVET, perception of females in TVET, factors hindering female participation in TVET, ways of encouraging female participation in TVET and it provides suggestion for recommendations.

Technical, Vocational Education and Training (TVET)

Technical, Vocational Education and Training (TVET) is generally regarded as education for work; that is the type of education that prepares individuals in the society for the world of work. Federal Republic of Nigeria (FRN) (2012), viewed TVET as a comprehensive term referring to those aspects of the education, 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. Furthermore, TVET prepare people for skilful performance on practical tasks. It involves the acquisition of skills and competences that can help individuals to function productively in industrial and commercial occupations (wapmuk, 2011). TVET can also be expressed as a form of education that deals with acquisition of skills, knowledge and attitudes needed for effective productivity for self-sustainability and enable individuals to secure employment in a specific occupation.

On a general note, TVET is meant to equip individuals with skills needed to function in an occupation, therefore it requires a unique pattern of human capital against liberal education. In conclusion, Technical Vocational Education and Training (TVET) is further understood to be stated by (Adelakun and Oviawe, 2005).

- An Integral part of general education.
- A means of preparing for occupational fields and for effective participation in the world of work.
- An aspect of lifelong learning and a preparation for responsible citizenship.
- An instrument for promoting environmentally sound and suitable development.
- A method of alleviating poverty.

The FRN (2004) stipulated the objectives of TVET as follows:

a. To provide trained manpower in applied science, technology and commerce particularly at sub-professional level.
b. To provide the technical knowledge and vocational skills necessary for agricultural, industrial, commercial and economic development.
c. To produce people who can apply scientific knowledge to the improvement and solution of environmental problems for the use and convenience of man.
d. To give introduction to professional studies in engineering and other technologies.
e. To give training and impact the necessary skills leading to the production of craftsmen, technicians and other skilled personnel who will be enterprising and self-reliant.
f. To enable young men and women have an intelligent understanding of the increasing complexity of technology.

Based on all the benefits of TVET programmes, it is noted that no nation can adequately developed technologically if neglect the development of its human resources which embraces males and females that should be given equal access to maximize their potentials. But the reverse is the case of females' education in Technical, Vocational Education and Training (TVET) in Nigeria.

Perception of Females Gender in Technical, Vocational Education and Training (TVET)

The term gender is used to refer to socially constructed relationship between women and men in a particular society. Biologically, sex refers to a state of being a male or female while gender as a social identity changes over time and space. Therefore, female as a concept denotes girls and women, and there has been gender disparity against females. Female in Nigeria have a basic human right to be educated, but the right does not have the free will to operate in the education system in the country especially in Technical Vocational Education and Training (TVET) programs. Females have fewer opportunities to education in comparison with males. According to Napikoski (2014), patriarchal society consists of a male -dominated power structure throughout organized society and in individual relationships. The female gender is generally disadvantaged in access to education, employment, wage and land acquisition just to mention few. The challenges militating against female equality include socio-cultural practices, low economic status, patriarchy and low education. According to Wubon (2013), education has not necessarily been a priority for the girl-child because of social-cultural beliefs and perverted mind sets. The traditional belief of some Nigerians is that the places of female children are in their husband houses, while the male children are given access to education. For instance, the below average living families prefer educating the male children with their little resources and with the hope of promoting the family names when they are successful after schooling. While they allow the female children to either hawk, produce babies, prostitution and so on. The 7 number of out of school girls is increasing tremendously both in Nort-east and North-west of Nigeria. According to United Nations Human Development Report (2008 – 2009) which is also corroborated by Afri-Development Information (2013), eight states in Northern Nigeria have the county's worst female children education and health indices. The recent score card by a group of non-governmental researchers revealed that Kebbi, Sokoto, Bauchi, Jigawa, Yobe, Zamfara, Katsina, and Gombe states have Nigeria's worst female children education, highest female illiteracy, highest adolescent girl marriage, highest under 15years child bearing and highest risk of maternal death.Ebonyi in the South-east of Nigeria is at number 10th state with the highest percentage of female children out of school. The abduction of female students of Chibok and Dapchi in the North-eastern part of Nigeria further worsen the situation and obviously contributed to out of school female children saga, because investigation conducted shows that most of the remaining female children in the above named secondary school were scared of pursing their education after the incident, some parents also were afraid of losing their daughters if allow them go back to school. Therefore, it has now become a disturbing and embarrassing situation to government and concerned individuals; this situation has been so poor world-wide that the 4th UN Conference on women Beijing, 1995, had "Girl-Child Education" as one critical area of concern. According to American Association of University Women (AAUW)(2011), women tend to be overwhelmingly clustered in low wage, low skill fields (they constitute 98 percent of students in the cosmetology industry, 87 percent in the child care industry and 86 percent in the health aide Industry). In high wages, high skill fields, they fall well below the 25 percent in the field commonly practiced by men (women account for 10percent of students in the construction and repair industry, and 16 percent in engineering).

According to Federico Mayor in Hoffmann-Barthes, Nair and Malpede (2006), in a world increasingly shaped by science and technology, scientific and technological literacy is a universal requirement. There's need to improve women and girls' literacy in science and technology related fields because of the importance of their educational role in the family which make them a major determinant of the behavior of present and future generations. The female inequality in TVET is reasonably greater when compare to other fields of education, with the female children lagging behind the male children opportunity, participation and performance. This conspicuous gender disparity demands females' participation in Technical, Vocational Education and Training (TVET)

Factors Militating Against Female Participation

The factors militating against females (women and girls) participation in TVET related courses are numerous and similar for both developed and developing countries. These factors range from cultural, social, religion and institutional curricular related factors. For better understanding, some cultural and social norms influence the choices of female students in studying TVET courses, such factors have been identified as one major cause behind the lower proportion of women in STEM fields (UNESCO – UNEVOC, 2010). These cultural and social norms had been observed as major determinant depriving female genders opportunities to participate in TVET associated courses. These conventional conceptions that adumbrate TVET courses as masculine or strenuous has greatly influence the participation of female students. For instance, TVET courses such as metalwork, woodwork, automobile to mention few are classified as strenuous and eventually become no go area for female students in TVET studying institutions in Nigeria. In corroboration of this fact, since 2008, no female students have ever been admitted for metalwork, woodwork, automobile technology at the researcher's place of work (Sikiru Adetona College of Education, Science and Technology, Omu-Ajose) formerly known as (Tai Solarin College of Education, Omu-Ijebu) in Ogun State.

This indicates that some TVET courses are perceived masculine or strenuous, therefore standing as obstacle for female student's enrolment, while other TVET courses such as electrical/electronic, building technology etc. experience very low turnout of females' enrolment yearly.

At secondary school level of education, science subjects that are a prerequisite of studying TVET related courses in Nigerian tertiary institutions, but these science subject are perceived mentally and psychologically strenuous at secondary schools where career choices start. Hence female students are cleverly made to believe that they are not, physically, mentally and psychologically fit to study TVET related courses. For instance, the higher rate of women pursuing professions such as teaching may be due to perception that such professions allow more flexibility to balance family and work responsibilities (World Bank, 2012).

This can also be linked with different ways in which boys and girls are treated in our society, girls are expected to be more accomplished in linguistic and social skills boys are supposed to be better in science, mathematics, mechanical and other problems solving tasks as pointed out by Minton & Schneider in Nguyen (2000). This stereotyping should be discouraged by using successful women in TVET courses as role model, for the female students and in return it will encourage more female participation in TVET. Also, there is need for instructors and lecturers to encourage female students during practical demonstration, because if they are supported and motivated they can bring different dimensions, qualities and skills to technology and engineering, which in returns will contribute to economic development and national growth.

Moreover, many cultures still believe in stereotyping conception that females are expected to take care of home and immediate families. These social and cultural norms prevented women and girls from engaging in productive skills jobs/trades, and when they do, they are expected to balance work and home responsibilities. Millions of women who are heads of families need to continue working to support themselves and dependents. Where families face poverty and deprivation, women's earning often make significant difference in well-being of children, and this is what TVET is advocating for Klevit and Bach (1996) state that stereotype is powerful in serving as a screen to observations of reality. Whenever a belief is confirmed in the behavior of any female member of the society, the belief is adjudicated but when the behavior of a male member of a group is contrary to the belief, it is abolished people have

been frustrated and confused because of the notion of men's and women's responsibilities of the past are incompatible with the realities of contemporary living. The assumption that the world of work is a man's world, while home is women's domain is losing credibility, because angry women with aspiration have strongly condemned it by challenging men in various fields and raising their shoulders high. Increasing numbers of women engaging in labor fields and it enables them to function both as home maker and wage earner.

Religion is known to be moral teaching that helps in molding and shaping one conduct. Kelly, (1984) viewed Islam as a force against women education; it discourages female gender from participating in technical and vocational courses. According to STAN (1992), a good number of students surveyed agreed that superstition and traditional beliefs prevent females from participating in technical and vocational education professions by lowering their aspirations. Furthermore, the Boko Haram insurgence operating in the Northern part of Nigeria cited Islam as the main reason for attacking and abducting female students of Chibok and Dapchi towns, they carried out the satanic action to scare the female students from receiving qualitative education. Some female students were later released after Federal Government of Nigeria has paid ransom, and the released females were taken abroad for further education.

Although it is a known fact that Islam is a religion of peace therefore no true Muslim will engage in such an evil act like that of Boko Haram insurgence. The Boko Haram insurgence only used Islam as cover up, but the fact still remains that some people use religion to prevent female students from participating in TVET programmes. The recent attacked on students of technical school, Kankara also confirmed the use of religion in preventing student's participation in TVET related courses.

In conclusion, curricular is related to the subjects comprising a course of study in a school or college. Some of these subjects are not friendly with female genders due to the difficult tasks involved. The curricular is designed in such a way that it accommodates male student's needs, hence overlooking the needs of female students. Recent visit to Government, Science and Technical Colleges in Ogun State clearly revealed the state of equipment, machines and tools. Also learning materials are far within the reach of female students, and where available, they are not sufficient for the use of all students. It now becomes survival of the fittest, and the fittest are always the male students. For instance, in India, girls undertaking engineering disciplines admitted that they were slightly handicapped due to loss physical strength when working in some of the laboratories and workshops (Nguyen, 2000). Therefore, there's need for curricula and learning material to undergo further rigorous review from a gender perspective to ensure that they do not perpetuate gender stereotype.

Ways of Enhancing Females Participation in TVET

Females in the context of the study denote girls and women; females have less opportunity to Technical, Vocational Education and Training. The major task of reducing gender gap in TVET is pegged on the governments initiatives and support. Government at all levels in Nigeria should address the institutionalizing of gender responsive action various sectors with focus on improving female participation in TVET.

Therefore, it is imperative that steps should be taken to ensure full involvement of female students in TVET as well as other related science courses. The promotion of such policy as noted by UNHDR (2008 – 2009) among girls and women who form slightly more than the 50% of the potential labor force will guarantee expended employment opportunities for the females. Also, the involvement of female students in school and home maintenance work provides avenue for the development of technology, which also serves as practical demonstration of the theoretical knowledge picked up in the classroom situations, which will impact female participations in TVET positively. Teachers are major stakeholders in TVET institutions, so they should be given adequate pre-and in-service training. In gender-responsive teaching strategies so that female and male students can develop their full potential in TVET related courses, most especially in higher levels of education where students look to their teachers as role models as they begin to shape career perspectives and choices. Also, promoting more female role models in TVET is another strategy that can be used to attract female students into TVET fields. The

female students need value encouragement to join TVET fields and this will seem a lot more important especially when it is from their peers, teaches, parents or employers.

Another important component of enhancing female's participation in TVET is the introduction of career talks and career counselling which should be branded gender-responsive career counselling for both female and male students to have support and objective guidance as they begin to make career choice. Non-availability of career talks in our schools is becoming worrisome, because the misconceptions that TVET related courses are meant for drop outs or students with low academic intelligent quotient (I.Q). This negative impression about TVET related courses discourage serious minded female students, but when there's frequent career counselling and talks for the female students. It will assist in erasing the wrong concept from their minds and install courage that will enable them to enroll for TVET related courses and stay on the course. Haven't said all the above, without adequate financing of TVET programs, whatever said above is effort in futility. Hence appropriate funding for equipment and resources should be allocated in order to stimulate students interest in TVET related courses, particularly among female students. Also, scholarship programs targeted at girls and women in TVET should be implemented to increase opportunities for young girls to pursue further study in TVET.

Conclusion

This paper has succeeded in exposing the status of female participation in TVET related courses as being low. This paper also pointed out factors militating against female participation in TVET, they include bad government policy on education, stereotyping, negative attitude attributed to the field, gender bias in the curriculum and failure by the system of education. It also procures ways for enhancing female role models in teaching at higher level of education, adoption of gender-responsive teaching strategies, reviewing of the curricula, introduction career talks and counselling for females, sufficient funding of TVET programs and scholarship programs.

The gender-responsive interventions enable female and male students to pursue career in which they can excel in TVET. Therefore, there is need to refocus on gender responsive strategies at all educational levels. At secondary school level, teachers need to be responsive in the way they convey messages relating to TVET courses, teachers need to be supportive and encourage female students in preparation for studying TVET courses. Also, at tertiary level, engineering and technology curricula should be designed to include humanities and be more female friendly, for example by inculcating programs that will attract female students to TVET courses.

Finally, the need for education and advantages associated with being educated as woman are enormous, so the government, the school system, the society and other stakeholders should join hands in eliminating inequality in the recent treatment of female students in matters of Technical, Vocational Education and Training.

Recommendations

This paper recommends the following ways of enhancing females participation in TVET related courses: -

1. Implementation of public orientation campaign to encourage parents, teachers and the public at large towards female education in TVET in particular.
2. Practicing women engineers and women that have embraced career in TVET should be attached to young scholars for role modelling and mentorship, and to educate young girls on the prospects of career development in TVET and other science related courses which resulted into gender stereotyping is baseless.
3. There should be comprehensive training and retaining of teacher in gender-responsive teaching strategies so that female gender can develop their full potential in TVET related courses.
4. All barbaric cultural, religious and socio-based institutional practices which are anti-female should be legislated against and decisions reached be fully implemented.
5. Adequate funding by government and other stakeholders in education and technological development should be carried out to ensure effective running of female in TVET programmes.
6. Government should as a matter of urgency convoke a conference of stakeholders in education and women leaders to address the conspicuous gap existing between males and females.

7. Female students seeking admission bro study TVET related courses should be given preferential treatment during admission.
8. State and Federal Government should introduce scholarship policies for female students in TVET tertiary institutions so as to encourage more female participation in TVET programmes.

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SUB-THEME: STEM AND SUSTAINABLE DEVELOPMENT

RE-THINKING THE FUTURE THROUGH CHEMISTRY EDUCATION CURRICULUM FOR ENTREPRENEURSHIP SKILLS TO ATTAIN NATIONAL DEVELOPMENT

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Abstract
This study investigated the relevance of Chemistry Education for Entrepreneurship skills acquisition. A descriptive survey was used. The population was the 300 Chemistry teachers in 261 state-owned secondary schools in the three Education zones of Niger State. All the 300 Chemistry Education Teachers were used for the study since the population was considered not large enough for sampling. Three research questions and one hypothesis guided the study. Data was collected using a 26-items questionnaire developed by researchers. A reliability of 0.84 was established for the instrument using Cronbach Alpha techniques. Mean was used to answer research question and t-test statistic was used to test the hypothesis at P<0.05. Results showed among others, that Chemistry curriculum is relevant for entrepreneurship skills acquisition and innovative teaching strategies foster entrepreneurship skills acquisition. Based on the findings, recommendations were made among which were the entrepreneurial skills of Chemistry education curriculum should be vigorously emphasized to make recipients self-reliant and saleable in the society and that teachers should use teaching strategies that foster entrepreneurship skills instead of relying so much on lecture method.

Introduction

The National Policy on Education (NPE) (2014) recognizes education as Instrument per excellence for individual and national development. In Nigeria as it is in world over, education is an inalienable right of every child. Through education, every child is expected to acquire desirable and functional knowledge, develop appropriate skills both intellectual and physical as well as positive attitude and values necessary to live successfully and become a useful member of the society. The over-all purpose of basic education is to produce a literate society in which the individual can apply their literacy in terms of knowledge, skills and values to enhance their survival. Technology plays a fundamental role in wealth creation, improvement of the quality of life, real economic growth and transformation of the society. Technology is the primary engine of economic growth and provides the keys to unlocking the country's potentials (Egbogba, 2014). Where this engine for development and economic growth fails, it always results in serious social, economic and developmental problems. These problems amongst others include poverty, unemployment and underdevelopment.

In Nigeria, the growing problem of unemployment in the country has contributed largely to worsening problem of poverty among the populace. Nigeria is one of the African countries faced with economic and political problems (Nwachukwu, 2012). These problems have given rise to the depreciation of naira, high rate of unemployment, crime, poverty, hunger and frustration. Olaitan (2013), stated that unemployment leads to frustration and disillusionment which may result in crimes or drug abuse in a futile attempt to escape from and forget the pains and humiliation of poverty and lack. The problem of unemployment has worsened as millions of school leavers and graduate of tertiary institutions have not secured gainful employment over the years. Many able-bodied persons who could not secured gainful employment have remained economically dependent on their parents. This is because they lack the necessary occupational skills to be self-employed and to effectively function in today's world of work (Ogunkunle, 2013). This present situation has occasioned increase awareness in Nigeria of the need for self-employed and self-release, which call for entrepreneurship education. These occupational skills can be provided through Chemistry education.

Chemistry is an investigation science subject which deal with the procedures and processes of making thing which could serve as a medium through which the science students and youths who could not further their education after senior secondary school can be gainfully employed according to (Okori 2013). Chemistry education is that aspect of education that involves the acquisition of knowledge of

science for the improvement of man's surrounding. This includes dealing with manpower training in professional areas such as engineering, business home economics etc. These skills involve practical works and applications that lead to particular occupation. Entrepreneurship means setting and running a business in a profitable and sustainable manner (Nwafor, 2012). The Federal Republic of Nigeria recognized the immense role of the development of entrepreneur skills in her secondary level products when it states that there should be Science and Technological skills for economic development (FRN, 2014). Entrepreneurial skills consist of effective utilization of ideas, information and facts that help the learners develop competencies, services or being productive employees of organization (Olibie & Obiduke, 2013).

Consequently, entrepreneurship education is a planned process leading to the acquisition of entrepreneurship skills for effective living. According to Nnamani (2012), entrepreneurship education is an instrument that empowers youths to be in control of the future. It creates job and business. The youths have more opportunities to exercise creative freedom, higher self-esteem and overall greater sense of control over their own lives. Considering these importance of entrepreneurship education, it becomes eminent that the inculcation of entrepreneurial skills of our youths should highly emphasized especially through the Chemistry education curriculum. Curriculum is the organized knowledge which the society presents to the learners in other to achieve pre-determined goals of education (Etuk et al., 2012).

Curriculum becomes relevant if it addresses currents and anticipated needs, problems and aspiration of the learner and society. Curriculum which is in use in Nigeria for science and learning has built-in strategies where learners are required to be involved in practical and related activities that will lead to development of science process skills. Science process skills involves ability to identify a problem, raise questions about, seek for information, analyze them and make inference logically.

NPE (2014), stated that the objective of Chemistry curriculum among others are to enable the learners to:

(1) Observe and explore the chemical environment
(2) Apply the skills and knowledge gained through the Chemistry to solve day-to-day problems.
(3) Manipulate simple apparatus for purpose of use, and
(4) Improve simple equipment from available junk in the chemic environment.

Offorma (2010), sees the curriculum as a document, plan or blueprint for instructional guide for teaching and learning to bring about positive and describe learners behavioral change. The curriculum describes the teaching, learning materials and assessment strategies available for a given subject/course of study. The curriculum schemata have placed a lot of burdens on the pedagogical demands of the teacher. This is why Ugwuda (2012) suggested that Chemistry education needs trained teachers' skills to tackle the problem of unavailability of teaching material in schools. It is on this note the Ugwu et al (2011) suggested that Chemistry education needs trained teachers' skills to tackle the problem of unavailability of teaching materials in schools. It is on this note the Ugwu et al (2011) suggested that Chemistry education curriculum implementers (teachers) should look at the prevailing circumstances at the schools and attempt to predict achievement goals and formulate curricular/lessons objectives.
The Chemistry education graduates should be able to undertake;

i. Food and water quality control skills.
ii. Instructional material production e.g models and chart as improvisation.
iii. Soaps and detergent production.
iv. Acid production for changing batteries.
v. Production of dyes coloring and paints etc.
vi. On Commercial scale for self-reliance and employment.

Research Questions

To guide the study, the following research questions were asked.

1. To what extent is the Chemistry education curriculum relevant in entrepreneurship skills acquisition.

2. What are the teaching strategies required of Chemistry education curriculum for entrepreneurship skills acquisition?
3. What constraints militate against Chemistry education students' entrepreneurship skills acquisition?

Hypotheses

The hypothesis was formulated and tested at 0.05 level of significance.

Ho1: There is no significant difference between the mean responses of male and female Chemistry education teachers on the relevance of Chemistry education curriculum in entrepreneurship skills acquisition.

Method

A descriptive survey research design was adopted for the study. The study was carried out in Niger State of Nigeria. There are three educational zone in Niger State. The schools used were spread across the three education zone of the state. The population of the study comprised all Senior secondary schools Chemistry teachers from the 261 secondary school in the state. The researcher did not involve any sampling or sampling technique since the number of Chemistry teachers was not large. The instrument for data collection was a 26-item questionnaire titled Relevance of Chemistry Education Curriculum on Entrepreneurship Skills Acquisition (RCEDCESA) developed by the researchers. The instrument was validated by two Chemistry educators and one specialist in measurement and evaluation from Federal Colleges of Education, Kontagora.

The corrections made by these specialists were noted and used to improve the quality of the final instruction. The instrument was trial-tested on 30 Chemistry teachers that were not involved in the main study. The result was used to determine the reliability of the instrument using Cronbach Alpha techniques. A reliability index of 0.84 was established. Face to face method of administration was used to ensure a hundred percent (100%) returns of the questionnaire. The research questions were answered using mean while t-test was used in testing the null hypothesis.

A modified four-point Likert Scale was used which was weighed as followed. Strongly Agree (SA) = 4; Agree (A) = 3; Disagree (D) = 2; Strongly Disagree (SD) = 1. A mean value of 2.50 was obtained by adding all the points on the scale and dividing the value by 4. All items of mean of 2.50 and above were accepted as positive response (Agreed) and those below 2.50 as negative responses (Disagree).

Results

Data analysis were presented in table according to research questions and hypothesis.

Table 1: Mean Rating of Chemistry Education Teachers on the Relevance of Chemistry Education Curriculum for Entrepreneurship Skills Acquisition

S/No	Questionnaire Items	Male Mean	Female Mean	Decision
1.	Chemistry education curriculum provides enough skills for identifying production areas.	3.35	3.01	Agreed
2.	Its links with other science subjects avail the learner an easy approach to economic problems.	3.40	2.95	Agreed
3.	Contents development are learner centered and oriented to real life situation.	3.01	3.10	Agreed
4.	Identifying the production techniques of different Chemistry education enterprises.	3.01	3.10	Agreed
5.	Providing and sourcing raw materials necessary in production.	3.46	3.01	Agreed
6.	Provide skills for marketing of produce.	2.97	2.86	Agreed
7.	For identification and analysis of problems such as food and soap uncertainty.	3.43	3.14	Agreed
8.	Provide collaborative skills in joining corporate societies like producer and consumer corporate.	3.43	3.14	Agreed

9.	For training students for reward keeping such as inventory production, sales, purchase and profit and loss account.	2.95	2.89	Agreed
10.	For team and organizational skills.	3.07	3.13	Agreed
11.	Provide adequate skills for saving and financial investment.	2.77	2.95	Agreed
12.	Require learning materials from the learners culture.	2.67	2.77	Agreed
13.	Computer-Aided Instruction suggested, assists learners development of critical thinking.	3.10	3.15	Agreed

In the table 1 above, respondents agreed that all the factors outlined for a relevant curriculum are applicable to Chemistry Education curriculum for entrepreneurship skill acquisition. The had mean score above the criterion mean 2.5.

Table 2: Mean Rating of Teachers on Teaching Strategies Required in Chemistry Education Curriculum for Entrepreneurship Skills Acquisition

S/No	Questionnaire Items	Male Mean	Female Mean	Decision
14.	Use of constructionist-based teaching strategy.	3.22	3.08	Agreed
15.	Use of conventional talk/chalk board/lecture method.	1.86	1.83	Disagreed
16.	Use of problem-based learning.	2.96	3.00	Agreed
17.	Use of Computer-Aided Instruction strategies.	3.56	3.25	Agreed
18.	Use of field trip.	3.03	2.92	Agreed

Data in Table 2 revealed that the mean ratings of the items from the respondents were above 2.50 except item 15, thus were accepted as relevant teaching strategies for entrepreneurship skills acquisition Chemistry education.

Table 3: Mean Response on the Constraints that Militate Students Entrepreneurship Skills Acquisition in Chemistry Education

S/No	Questionnaire Items	Male Mean	Female Mean	Decision
19.	Non availability of effective and functional workshop for the construction of the works.	3.40	3.15	Agreed
20.	Lack of material needed for the construction of works.	3.01	2.95	Agreed
21.	Lack of co-operation among students when it involves group works.	2.95	3.15	Agreed
22.	Students' unwillingness to learn the skill involved.	2.04	2.16	Disagreed
23.	Poor knowledge of skills involved in construction of the works	3.20	2.87	Agreed
24.	Students poor knowledge background in Chemistry.	3.01	3.05	Agreed
25.	Insufficient time allocated for the accumulation of skills required.	2.85	2.91	Agreed
26.	Inadequate provision of textbooks for referencing.	2.71	3.07	Agreed.

In Table 3, the respondents agreed with all the items as constraints except item 22 that is student unwillingness to learn the skills involved.

Table 4: T-test in the Mean Responses of Male and Female Chemistry Teachers on the Relevance of Chemistry Education Curriculum for Entrepreneurship Skills Acquisition

Group	N	df	$\bar{X}$	SD	t-value	P-value	P<0.05
Male	120		2.62	0.75			
		298			0.534	1.98	Not Significant
Female	180		3.24	0.73			

Table 4 shows that the t-value was 0.534 and p-value was 1.98 (t-value < P-value). Hence, the hypothesis of no significant difference was retained.

Discussion

The findings of this study showed that factors/qualities in Table 1 had mean scores above 2.5. these is in agreement with Etuk et al. (2012) that said it becomes eminent that the inculcation of entrepreneurial skills of our youths should be highly emphasized especially through science education curriculum. In Table 2, the study revealed innovative teaching strategies for entrepreneurship skill acquisition of Chemistry education. The result showed that these strategies with mean 2.5, which when applied would empower Chemistry students in entrepreneurship skill acquisition.

Furthermore, this study revealed the constraints that militate against teachers' entrepreneurship skill acquisition in Chemistry education. These findings are in line with Ugwu et al (2011) that suggested that Chemistry education curriculum implementers (teachers) should look at the prevailing circumstances at the school and attempt to predict achievement goal and formulate curricular/lesion objectives. This means selection and in-depth study of less contents area that are important to individuals and the society. The result also revealed that gender has not significant effects on the responses of the subject on the relevance of the Chemistry education curriculum in entrepreneurship skills acquisition.

Conclusion

A relevant curriculum endows its learners with appropriate entrepreneurship skill acquisition that will enable them in achieving socio-economic and industrial development. Entrepreneurship skill acquisition in Nigeria would entail focusing on what should be done to bridge the gap between the school and industry where the learner will work on graduation, so as to be self-reliant and saleable in the society.

Recommendations

The following recommendations are made based on the findings of the study.

1. Entrepreneurial skills in Chemistry education curriculum should be vigorously emphasized to make recipients self-reliant and saleable in the society.
2. Teacher should use teaching strategies that foster entrepreneurship skills acquisition instead of relying so much on lecture method.
3. Government should adequately fund Chemistry education in area of provision of facilities and materials for entrepreneurial skill acquisition.
4. All the stakeholders should be out to motivate students in the entrepreneurship skills acquisition that will make them employers rather than employees of labor.

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EFFECTS OF CONCRETE-REPRESENTATIONAL-ABSTRACT SEQUENCE STRATEGY ON STUDENTS' ACHIEVEMENT IN MATHEMATICS IN OGUN STATE, NIGERIA.

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Abstract

This study examined the effects of the Concrete-Representational-Abstract (C-R-A) Sequence strategy on students' achievement in Mathematics. 2 x 2 pre-test, post-test, control group, quasi-experimental design was adopted for this study. Eighty (80) Senior Secondary School two (SSS2) students from two schools in Ogun State were involved in the study. Purposive sampling Technique was used to select two secondary schools among the schools in Odogbolu Local Government of Ogun-State while the Simple Random Sampling Technique was used to select the 40 students into the experimental group and 40 students into the control group respectively. The instrument used for data collection is Mathematics Achievement Test (MAT). The reliability of MAT was 0.82 using test-retest reliability method. The data collected were analyzed using descriptive statistics (Mean and Standard Deviation) and Analysis of Covariance (ANCOVA). The findings showed that there exists significant difference in the post-test mean achievement scores of the students exposed to CRA sequence strategy ($F(1, 75) = 6.588$ and $p < 0.05$). Also, the result revealed that there is no significant difference between the achievement scores of male and female students exposed to the strategies (C-R-A-Sequence and Conventional Method) in mathematics. No significant interaction effect of strategy and gender on the students' achievement Mathematics. The study concluded that Concrete-Representational-Abstract sequence strategy was effective because every student participated in one activity or the other which enhances their achievement in mathematics. The study recommended that the teachers should be discouraged from using teacher-centered instructional strategies but student-centered instructional strategy such as CRA-sequence.

Keywords: Achievement, Concrete-Representational- Abstract Sequence, Gender, Students.

Introduction

The use of Mathematics in everyday activities cannot be underestimated. Mathematics is regarded as the science of numbers, operations, generalization, interrelation, combination and abstraction, space configuration and their structure measurement, transformations and generalizations (Trusty & Watts, 2016). Mathematics is further described by Trusty & Watts (2016) as the queen and the servant of all school subjects since it crosses all academic disciplines. In the history of education, mathematics holds its leading position amongst all other school subjects because it has been considered as an indispensable tool in the formation of the educated man (Adedayo, 2011). Mathematics is an important subject that requires a credit pass to further learning in higher institutions. Mathematical skill is required in daily activities, regardless of educational background and social status of an individual. The benefit of Mathematics is not only limited to knowledge in computation but more importantly, it makes thinking more rational and critical Obiefuna, 2014)

Despite the importance of mathematics, the Chief Examiner Report of West African Examination Council revealed that students used to perform woefully in the subject. Also, most candidates find it difficult to solve correctly most of the mathematical problems (WAEC Chief Examiner Report, 2020). To remediate these weaknesses, the Chief Examiner suggested that concepts in mathematics should be well explained and demonstrated to the candidates using concrete objects during the teaching and learning process. Various factors, related to students, teachers and school, have been identified as possible causes of poor performance of students in mathematics. Studies have shown that some students' personality variables like attitudes, study habit, interest, anxiety, gender, cognitive style, self-

concept and achievement-motivation exerts great influence on students' achievement in Mathematics (Etukudo & Nnaobi, 2015; Achor, 2013; Ifamuyiwa & Kehinde, 2013). Furthermore, over the past years, researchers have identified a number of teacher factors such as; teachers' methods of teaching (Donaly, Deborah & Kim, 2010), teacher personality attributes (Oyewole, 2018) and teaching skills (Alebiosu, 2013), that are highly related to learning outcomes in Mathematics. Similarly, Adedayo (2011), the observed that failure of the learners in mathematics at Senior Secondary School has been narrowed to the inability of the teachers to make use of appropriate teaching methods.

Flores & Hinton (2014) observed that most of the conventional methods of teaching might be ineffective in teaching and learning of Mathematics. Furthermore, lack of motivation in the part of the students, little or no room for students' participation, lack of students-teacher interaction, lack of active participation by the students, discouragement of weak students is some of the drawback of the conventional methods of teaching mathematics. In order to determine the effects of students' centered teaching method on their achievement in mathematics, this study used the Concrete-Representational-Abstract (CRA) Sequence teaching techniques to teach mathematics in the selected secondary schools.

CRA sequence is a three-stage teaching method that involves students manipulating concrete materials, learning about graphical representations of those manipulations, and then using abstract notation to solve problems (Witzel, 2014). This sequence of instruction has been used to teach problem-solving in integers (Maccini & Ruhl (2012), Algebra transformation equations (Witzel, Mercer, & Miller (2013), and solving linear algebraic functions (Witzel, 2014). Teaching students through CRA has been shown to be beneficial to secondary school students with learning difficulties (Witzel, 2014).

CRA sequence plays an important role in concretizing the abstract nature of mathematics thereby, motivating the learners to actively participate in the learning and teaching process. More broadly, CRA sequence plays an important role in bridging vacuum created using inappropriate methods of teaching thereby aiding students' mathematical concept. According to Tripathi (2016), making use of CRA Sequence for teaching of mathematics is a good method that eases students' understanding of mathematics. Concrete –Representational-Abstract strategy is capable of concretizing the abstract nature of mathematics thereby enhancing students' performance.

The existence of gender imbalance in Mathematics is bothering the researchers, mathematicians and educators in Nigeria and outside the country. This is so because researchers have not been able to agree on the gender perform better in Mathematics. Allsopp (2012) observed that male students outperformed female students in mathematics, according to Ezugo and Agwagah (2000), but female students outperformed their male counterparts, according to Forgasz, Leder & Vale (2017). In his study, Etukodo (2012) found no discernible difference between male and female students' performance in mathematics. Which gender excels more than the other in mathematics is still a subject of debate among researchers. The use of the Concrete-Representational-Abstract sequence was therefore used to examined if gender disparity in student achievement in mathematics can be established.

Objectives of the study

The objectives of this study include:

(i) To ascertain how the Concrete-Representational-Abstract (CRA) Sequence affected students' achievement in mathematics.
(ii) To examine the effects of gender on students' achievement when CRA sequence is used as a strategy.
(iii) To establish the interaction effects of the strategies and gender on students' achievement when CRA sequence is used as strategy.

Statement of the Problem

The students' incessant poor performance in external examination is posting a threat to their educational development. Reports by WAEC's Chief Examiner (2015-2021) indicated that students have continued to perform below expectation in mathematics in secondary schools. This poor performance is attributed to a number of factors according to literature, these factors include the abstract nature of Algebra, failure to use appropriate teaching method by the teaches that are teaching mathematics, learners'

misconception about using letters and symbols to represent variables in mathematics. To remediate these weaknesses, the WAEC Chief Examiner reports suggested that mathematical concepts should be well explained and demonstrated to the students using concrete objects to enable them to understand the abstract nature of mathematics. Therefore, in this study, the researchers used Concrete-Representational-Abstract (CRA) sequence strategy in teaching of mathematics in order to concretize the abstract nature of mathematics so as make the teaching and learning of mathematics simple and attractive to the learners.

Research Questions

(i) What is the mean achievement scores of mathematics students in the experimental and the control group?

(ii) What is the mean achievement scores of male and female students in the experimental and control group?

Statement of the Hypothesis

The following hypotheses were generated and are tested at 0.05 level of significance.

(i) There is no significant difference in the achievement scores of students subjected to the two levels of instructional strategies (Concrete-Representational-Abstract (CRA) Sequence and Conventional method in mathematics.

(ii) There is no significant difference in the mean achievement scores of students in mathematics based on gender.

(iii) There is no significant interaction effects of the strategies and gender on students' achievement in mathematics.

Research Design

This study adopted a pretest, posttest, quasi-experimental control group design. Intact class were subjected to different treatment conditions. The moderating and independent variables were crossed in 2×2 factorial matrix. The groups consisted of two treatment groups (Concrete-Representational-Abstract (C-R-A) Sequence) and a Conventional Method of Chalk-talk method of teaching as a control group. Two gender group was made up of male and female.

Target Population

All the Students in Ogun State, Nigeria's secondary schools (SSS2), made up the population of this study.

Sample and sampling Techniques

The sample of this study consisted of 80 respondents selected from two secondary schools. Purposive sampling Technique was used to select two secondary schools among the schools on Odogbolu Local Government of Ogun-State while Simple Random Sampling Technique was used to select the 40 respondents into the experimental group and 40 students into the control group respectively.

Instruments

The instrument for data collection is Mathematics Achievement Test (MAT). This instrument is a 40-items with four options per item. MAT was designed by the researcher. The instrument measures the students' achievement in Mathematics. The Mathematics Achievement Test (MAT) covers the area of knowledge, comprehension and application levels. A specification table was drawn to guide the development of the items. MAT was used for pretest, posttest. MAT measured students' entry behavior before the exposure to the treatment, their level of achievement after the treatment in mathematics. The total scores obtained were taken as the measure of students' achievement in mathematics. The reliability of MAT was 0.82 using test-retest reliability method.

Data were analysed using inferential statistics of Analysis of Covariate (ANCOVA).

Results

Research question One: What is the mean achievement score of the mathematics students in the experimental and the control strategies?

Table 1: Mean achievement score and standard deviation of the students that were subjected to experimental and control strategies.

Groups		Pre-Test	Post-test	Mean Gain
Concept-Representational Abstract (CRA) Sequence	**N**	40	40	
	Mean	14.88	18.88	4.00
	S.D	4.837	5.254	
	Max	28	31	
	Min	4	11	
Conventional	**N**	40	40	
	Mean	13.60	15.38	1.78
	S.D	5.022	3.854	
	Max	23	22	
	Min	3	7	

The mean achievement score for students in mathematics who used the Concrete-Representational-Abstract (CRA) Sequence and the conventional mode of instruction was shown in Table 1. Students in the CRA-Sequence group had post-mean achievement scores of 18.88 and 5.254 standard deviations. The post-mean achievement score and standard deviation for the students who received conventional instruction were 15.38 and 3.854, respectively. Results in Table 1 further revealed that the Mean achievement gains occurred across the two groups (CRA-Sequence and CM). The group exposed to the CRA-Sequence strategy with achievement gain of (4.00) while the group that were subjected to control group had the least mean achievement gain of 1.78.

Research question Two: What was the mean achievement score for both male and female students in the experimental and control?

Table 2: Mean achievement score and standard deviation of male and female students that were subjected to experimental and control strategies.

Groups	Sex		Pre-Test	Post-test	Mean Gain
Concept-Representational Abstract (CRA) Sequence	Male	N	20	20	
		Mean	13.70	18.10	4.40
		S.D	5.401	5.077	
		Max	28	29	
		Min	5	11	
	Female	N	20	20	
		Mean	15.05	19.65	
		S.D	5.511	5.441	4.60
		Max	25	31	
		Min	4	13	
	Total	N	40	40	
Control	Male	N	20	20	
		Mean	12.85	15.20	2.35
		S.D	4.043	4.175	
		Max	21	21	
		Min	4	7	
	Female	N	20	20	
		Mean	14.35	15.55	1.20
		S.D	5.851	3.605	
		Max	23	22	
		Min	3	7	
	Total	N	40	40	

The mean and standard deviation of achievement scores of male and female students who were subjected to the CRA-sequence and conventional method were shown in Table 2. The post mean for the CRA-sequence group for male students was 18.10, with a standard deviation of 5.077, while the post achievement score for female students was 19.65, with a standard deviation of 5.441. In the conventional group, the post mean for male students was 15.20 with a standard deviation of 4.175, while the post mean for female students was 15.55 with a standard deviation of 3.605. The highest post-mean achievement gains for female students who were exposed to the CRA-Sequence method was 4.60 while the smallest post-mean achievement gain of 1.20 was achieved by female students in the Conventional group.

Hypothesis One: There is no significant difference in the achievement score of the students subjected to the two levels of instructional strategies (Concrete-Representational-Abstract (CRA) Sequence and Conventional method in mathematics.

Table 3: Summary of the Analysis of Covariance of students' achievement in Mathematics according to the strategies and gender.

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	1004.971[a]	4	251.243	12.147	.000
Intercept	605.912	1	605.912	29.295	.000
pre_test2	566.876	1	566.876	27.408	.000
Strategy	136.255	1	136.255	6.588	.012
Gender	109.674	1	109.674	2.303	.245
Strategy * Gender	29.204	1	29.204	1.412	.238
Error	1551.229	75	20.683		
Total	72886.000	80			
Corrected Total	2556.200	79			

a. R Squared = .393 (Adjusted R Squared = .361)

The main effects of the method (CRA-Sequence and Conventional) on the students' achievement in mathematics were shown by the results in Table 3. The results of the data were significant ($F(1, 75) = 6.588$ and $p < 0.05$). This suggests that the post-mean achievement scores of the students who are exposed to the two levels of the instructional methodologies significantly differ from each another. Hence the null hypothesis that there is no significant difference in the achievement score of the students subjected to these strategies is therefore rejected. It was concluded that the achievement scores of the students exposed to the two levels of instructional strategies—the Concrete-Representational-Abstract (CRA) Sequence and Conventional method are significantly different from each another.

Hypothesis Two: There is no significant difference in the achievement score of the student in mathematics based on gender.

The main effects of gender on the achievement of the students in mathematics is showed in Table 3, which indicates that there is no statistically significant difference between students' gender and their achievement in mathematics ($F(1, 75) = 2.303$ and $p < 0.05$). This shows that there is no significant difference between the posttest mean achievement score of male and female students. As a result, the null hypothesis, which states that there is no significant difference between male and female students' achievement scores in mathematics is therefore accepted, and we draw the conclusion that there is no significant difference between male and female students' achievement scores in mathematics when CRA sequence is used.

Hypothesis Three: There is no significant interaction effects of the strategies and gender on students' achievement in mathematics.

The results of the two-way interaction between the strategies and the genders of the students are presented in Table 3, which shows no statistically significant interaction between the method and the gender on the students' achievement in mathematics ($F(2, 75) = 1.412$ and $p < 0.05$). According to this

finding, there is no significant differences between male and female students' posttest mean achievement in the two levels of strategies in mathematics. It is concluded that there are no significant interaction effects of the strategy and gender on students' achievement in mathematics when CRA sequence is used.

Discussion of findings

The result of this findings indicated that the students that participated in the Concrete-Representational-Abstract (CRA) Sequence outperformed the Conventional Group by a wide margin. This demonstrates the effectiveness of CRA in encouraging and supporting student achievement in mathematics. This finding is consistent with previous research (Maccini & Hughes, 2010; Maccini and Ruhl (2012); Tripathi (2018); Witzel *et al* (2013)) that the effects of the CRA instructional sequence resulted in mathematical gains in mathematics. Concrete-Representational-Abstract Problem-Solving made used of student-centered learning approaches where the students worked together in groups in a meaningful medium with little guidance from the teacher during the teaching and learning process. Additionally, during the teaching and learning process, students in the experimental groups collaborated to interpret mathematical concepts and synthesize these notions into new mathematical values. The strategy helped the learners comprehend mathematics conceptually and equipped them with the skills needed to solve mathematical problems. A student who has a deep comprehension of a concept is able to use the idea or concepts in question to handle new and unfamiliar situations (Gagnon & Maccini, 2016). This is in sharp contrast to the conventional teaching methods as observed, where the lessons were teacher-centered and the students learnt abstract mathematical concepts with no evidence of incorporation of group learning or the integration of meaningful authentic real-life problems.

The finding of the study indicates that there is no statistically significant difference between students' gender and their achievement in mathematics. This demonstrates that there is no statistically significant difference between the post-mean achievement scores of the male and female students who were exposed to the two levels of the teaching technique. The fact that both sexes perceive themselves as equal and capable of collaboration and competition in the classroom activities may not be unrelated to the equal performance of male and female students. Additionally, because both genders received the same instruction using the same methodology, they were able to achieve and reach the same levels of learning. The finding that there is no gender difference in students' achievement in mathematics consistent with Olagunju's (2001) finding that there is no main effect of achievement of boys and girls in mathematics. This finding is also in support of Abonyi and Umeh (2014) that achievement of learning is not affected by gender but by the degree of original learning, time at which achievement is measured. This non-significant difference is at variance with research by Adeleke (2017) who found that when male and female respondents were placed in the same group to learn mathematics using conceptual and procedural learning strategies, female students' achievement rates were higher.

Results of this study also showed that there is no significant interaction effect of strategy and gender on students' achievement in mathematics. This finding suggests that there is no significant difference between the student's posttest achievement in mathematics across the two levels of the treatments applied, regardless of the student's level of gender. This suggests that the teaching method—the Concrete-Representational-Abstract Sequence is appropriate for both teaching male and female students, and that gender has less to do with students' mathematics achievement than orientation does. This result is in line with the observation of Paden and Dereskiwsky (2017) in their study that achievement rate in mathematics is independent of student gender and the instructional modality adopted by teachers. This result supports Oghonna's (2010) finding that both genders will do better and equally well in mathematics with the use of an effective teaching strategy.

Conclusion and Recommendation

In this study, the effects of Concrete-Representational-Abstract Sequence on students' achievement in mathematics was investigated. The instructional strategy that was employed in this study emphasized the participation and active intellectual involvement of students. This learner-centered, activity-based strategy enhanced students' outcomes better than the Conventional Method. According to the results, the CRA-sequence technique improved students' performance in mathematics. It was then

recommended that the teachers should be discouraged from using teacher-centered instructional strategies but student-centered instructional strategies such as Concrete-Representational-Abstract and other methods that will aid high level of teaching and learning of mathematics. Also, Concrete-Representational-Abstract strategy should be incorporated into the learning and teaching of Mathematics in Secondary Schools.

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MATHEMATICS TEACHERS' PERCEPTION OF EFFECTIVENESS AND AWARENESS OF HEURISTICS STRATEGY IN TEACHING MATHEMATICS CONCEPTS IN KONTAGORA LOCAL GOVERNMENT

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Abstract
The paper examined the perception of mathematics teachers on the use of Heuristic Strategy in teaching mathematical concepts to ensure quality education in Kontagora Local Government Area of Niger State. The objective of the study is to find out the mathematics teachers' awareness of Heuristic Strategy, its usage and differences in the perception of mathematics teachers in the public and private schools, and the gender difference perception. The researcher employed the use of descriptive design to carry out the research. Mean and Standard Deviation were used to answer the research questions. The t-test was used to test the hypothesis. The result shows that the proper use of Heuristic Strategy gives room for effective teaching and good academic performance of students

Introduction

Mathematics has all through the years been an important subject both in the role it plays in our everyday activities and its usefulness in other sciences. Mathematics as a subject is applicable to all fields of human endeavors (Jimoh, 2019). The role of Mathematics in the achievement of scientific technological development of any nation cannot be overemphasized. Mathematics is a core subject in both primary and secondary schools in Nigeria because it forms the basic foundation of not only higher Mathematics but also for all sciences and technology. According to Ajayi et al., (2011), mathematics is the foundation and queen of all sciences and apart from being a science of quantities, structures, space, change and also academic discipline it is also the cornerstone in every field of education. It is well known that any laudable achievement in technological development will be hampered if the potential scientists, technologists and engineers are not fast with sound knowledge of mathematics, which is the back bone of technology. One of the objectives of secondary education under the National Policy on Education is to equip the students with the skills to live effectively in a modern age of science and technology. Jesutoki (2019) sees mathematics as a school subject that is taught solely for the purpose of developing the learners' habit of effective critical thinking, reflection on oneself, environmental/societal issues, competence in the basic skill and organizing one's experience for possible solution to problems.

Active learning in mathematics encompasses the use of different instructional strategies that promote student's engagement and active participation in constructing knowledge and understanding of a particular mathematics concept. This strategy may take the form of hands-on activities, problem-solving, task critical thinking.
Heuristic method is an approach for finding a solution to a problem. The term originates from the ancient Greek word "eurisko" meaning to 'find', 'search' or 'discover' (Ofori-kusi, 2017). It is about using a practical method that does not necessarily need to be perfect. Abonyi and Umeh (2014) observed heuristic in mathematics as a general way of solving problems and is particularly used to come to a solution that is hoped to be close to the best possible solution of a mathematical problem. This means that heuristic strategy does not solve problems but rather provides a way of looking at problems different ways to find new insight. Heuristics teaching method is one of the important teaching method that can be utilized in teaching and learning problem solving in mathematics. The use of heuristics strategy will be effective if it is well used by the teacher, practiced freely by the learners to solve mathematics problems (Fasasi, 2015).

Heuristic method has its strength and weakness, merits and demerits. The merits of heuristic strategy include:
It helps to achieve cognitive, effective and psychomotor objectives, meaning, it helps in the overall development of a child.

It helps to put students into a situation to learn by self-experience. It develops self-confidence and reliance in the learners.

It helps in developing a scientific attitude and creativity in the learners.

The teacher encourages the learners to explore the environment in search of the solution to the problems. By doing so, some new knowledge is discovered by them.

The teacher is always ready to provide individual guidance regarding the solution to the problem. Thus, the interaction between the teacher and the learners take place in a cooperative environment.

Although the strategy has its strength, some of its weakness includes;
Since it needs to be applied after critical thinking and excellent teaching methodology, it cannot be taught at primary level.

At higher school level, this methodology is applicable. But some of the students are below average and more likely cannot understand this. Thus, this method is frustrating to them.

Most students lack confidence and cannot ask directly to the teacher. However it becomes difficult to seek guidance for this method then, so they cannot understand it and fail.

It required highly qualified expert to be taught.

It is a long term method: thus it is challenging to cover the syllabus in time.

For beginners' learners of primary level, this methodology is not suitable: thus, it fails to satisfy the teaching-learning process.

Having identified the importance of mathematics in the development of a nation, the problem of students' poor performance in mathematics still remain noticeable. Heuristic strategy have being identified as a teaching strategy that can improve students' performance in mathematics. The study therefore will examine the effectiveness of the strategy on the teaching of mathematics concepts in secondary schools, the level of awareness and usage of heuristic strategy by mathematics teachers in Kontagora Local Government Area of Niger State.

Statement of the Problem.
Many researchers have identified different causes responsible for students' poor performance in mathematics at different levels, however teaching strategy/method is one important factor identified. Teaching methods has impact in the improvement of the performances of students in learning of mathematics concepts. Although, various methods/strategies are used in teaching mathematics concepts, the question remains whether the strategy have improved students understanding, comprehension and retaining mathematical concepts learned?

Therefore, this study tends to examine the mathematics teachers' perception in Kontagora Local Government Area of Niger State on the effectiveness and usage of Heuristic strategy.

Objectives of the Study.
The objectives of this study is to find out:
The perception of mathematics teachers at secondary school's level on the effectiveness and usage of heuristic strategy in teaching mathematics.
The extent of mathematics teachers' awareness on heuristic strategy.
The extent to which heuristic strategy is used by mathematics teachers in solving mathematical problems.
The differences in the perception of mathematics teachers based on gender on effectiveness of heuristic strategy.

The differences in the perception of mathematics teachers in public and private schools on heuristic strategy.

Research Questions.
The following research questions are raised for the study:

- What are the perceptions of mathematics teachers at secondary school level on the effectiveness of heuristic strategy in teaching mathematics?
- To what extent is mathematics teachers aware of heuristic strategy in the secondary schools?
- To what extent is heuristic strategy used by mathematics teachers in solving mathematical problems?
- What is the differences in the perception of mathematics teachers based on gender in effective use of Heuristic strategy?
- What is the difference in the perception of mathematics teachers on heuristic strategy in public and private schools?

Research Hypotheses
HO_1: There is no significant difference on the perception and awareness of male and female mathematics teachers in secondary

HO_2: There is no significant difference in the perception and usage of Heuristic strategy among mathematics teachers in private and public secondary schools.

HO_3: There is no significant difference in the perception and usage of Heuristic strategy between the experienced and highly experienced mathematics teachers.

Research Methodology
Research Design
The research design that was adopted in this study was descriptive survey.

Population of the Study
The target population of the study consists of all secondary school mathematics teachers in Kontagora Local Government Area of Niger State. The total population are 48 mathematics teachers which comprises 31 males and 17 females, twenty-three (23) of these teachers teaches in private schools while the rest twenty-five (25) teaches in public schools

Sample and Sampling Technique
The sample of the study consists of five (5) government secondary schools and five (5) private secondary schools were randomly selected from all the secondary schools in Kontagora Local Government Area of Niger State.

Instrument
The items of the questionnaire were divided into three (3) sections. Section A comprises personal data of the respondents in terms of sex, qualification, school of teaching, year of teaching experience. Section B contains twenty (20) structured statements covering mathematics teachers' perceptions on Heuristic strategy, its awareness, its usage and importance to problem solving in mathematics.

Result Presentation
Table 1: Demographic Data of Respondents (N=24)

Variables	**Frequency**	**Percentage (%)**
Gender		
Male	17	70..8
Female	5	20.8
Total	**24**	**100**
Teaching School	12	50
Public School	12	50

Private School	**24**	**100**
Total		
Highest Qualification		
NCE	3	12.5
B.Sc/B.Sc(ed)	16	66.6
Masters' degree	4	16.6
Ph.D		
Total	**24**	**100**

Source: Author's Field Survey, 2023.

Table 2: Mean rating of Mathematics Teachers regarding Heuristic Strategy in Teaching Mathematics Concepts in Kontagora Local Government Area of Niger state.

S/N	ITEMS DESCRIPTION	SD	$\bar{x}$	Decision
1	Heuristic strategy is a familiar method of teaching to me	0.685	3.12	Accepted
2	Heuristic strategy is a very effective strategy in teaching	0.658	3.33	Accepted
3	Heuristic strategy is a discovery strategy	0.652	3.48	Accepted
4	Heuristic strategy is a demonstration strategy	0.676	3.00	Accepted
5	Heuristic strategy is widely used by most mathematics teachers in teaching.	1.024	2.33	Rejected
6	I use always Heuristic strategy in teaching mathematics concepts.	1.093	2.57	Accepted
7	All mathematics teachers use heuristic strategy in teaching.	0.800	2.46	Rejected
8	All mathematics teachers use heuristic strategy in teaching.	0.995	2.33	Rejected
9	Mathematics concepts cannot be effectively taught without heuristic strategy	0.973	2.75	Accepted
10	I don't have any knowledge of Heuristics strategy	0.945	1.95	Rejected
11	Heuristics strategy is not appropriate for teaching in secondary schools.	0.976	2.00	Rejected
12	I use heuristics strategy when teaching abstract concepts only.	0.865	2.57	Accepted
13	I prefer heuristics strategy to other teaching methods	1.189	2.65	Accepted
14	Heuristics strategy should not be adopted for teaching at any level of teaching	1.865	1.73	Rejected
15	Heuristics strategy is too expensive for a low paid teacher to adopt for teaching.	1.165	2.86	Accepted
16	Heuristics strategy can only be adopted for use in public school because it will be fund by the government.	1.049	2.35	Rejected
17	Heuristics strategy can only be adopted for use in private schools because they want to maintain standard	1.077	2.26	Rejected
18	Heuristic strategy is not female gender friendly.	1.360	2.35	Rejected
19	Only highly experienced teachers can use heuristic strategy.	0.950	2.91	Accepted
20	Heuristic strategy is more of teacher centred	1.140	2.74	Accepted
21	Heuristic strategy make most students unserious	0.899	2.04	Rejected
Total Mean Weight Average/Cluster Mean		**1.002**	**2.56**	**Accepted**

Source: Author's field survey, 2023

Research Question One (1): What are the perceptions of mathematics teachers at secondary school level on the effectiveness of heuristic strategy in teaching Mathematics?

Table 3: Mean rating of Mathematics Teachers' Perception on the Effectiveness of Heuristic Strategy in Teaching Mathematics in Kontagora Local Government Area of Niger state.

S/N	ITEMS DESCRIPTION	SD	$\bar{x}$	Decision
2	Heuristic strategy is a very effective strategy in teaching	0.658	3.33	Accepted
3	Heuristic strategy is a discovery strategy	0.676	3.48	Accepted
4	Heuristic strategy is a demonstration strategy	1.024	3.00	Accepted
9	Mathematics concepts cannot be effectively taught without heuristic strategy	0.973	2.75	Accepted

11	Heuristics strategy is not appropriate for teaching in secondary schools.	0.976	2.00	Rejected
13	I prefer heuristics strategy to other teaching methods	1.189	2.65	Accepted
14	Heuristics strategy should not be adopted for teaching at any level of teaching	0.865	1.73	Rejected
15	Heuristics strategy is too expensive for a low paid teacher to adopt for teaching.	1.165	2.86	Accepted
16	Heuristics strategy can only be adopted for use in public school because it will be fund by the government.	1.049	2.35	Rejected
17	Heuristics strategy can only be adopted for use in private schools because they want to maintain standard	1.077	2.26	Rejected
18	Heuristic strategy is not female gender friendly.	1.136	2.35	Rejected
19	Only highly experienced teachers can use heuristic strategy.	0.950	2.91	Accepted
20	Heuristic strategy is more of teacher centred	1.140	2.74	Accepted
21	Heuristic strategy make most students unserious	0.899	2.04	Rejected
Total Mean Weight Average/Cluster Mean		**0.984**	**2.60**	**Accepted**

Source: Author's field survey, 2023

Data presented in table 3 above showed that the mean rating for items 2, 3, 4, 9, 11, 13, 14, 15, 16, 17, 18, 19, 20 and 21 are 3.33, 3.48, 3.00, 2.75, 2.00, 2.65, 1.73, 2.86, 2.35, 2.26, 2.35, 2.91, 2.74 and 2.04 respectively. The results of the analysis showed that items 2, 3, 4, 9, 13, 15, 19 and 20 were rated above the cut-off point of 2.5 and thus accepted while items 11, 14, 17, 18 and 21 were rated below it and rejected. Moreover, the cluster mean of 2.60 was found to be above the cut-off point of 2.5. This implies that the respondents (Mathematics Teachers) are affirmative to the Effectiveness of Heuristic Strategy in the Teaching of Mathematics Concepts in Kontagora Local Government area of Niger state.

Research Question 2: To what extent is mathematics teachers aware of heuristic strategy in the secondary schools?

Table 4: Mean rating of Mathematics Teachers' Awareness of Heuristic Strategy in Teaching Mathematics Secondary Schools of Kontagora Local Government Area of Niger state.

S/N	ITEMS DESCRIPTION	SD	$\bar{x}$	Decision
1	Heuristic strategy is a familiar method of teaching to me	0.685	3.12	Accepted
2	Heuristic strategy is a very effective strategy in teaching	0.658	3.33	Accepted
3	Heuristic strategy is a discovery strategy	0.676	3.48	Accepted
4	Heuristic strategy is a demonstration strategy	1.024	3.00	Accepted
9	Mathematics concepts cannot be effectively taught without heuristic strategy	0.973	2.75	Accepted
10	I don't have any knowledge of Heuristics strategy	0.945	1.95	Rejected
Total Mean Weight Average/Cluster Mean		**0.827**	**2.93**	**Accepted**

Source: Author's field survey, 2023**.**

Data presented in table 4 above showed that the mean rating for items 1, 2, 3, 4, 7, 9 and 10 are 3.12, 3.33, 3.48, 3.00, 2.46, 275 and 1.95 respectively. The results of the analysis showed that items 1, 2, 3, 4 and 9 were rated above the cut-off point of 2.5 and thus accepted while item 10 was rated below it and rejected. Moreover, the cluster mean of 2.93 was found to be above the cut-off point of 2.5. This implies that the respondents (Mathematics Teachers) were affirmative to the Awareness of Heuristic Strategy in the Teaching of Mathematics Concepts in Kontagora Local Government area of Niger state.

Research Question 3: To what extent is Heuristic strategy used by mathematics teachers in solving mathematical problems?

Table 5: Mean rating of Heuristic strategy's usage among Mathematics Teachers in solving mathematical problems.

S/N	Items description	SD	$\bar{x}$	Decision
5	Heuristic strategy is widely used by most mathematics teachers in teaching.	1.093	2.33	Rejected
6	I use always Heuristic strategy in teaching mathematics concepts.	0.978	2.57	Accepted
7	All mathematics teachers use heuristic strategy in teaching.	0.800	2.46	Rejected
8	All mathematics teachers use heuristic strategy in teaching.	0.995	2.33	Rejected
13	I prefer heuristics strategy to other teaching methods	1.189	2.65	Accepted
Total Mean Weight Average/Cluster Mean			**2.47**	**Accepted**

Source: Author's field survey, 2023**.**

Data presented in table 5 above showed that the mean rating for items 5, 6, 7, 8 and 13 are 2.33, 2.57, 2.46, 2.33 and 2.65 respectively. The results of the analysis showed that items 6 and 13 were rated above the cut-off point of 2.5 and thus accepted while items 5, 7, and 8 were rated below it and rejected. Moreover, the cluster mean of 2.47 was found to be below the cut-off point of 2.5. This implies that the respondents (Mathematics Teachers) were not affirmative to the usage of Heuristic Strategy in solving mathematical problems.

Hypotheses Testing

HO_1: There is no significant difference on the perception and awareness of Male and Female Mathematics Teachers in Senior Secondary Schools.

Table 6: t-test mean analysis of perception and awareness of Male and Female Senior Secondary School Mathematics Teachers.

Gender	N	Mean	Sd	Df	t-cal	t-crit	Decision
Male	17	2.55	0.89	22	0.6365	2.069	NS
Female	5	2.72	1.05				

Table 6, revealed that t-calculated is less than t-critical. This implies that the Null Hypothesis I (H_{O1}) at P<0.05 that stated there is no significant difference on the perception and awareness of Male and Female Mathematics Teachers in Senior Secondary Schools was accepted. However, the mean perception of female mathematics teachers of 2.72 was found to be greater than the male mean perception of 2.55.

HO_2: There is no significant difference in the perception and usage of Heuristic Strategy among Mathematics Teachers in Private and Public Senior Secondary Schools.

Table 7: t-test mean analysis of perception and usage of Heuristic Strategy among Mathematics Teachers in Private and Public Senior Secondary Schools.

Variable	N	Mean	SD	Df	t-cal	t-crit	Decision
Public School Teachers	10	2.501	1.0269	23	0.2521	2.064	NS
Private School Teachers	14	2.604	0.9281				

In table 7, t-calculated of 0.2521 is less than t-critical of 2.064. Since t-cal > t-crit. Hence, Hypothesis II (H_{O2}) that states no significant difference in the perception and usage of Heuristic Strategy among mathematics teachers in private and public senior secondary schools was accepted. However, the mean perception of private school mathematics teachers of 2.604 was found to be greater than the mean of mathematics teachers in public schools' perception of 2.501.

Discussion of Findings

From the results obtained in prior sub-headings, the respondents being teachers and majorly males (17) in number; while females were (5), the majority (16) were BSc holders. For the research question one

(1) which state thus: "what are the perceptions of mathematics teachers at secondary school level on the effectiveness of Heuristic strategy in teaching mathematics'? it was discovered that the respondents were affirmative in their perception towards the effectiveness of Heuristic strategy in Teaching Mathematics in Kontagora local government area of Niger state. This result is in agreement with the finding of Zhao (2012) who emphasized that Heuristic strategy/method of teaching yields a desirable outcome in the rate of knowledge acquired by students.

More so, as regards to the research question two (2) which states thus: "to what extent is Mathematics Teachers aware of Heuristic strategy in secondary schools'? the results obtained in table 4 above, it was discovered Mathematics Teachers are adequately aware of Heuristic strategy while teaching in their respective secondary schools. Furthermore, the research question three (3) which states that: "to what extent is Heuristic strategy used by Mathematics Teachers in solving mathematical problems?" got it's answer from the fact obtained as presented in table 5 above, where it was observed that Mathematics Teachers were not affirmative to the usage of Heuristic strategy in solving mathematical problems in secondary schools. This finding is in line with the postulation of Gauhar, *et. al.* (2019) who buttressed that there is a rising usage of Heuristic strategy in the teaching and learning process across borders.

In addition to the aforementioned, the research hypothesis 1 (H_{O1}) which states that: there is no significant difference on the perception and awareness of Male and Female Mathematics teachers in Senior Secondary School was accepted based on the results obtained in table 6. This result tallied with findings of Lawspet (2008) who revealed that teachers (both male and female) are adequately aware of Heuristic strategy and its importance to effective teaching and learning in various institutions.

Furthermore, the research hypothesis 2 (H_{O2}) which states that: there is no significant difference on the perception and usage of Heuristic strategy among Mathematics Teachers in Private and Public Senior Secondary Schools was accepted based on the results obtained in table 7. This result tallied with findings of Gauhar, *et. al.* (2019) who revealed that Heuristic strategy is used by teachers in both private and public-established schools of learning (without boundary).

Conclusion

From the findings of the study, it is possible to make the followings conclusions

- There are affirmative effectiveness and awareness of heuristic strategy in teachings of mathematics concepts
- There were no affirmative to the wage of heuristic strategy in solving mathematical problems
- There is no significant different in the perception of heuristic strategy mathematics the male and female mathematics teachers and those in public and privates' schools

Recommendation

Based on the findings of the study and their educational implications, the followings recommendations were made

- Trainings programs. seminar and workshop should be organized for mathematics teachers on the awareness and usage heuristic strategy
- Mathematics teacher teaching in secondary schools should be committed to the use of heuristic strategy to help the students make discoveries that will enhance their proper knowledge of mathematics concepts and formula
- School owners/ management should be enabling environment for the use of heuristic strategy in teaching mathematics concepts.

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QUALITY EDUCATION FOR SUSTAINABLE DEVELOPMENT

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Abstract
Education is the key to the development of any nation. The social welfare and economic empowerment are paramount important in national development goals of any nation and the level of Sustainable Development (SD) of any nation is directly link the quality of education learned and applied by the citizenry. The purpose of this paper is to examine the involvement of QE in promoting SD. The paper considers the concept of education and QE as a tool for achieving SD in Nigeria. It talks about SD as it relates to QE. Lastly the paper looks at the relationship between QE and SD. In conclusion, the paper observed that to make education a tool for SD in Nigeria, content, teacher education, and curriculum materials should be given special attention. Consequently, the paper recommended that, adequate training and motivation of teachers, connecting knowledge gained in school to everyday life and provision of adequate and infrastructural facilities will help improve the quality of education which promotes and sustains the nation's development.

Keywords: Education, Sustainability, Development, Nigeria

Introduction

In the world today, education impacts in-depth knowledge and understanding so as to advance the members of the society to new frontiers of knowledge in different walks of life. Education is a fundamental human right and very vital to the development of an individual and the nation at large. It lies in at the heart of promoting behavioral change in man, and has been identified as an instrument for socio-economic, cultural, political development and transformation. The economic transformation requires substantial re-organization of the economy, adoption of new technologies and promoting sustainable patterns of consumption and production, protecting efficient management of human and material resources (Enrico & Lngeborg, 2015).

Hornby, (2012) define education as a social science, teaching and learning that encompass specific knowledge, beliefs and skills. Education efforts are deliberately selected to impact and help people with the objective of enhancing knowledge, physical and morals that can gradually deliver the people to live happily and all that will be beneficial to the people and the society at large (Herman, 2013).

Education is a deliberately planned process through which an individual is helped to attain the development of his potentialities. Through education, an individual acquires the necessary knowledge and skills needed for lifelong sustainability and development of the society or nation. Maclean (2008) pointed out that, although there are many methods of development such as improved infrastructure as dams, roads, telecommunication facilities, ports and the likes, education is regarded as the gate to development.

Education in Nigeria should be geared towards the development of individuals for the achievement of SD and global competitiveness. Ensuring Quality Education (QE) will lead to achieving sustainable national development. The key to energizing education system throughout the country should be a consensus on content standards for the teaching and learning process (Kumar, 2000).

Concept of Quality Education

Quality is the process, product or service or its performance in customers or client perception of that performance. Quality involves reduction of wasted and improvement of productivity and efficiency in achieving its objectives. In the same vein, Ajayi and Adegbesan (2007) pointed out that Quality Education (QE) is related to accountability which is concerned with maximizing the effectiveness and efficiency of educational system and services in relation to their contexts, missions and stated objectives. Ibukun (2004) affirmed that the quality of human resources informs of teachers often

dictates the extent of the effectiveness of educational programs. No society can develop beyond its educational system. It isthe product of education that transforms the society. The quality of education will therefore determine the quality of manpower and the products.

The term QE has been linked to three major indices which are the acquisition of measurable knowledge, skills and attitudes among learners. Some other indices of QE include adequate and proper equipment and staffing, sufficient staff quarters and classroom in schools, conducive and appropriate teaching and learning environment,effective quality control, proper funding, good quality andwell-motivated staff that are truly committed. Yang (2017) argues that the vital roles played by QE are to arouse learner's inner capabilities, provide full play to learners' initiative spirits and promote learners' personalities.

UNESCO (2005) defined QEin terms of his ability to deliver satisfactory human fulfilmentand to prepare learners to master their educational challenges and contribute to social progress and social change, Mosha (2000) on his part described QE as a degree of goodness or excellence. Similarly, Lomas (2002) regards it as a degree of fitness to what the educational beneficiary desires.

Quality refers to thing that differentiates something from others; it is also the degree of goodness of a thing. Quality is the freedom from deficiencies, freedom fromerrors that requires doing work over again (Amed, 2011). The concept of quality in academic according to Akinbobola (2014) is the quality of educational input and output in its entirety. Quality is considered as base line standard in education which can be measured on a scale of preference, standard, accepted principles, rules, guidelines or levels established by group of people, organizations or society. Quality is defined as the degree of good or value of characteristics of how good or bad things are.

Quality Education will give room for result research that can propel technological innovation. QE produces learners who are healthy and well- nourished and ready to participate and contribute meaningfully to the economic growth of nations (UNICEF, 2000). In Nigeria, it is observed that the quality of education hasbeen dwindling especially in the last decade for instance most of the graduates that are turned out in our various institutions of learning do not have in-depth knowledge of their courses of study. The quality of education in Nigeria can be improved by ensuring that education curriculumis more evolving to equip graduates with knowledge and skills needed in their field of study.

Quality Education gives students with Knowledge they need to become economically productive, develop sustainable livelihoods, contribute to peaceful anddemocratic societies and improve individual well-being. In the 21st century, QE is determined by effective teaching which is generally and widely known as teaching that is student centered. Hence, good and competent teachers are oftenperceived as those who know how to stimulate the interest of their learners, how to deliver concepts and how to assist learners overcome challenges in their learning (Ojokheta, 2019). The role plays by QE vital to national development, therefore QE is the foundation for everycommunity, for QE to be attained in educational institutions in Nigeria, the principal actors of learning who arethe teachers must be adequate in quality and quantity, the learners must be well trained and facilities must be provided as well, however QE is the right of every citizen.

Concept of Sustainable Development

Historically speaking, Sustainable Development (SD) is an electric concept as a wide array of views fall under its umbrella. SD is wide concept to define because it continues to change. Brundtland commission, (1987) stated that SD try to investigate and emphasize the development of thepresent without compromising the future of the upcoming generations. In 2011, Brundtl and Commission defined SD as the development that meets the requirements of the present without compromising the ability of future generations to meet their own requirements. Sustainable national development can be seen as a process of improving the range of opportunities that will enable people to achieve their aspirations and full potential over aperiod of time while maintaining the resilience of economic, social and environmental systems. Basically it involves a knowledge base which revolves round three basic concepts which are the economy, the environment, and the society. The members of a society are financially empowered and responsible to not damage the environment so that our children's future is not compromised (McKeown, 2002).

While many nations around the world have embraced the need for education to achieve sustainability, a lack of vision and awareness has impeded progress in Nigeria, which can be partially attributed to lack of planning, proper supervision and implementation of well-designed policies. By addressing these critical issues, the Nigerian government can prevent or reduce delays or derailment of SD projects and ultimately attain sustainability. To achieve this in Nigeria, the relevant focal points for SD must be identified and addressed. What are the key issues that needaddressed in order to steer the country towards SD?

However, in our country today, SD is very sacrosanct for us to have a good and stable economy. Education for SD allows individual to acquire the knowledge, skills, attitudes and values necessary to shape as us tenable future. For example, climate change, poverty reduction, disaster risk reduction, biodiversity etc. In other words, it means a better quality of life for everyone, now and for generations to come.

Sustainable Development is a pattern of economic growth in which resources used aim to meet human needs while preserving the environment so that these requirements can be provided not only in the present but also for future generations. Specifically, Ahuja (2012) stresses that economic development is expressed in the following parameters;

3.0 Increase in improvement in human capital
3.1 Increase in food supply and agricultural output
3.2 Increase in income.

Achieving SD depends on the initiative, resourcefulness, creativity and discipline of human beings who are managers of developmental programs. However, Michael (2012), referred to SD as, the ability to meet the needs of the present while contributing to the future generation needs. Hence sustainability is a process which tells of development of all aspects of human life affecting substance. Education for SD consequently promotes competencies such as critical thinking, imaging futures scenario and making decision in a collaborative way.

Quality Education for Sustainable Development

The concept of SD emerged as a result of the impacts of human beings on environment. It overlaps three pillars which are economy, society and the environment. Governments and non-governmental organizations are concerned with the way's society can meet their needs without compromising future generations. QE is the foundation of every development in society. SD is the aspect of engaging in SD activities while sustaining natural resources and services where society depends for survival. According to United Nations, the fourth SD goal is QE (United Nations, 2018). Access to QE contributes to developing innovation skills to utilize domestic resources for sustainable growth. However, this can be achieved by integrating SD education in higher learning institutions to equip students with required training and skills to improve the living standards of people in their nations.

The Roles of Quality Education in Enhancing Sustainable Development

Quality Education is an important aspect any society since it contributes to SD. It provides income for the people; thereby, enhancing economic development. Poverty is a major factor affecting economic development since people cannot contribute significantly to the economy (United Nations, 2018). Lack of QE in poor nations according to United Nations can lead to transmission of poverty from one generation to another. For instance, people in growing economies does not possess basic skills to apply natural sustainably to enhance their GPD without compromising needs of the future generations (United Nations, 2018). Therefore, QE reduces poverty levels by providing nations with necessary skills such as Agriculture to improve food production to meet the requirements of the growing population. Hence, QE contributes in a major way to enhancing economic condition of poor nations. Economies will be wealthy when governments empower people to us their talents for economic growth and sustenance of human requirements. In the same vein, QE reduces poverty, contributing to SD by reducing unemployment levels. Presently, 91% of children in developing nations have access to basic education. But, the level of unemployment is increasing. For instance, in 2015, international unemployment level was 12.9% and grew to 13.2% in 2017 (United

Nations, 2018). QE plays a vital function in managing unemployment by providing youth with basic technical skills to enable them become self-employed. But, this may not come to reality if SD does not incorporate learning programs into education curriculum. The goal or aim is to change the mind-set of learners that they should provide jobs and not always looking for job. The changes will enhance their participations to SD by alleviating unemployment levels in their nations.

Employment can reduce poverty because people will have other sources of economy without exploiting their surroundings thereby reducing dependency ratios. Poor nations exploit surrounding natural resources for short-term benefits, and this has long-term influence on the future generations. Therefore, QE contributes to SD by providing people with skill to engage in economic growth activities like new agriculture, and recycling of resources; thereby, contributing to growth sustainability. Enhancing provision of QE contributes to SD by re-orienting education in society and transforming their environmental perceptions so that they engage in behaviours required for environmental sustainability. The education curriculum should focus on educating people about the impact of environmental pollution by introducing biodiversity in the higher learning system (United Nations, 2018). Education can be of high quality if it provides students with behaviours that will enable them to play a major role in preserving the environment (Ferguson et al., 2018). Therefore, QE changes the behaviors of people in community. For instance, they obtain knowledge on the significant of preserving forests, and modern farming techniques.

In many nations, unsustainable practices are taking place due to lack of adequate education and awareness. For instance, citizens use non-renewable sources of energy since they lack knowledge on other energy sources that can be used as substitute (Thoresen, et al., 2015). Through QE, learners gain knowledge and skills on the other sources that can be used as substitute of energy that have a long-term impact. Sustainable activities must take into consideration the use of renewable sources of energy to sustain the environment and development activities in the future without exploiting energy sources as well as compromising generations to come.

There is also a need for modern education that will integrate activities innovation to use societal resources without exploitation. For instance, it should introduce faring techniques that applies technology so that people understand how to use scarce resources such as land to produce enough food to sustain the increasing population without compromising future requirements (World Economic Forum, 2015). The population is increasing, but land and other natural resources are scarce; therefore, the need to train learners becomes innovative. Thus, QE can have used to fight social challenges like hunger, especially in poor nations.

Innovation can also be used to improve health welfare of the society by reducing the number of death resulted from diseases like tuberculosis and HIV The QE will provides learners with health behaviors that would help them fight infections (Lotz-Sisitka et al., 2016). Deaths resulted from these infections can lead to an increase in the number of dependents that the developing nations cannot not cater for. Thus, QE contributes to social sustainability by reducing communicable diseases in society, and this improves social status of many households.

The system of education should be able to incorporate technical skills that will assist students to good employees and employers and becoming responsible employees (Ofei-Manu 2014). Thus, QE supports innovation and initiatives in different countries, contributing to SD. It is the role of governments in developing nations to ensure development of an integrative and innovative education system that would grow talents and skills in learners so that they become creative sustaining their activities.

Conclusion

Education is vital for national socio-economic growth and development, empowers the nation's active workforce with knowledge and skills acquisition which leads to many employment opportunities for the youths. The basis of any productive economy is employment which leads to productive engagement of the country's citizens. Since QE is a tool for SD, the following aspects should be given special attention, content and methods of teaching science, teacher education and curriculum materials.

The implementation of the needed curriculum should result in rapid economic development, poverty reduction, growth in productivity, clean and healthier environment. If all the necessary approaches are provided by the stakeholders, Nigeria will in no distant future attain its sustainable national development which is key to reduction of some major problems such as chronic unemployment, poverty and insecurity, be deviling the well-being of the citizenry.

The actual picture and issues that exist currently in our various educational institutions reveal that quality improvement is vital for tackle the basic problems and development in educational institutions. QE should begin with the teachers by encouraging the learners to have passion for education. Sustainable national development can be attained through functional educational programs and adequate attention should also be given to education at all levels by the government.

Suggestions

For sustainable National development to be attained through QE the following suggestions are made.

i. There should be setting of quality assurance units in all our institutions to ensure QE.
ii. Regular inspection should be carried out in terms of maintenance of equipment and other educational programs for flaws or breakdown.
iii. Innovative teaching method can be adopted inadditions to the conventional method
iv. Well established Laboratory facilities should be provided to encourage skill acquisition
v. Government should provide adequate fund for the training and retraining of teachers.
vi. Government should provide good welfare for teachers – this will serve as encouragement to them.

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SCIENCE STUDENTS' MOTIVATION AND ATTITUDE AS PREDICTORS OF THEIR ACADEMIC ACHIEVEMENT IN MALUMFASHI LOCAL GOVERNMENT, KATSINA STATE, NIGERIA

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Abstract
This study investigated whether or not students' motivation and attitude towards science can serve as predictors of their academic achievement. Two research questions and two hypotheses were raised and tested at 0.05 levels of significance. The study adopted correlational survey design. The population of the study consisted of one thousand and ninety-nine (1,099) SSII science students from which a total of two hundred and eighty-five (285) students were sampled using simple random sampling technique. A fifty (50) items multiple-choice "Science Achievement Test" (SAT), a 20 items "Science Students Attitude Scale Questionnaire" (SSASQ) and a 30 items "Science Students Motivation Questionnaire" (SSMQ) were used for data collection. The SAT, SSASQ and SSMQ were validated by specialist in science education and psychology. The reliability of SAT was established using Spearman Brown formula and yielded reliability index of 0.858 and the reliability of SSASQ and SSMQ were established using Cronbach' Alpha and yielded reliability index of 0.83 and 0.88 respectively. The collected data was analyzed using SPSS Version 26 using Scattered Plot and Linear Regression Analysis. The findings of the study revealed that motivation and attitude of the students had significant positive relationship with their academic achievement in science. The researchers therefore concluded that motivation and attitude are major predictors of students' academic achievement in science and therefore recommended that science teachers should use instructional strategies that will motivate and bring positive attitude of learners during science subject's instruction to enhance students' achievement.

Keywords: Motivation, Attitude, Academic Achievement and Science Students

Background to the Study

The world has become a global village as a result of innovation due to science and technology. So to say, science is a verified body of knowledge which is arranged in an orderly manner. Science comprises the basic discipline such as physics, chemistry, biology and Mathematics. In addition, National Academy of Science (2008) view science as the use of evidence to construct testable explanation and prediction of natural phenomena, as well as knowledge generated through this process. Science is an integral part of everyone's life. It is a systematic investigation of nature with a view to understanding and harnessing to serve human needs.

Science education can be defined as the study of physics, chemistry, biology and Mathematics with teaching method in order to impart scientific knowledge to individuals or community. It is a field of specialization concerning with two basic aims, which are the production of scientifically interactive society and technological manpower. Science education in the area of academic and industrial activity is the backbone of industrialization and development of any nation. The science related disciplines that will enable the learner to have true knowledge of science and to be able to use it in solving problem are Physics, Chemistry, Biology and Mathematics. Science education are school subject that play an important role in life, they are important because they are the basic subject for the development of many study fields such as mechanical engineering, electronics, nuclear sciences, medicine and surgery, medical laboratory sciences, pharmacy and digital information system. Science education presents various problems, from the simplest to the complex ones, as well as from the macro to the micro ones. Science education contributes to the technological infrastructure and provides trained personnel needed to take advantage of scientific advances and discoveries (Saifullahi, 2021). It plays a major role in the area of health, economic development, energy and environment. It generates fundamental knowledge needed for future technological advances that will continue to drive the economic engine of the world.

Motivation is an internal drive that spurs one into action (Tus, 2020). It is an important psychological construct that drives a person action. Motivation is a strong desire or passion in a person that encourages the person to try and do something in order to succeed. Motivation affects student learning and plays an important role in directing behavior towards a certain goal, increasing the effort and energy towards a goal, increasing the initiative and perseverance of an activity, and improves individual performance. Teaching science in a fun and effective manner will increase students' motivation to learn science (Dan'inna & Bagiwa, 2020),). They believe that, if teachers give suitable feedback to the students on their level, initiate students' interest, makes them understand the importance of the content, and have students share their idea in classroom discussion, then the student's motivation increases as well as their achievement. Student effort toward academic achievement is controlled by motivational factors such as interest, competence and autonomy.

Academic achievement is a measure of what a person has accomplished after exposure to an educational program. It is a means of accomplishment or proficiency of performance in a given skills or body of knowledge. Students' academic achievement corresponds to their performance in school subjects as symbolized by a score on achievement test. It is commonly measured by means of examination or continuous assessments, it represents the level of success of the teaching and learning process, it indicates the extent to which the established goal has been achieved, it also provides feedback to the teacher and student. Academic achievement of students in secondary schools has been a subject of concern by many people including parents, administrators, educators, psychologists and counselors. According to Saifullahi, (2021) student's academic achievement depends on teaching method and learning environment. Using good teaching strategy by the teachers will make students have higher understanding, gain reasonable academic achievement and positive attitude.

Students' attitudes towards learning science play an important role in the teaching and learning process of science subjects. In fact, it affects their achievement in the subject to the extent that their success or failure in physics, chemistry, biology and mathematics depends on their attitudes towards the subject. Attitudes also influence the learner' rate of participation in the class during lessons, and it was found that positive attitudes towards mathematics lead students towards success in mathematics achievement (Dan'inna, 2016). Healthy attitude towards science on the part of students may result from the teacher' attitudes toward the subjects, if the (science) teachers dislike science subjects they would transmit these feelings to the students. As a result of this, no matter what amount of effort, the students are not likely to make or develop interest in it.

West African Examination Council (WAEC, 2015-2019) has shown that students' academic achievement in physics, chemistry, biology and mathematics is very poor. This consistent poor performance of students in physics, chemistry and mathematics at Senior Secondary School Certificate Examination leaves one in doubt about the effectiveness of teaching methods popularly used by teachers for teaching the subjects. Some researchers have discouraged the use of traditional method of teaching which leads to memorization of fact and concept and there is need to find out the effectiveness of other teaching strategies relative to the traditional (Mankilik & Ofodile, 2015).

Objectives of the Study

The specific objectives of the study are set to:

i. Determine whether there is significant relationship between science student's motivation and their academic achievement in Malumfashi Local Government, Katsina State, Nigeria.
ii. Find out whether there is significant relationship between science student's attitude and their academic achievement in Malumfashi Local Government, Katsina State, Nigeria.

Research Questions

In line with the objectives of the study, the following research questions were raised to guide the study:

i. What is the relationship between science student's motivation and their academic achievement in Malumfashi Local Government, Katsina State, Nigeria?
ii. What is the relationship between science student's attitude and their academic achievement in Malumfashi Local Government, Katsina State, Nigeria?

Research Hypotheses

Based on the stated research questions, the following null hypotheses were formulated and tested at 5%level of significance to guide this study:

H_{01} There is no significant relationship between science student's motivation and their academic achievement in Malumfashi Local Government, Katsina State, Nigeria?

H_{01} There is no significant relationship between science student's attitude and their academic achievement in Malumfashi Local Government, Katsina State, Nigeria?

Theoretical Framework

The theories that underpinned this study are Maslow's Pyramid Hierarchy of Need (1954) and Walberg Theory of Academic Achievement (1981). Psychologist Abraham Maslow (1954) first introduced the concept of hierarchy of needs in a paper titled "A Theory of Human Motivation" This hierarchy suggests that people are motivated to fulfill basic needs before moving on to other needs. Maslow's hierarchy of needs is most often displayed as a pyramid, with lowest levels of the pyramid made up of the most basic needs and more complex needs are at the top of the pyramid. Needs at the bottom of the pyramid are basic physical requirements including the need for food, water, sleep and warmth. Once these lower-level needs have been met, people can move on to the next level of needs, which are for safety and security. As people progress up the pyramid, needs become increasingly psychological and social. Soon, the need for love, friendship and intimacy become important. Further up the pyramid, the need for personal esteem and feelings of accomplishment become important. Hence, Maslow emphasized the importance of self-actualization, which is a process of growing and developing as a person to achieve individual potential.

The hierarchy of needs theory is relevant to this study as the theory is applicable to teaching and learning as well as students' performance. The theory is able to suggest how teachers can lead their students to become self-actualized. The idea implies the dual role of the theory first to teachers and second to administrators on the basis that both the teachers and the administrators must decide on the performance of their students. The cultural framework of the teachers should reflect the fact that students' physiological and security needs are paramount; therefore, when such needs became culturally focused, students' performance will be improved tremendously in that school (Maslow, 1954). This argument implies a reversed effect that if the need is not culturally focused on, the performance standard of students will not be met.

The second theory which underpinned this study is Walberg theory of academic achievement. This theory is also called Walberg theory of educational productivity. Walberg (1981) identified nine factors which affect the learner's cognitive, as well as affective outcomes. These nine factors include: Learner ability, age, motivation, quantity of instruction, quality of the instructional experience, the home environment, the classroom or school environment, the peer group environment, the mass media. The first three variables in Walberg's model (ability, age, and motivation) can each be seen as internal traits to the learners' or student talent. Ability includes factors that can be measured by the usual standardized test. To Walberg, the age includes chronological age, development and stage of maturation. In his research, Walberg has attempted to keep the age variable as a constant. Motivation or self-concept, in the Walberg model, is practically measured as scores on personality tests of the student's willingness to persist steadfastly on learning tasks. The relevance of Walberg theory of academic achievement as a guide in this study is that it identified important variable that could influence student's academic achievement. These variables include: age, learners' ability, peer group, mass media, quantity and quantity of instruction, classroom environment, and motivation.

Methodology

This research adopted a correlational survey research design. This type of research design seeks to establish what relationships exist between two or more variables. Also, this type of research indicates the direction, magnitude and strength of the relationships between the variables (Creswell 2014). The population of the study comprises all senior secondary school science students in all (18) public senior secondary school in Malumfashi Local Government, Katsina State. The target population for this study

consisted of all senior secondary school three (SSIII) science students in public co-educational school with a total number of one thousand and ninety-nine (1099) students. Simple random sampling technique was used to select two hundred and eighty-five (285) senior secondary school three (SSIII) science students from the eighteen schools in the study area.

Science Achievement Test (SAT) was used as an instrument for data collection in this study. It was developed by the researcher; it consisted of forty (50) multiple-choice items with option ranging from A-D from which students are expected to choose the correct responses. The items of the instrument were adapted from the Physics, Chemistry, Biology and Mathematics senior secondary school certificate examination (SSCE) past question (WAEC & NECO, 1998-2020). The adaption of the items of the instrument was employed in order to simplify the wordings to the level of students. The items of instrument were scored two marks for each correct answer and zero for each incorrect answer. Marking guide was prepared in order to guide the marking of the students' script. The maximum score is 100 marks while the minimum score is 0 marks.

Science Students Motivation Questionnaire (SSMQ): The researcher adapted Science Students' Motivation Questionnaire constructed by Mubeen & Reid, (2014). The Questionnaire consists of 20 items. Scoring the questionnaire was done using a "Five- Choice Likert Scale". These are Strongly Agree (SA), Agree (A), Undecided (UD), Disagree (DA) and Strongly Disagree (SD). Each option was carried a weight in the order of priority from five to one in positive motivation responses and from 1-5 in negative motivation responses. The students were asked to freely indicate their motivation to science by simply ticking one of the five options that suit their motivation. From the items, maximum score is (100%), minimum score is (20%).

Science Students Attitude Scale Questionnaire (SSASQ): this instrument was constructed by the researcher. The Questionnaire consists of 25 items. Scoring the questionnaire is done using a "Four-Choice Likert Scale". These are Strongly Agree (SA), Agree (A), Disagree (DA) and Strongly Disagree (SD). Each option was carried a weight in the order of priority from four to one in positive attitude responses and from 1-4 in the negative attitude responses. The students were asked to freely indicate their attitude to science by simply ticking one of the four options that suit their attitude. From the items, maximum score is 100%, minimum score is 25%.

The three instruments were validated by two senior lecturers from Science and Technology Education Departments, Bayero University Kano; one professor from Science and Technology Education Departments, Federal University of Technology Minna and one experience Physics, Chemistry and Biology teachers at secondary school level with 16 years teaching experience. Their corrections were considered in the construction of the final instruments. Two schools apart from those selected for the main study were used for pilot testing of the instrument. The reliability of the Science Achievement Test (SAT) was established using split-half reliability method; the coefficient was calculated using Spearman Brown's formula and it was found to be 0.85. For Science Students Motivation Questionnaire (SSMQ) and Science Students Attitude Scale Questionnaire (SSASQ), the researcher established internal consistency reliability using Cronbach's Alpha method using SPSS, and the reliability index was found to be 0.88 and 0.83 respectively.

The researcher visited the sampled schools and sought for their permission to conduct the study and addressed the principals and science teachers on the duration and nature of the study. The researcher administered the Science Achievement Test, Science Students Motivation Questionnaire and Science Students Attitude Scale Questionnaire to the selected students. The scripts were marked by the researcher and the students' scores were recorded. The data obtained were recorded and subjected to data analysis using (SPSS v. 26) for both descriptive and inferential statistical tool. Scattered Plot was used to answer the research questions while the null hypotheses were tested at 0.05 significance level using Kendal Tau-B statistical tool

Analysis of Result

Research Question One: What is the significant relationship between science student's motivation and their academic achievement in the subjects in Malumfashi Local Government, Katsina State, Nigeria?

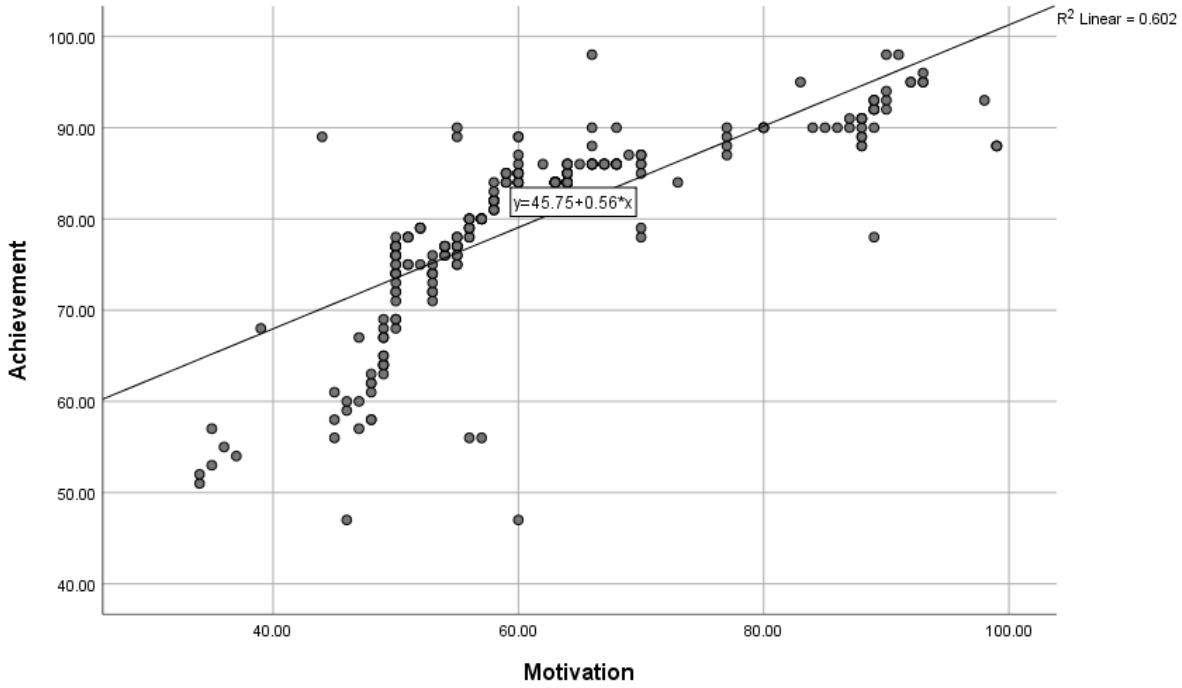

Figure 1: Simple Scattered Plot of Science Student Academic Achievement and Motivation

Figure 1 shows the graph of simple scattered plot of science student academic achievement and motivation. It was revealed from the graph that there was strong positive relationship between science students' motivation and their academic achievement with a coefficient of determination of 0.602 indicating 60.2% of variation in students' academic achievement in science is predicted by their motivation. This means that there was a positive relationship between motivation and students' academic achievement in Science. Hence, the more students are motivated, the better they will perform in science subjects.

Research Question Two: What is the significant relationship between science student's attitude and their academic achievement in Malumfashi Local Government, Katsina State, Nigeria?

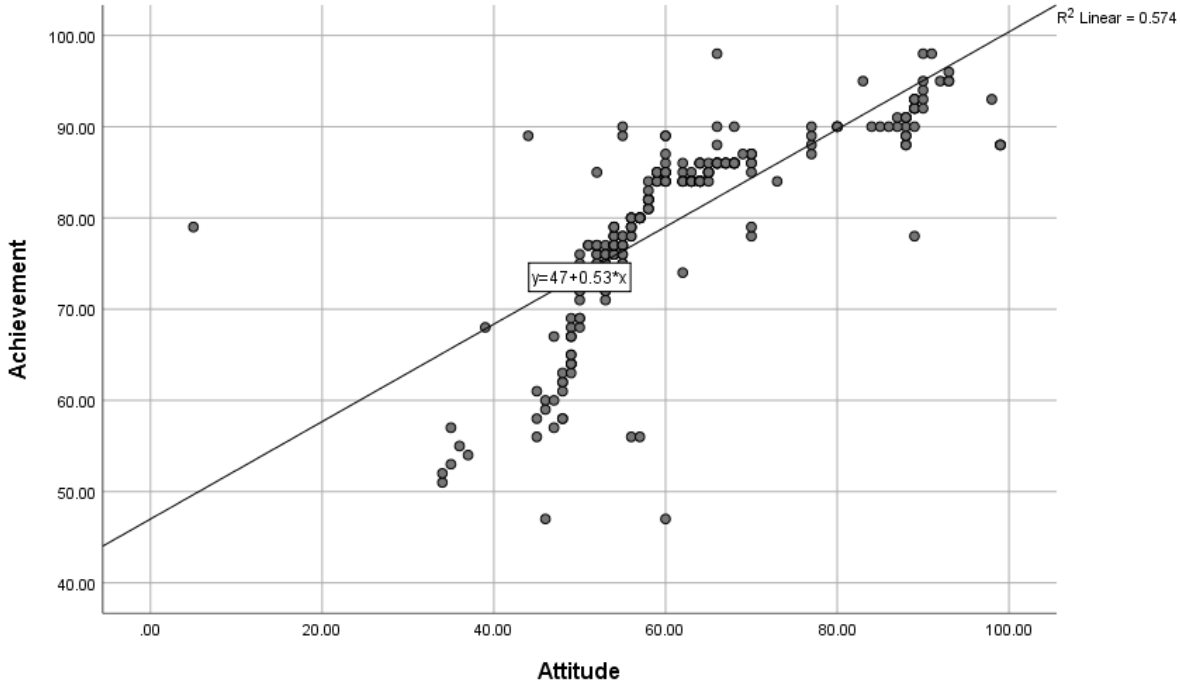

Figure 2: Simple Scattered Plot of Science Student Academic Achievement and Attitude

Figure 2 shows the graph of simple scattered plot of science student academic achievement and their attitude. From the graph above, it was revealed that there was a strong positive relationship between science students' attitude and their academic achievement with a coefficient of determination of 0.574 indicating 57.4% of variation in students' academic achievement in science is predicted by their attitude. This means that there was a positive relationship between science students' attitude and their academic achievement. Hence, the more students developed positive attitude, the better they will perform in science subjects.

Null Hypothesis Testing

Table 1: Linear Regression Analysis of Students' Motivation, Attitude and their Academic Achievement in Science

Model	R	R Square	df	P-value
Motivation	0.776	0.602	283	0.000
Attitude	0.757	0.574	283	0.000

Dependent Variable: Academic Achievement
Predictors: (Constant), Motivation, Attitude

Null Hypothesis One: There is no significant relationship between science student's motivation and their academic achievement in Malumfashi Local Government, Katsina State, Nigeria?

Table 1 shows Linear Regression Analysis of students' motivation, attitude and their academic achievement in science. The result revealed that there is significant a strong positive relationship between science student academic achievement and their motivation (N=285, R = 0.776, R^2 = 0.602, p<0.05). Thus, null hypothesis 1 is hereby rejected at $p < 0.05$ and concluded that there is significant relationship between science student's motivation and their academic achievement. Hence, motivation is a predictor of science students' academic achievement.

Null Hypothesis Two: There is no significant relationship between science student's attitude and their academic achievement in Malumfashi Local Government, Katsina State, Nigeria?

Table 1 shows Linear Regression Analysis of students' motivation, attitude and their academic achievement in science. The result revealed that there is significant weak positive relationship between science student academic achievement and their attitude (N=285, R = 0.757, R^2 = 0.574, p<0.05). Thus,

null hypothesis 1 is hereby rejected at $p < 0.05$ and concluded that there is significant relationship between science student's attitude and their academic achievement. Hence, attitude is a predictor of science students' academic achievement.

Discussion of the Result

The finding of this study revealed that there was significant positive relationship between science students' motivation and their academic achievement. This means that motivation is a predictor of students' academic achievement in science. This finding is in agreement with the findings of Mubeen and Reid (2014), Mohammed et al (2015), Çetin, (2015), Ugwuanyi et al (2020), Tus (2020) whom found that, high students' motivation might lead to high students' academic achievement.

It was also observed in this study that there was significant positive relationship between science students' attitude and their academic achievement. This means that attitude is a determiner of students' academic achievement in science. The result of this study is in accordance with the findings of Bakara, et al. (2009), Kpolovie et al (2014), Dogan, (2015), Dan'inna, (2017), Dan'inna and Bagiwa, (2020), whom found that, positive students' attitude might lead to high students' academic achievement.

Conclusion

The findings of the study revealed that the motivation and attitude of the students had significant strong positive relationships with their academic achievement in science. Hence, the researchers therefore concluded that motivation and attitude are major predictors of students' academic achievement in science. In other words, high motivation and positive attitude might lead to high students' academic achievement in science. Thus, motivation and attitude of students should not be disregarded in their ability to achieve higher students' achievement in science.

Recommendations

Based on the findings of this study, the researchers made the following recommendations.

1. Science students should be taught in a fun and effective manner that will increase their motivation to learn science subjects adequately thereby improving their academic achievement.
2. Science teachers should use instructional strategies that will motivate and bring positive attitude of learners during science subject's instruction to enhance students' achievement.

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RISK-TAKING PROPENSITY AS PREDICTOR OF PRE-SERVICE UNIVERSITY SCIENCE TEACHERS ENTREPRENEURIAL INTENTION IN NIGER STATE.

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Abstract
The study investigated risk-taking propensity as a predictor of pre-service university science teachers toward entrepreneurial intention in the Federal University of Technology, Minna, Niger State. Three research objectives, three research questions and one corresponding hypothesis guided the study. A correlational research design was adopted for this study. The population of the study comprised of three hundred and seventy-four (1,820) pre-service university science teachers out of which one hundred and eighty-one (90) pre-service university science teachers were selected and participated in the study. A fifteen (15) items Risk-Taking Propensity Questionnaire (RTPQ) and Entrepreneurial Intention Questionnaire (EIQ) were used to collect data. The two instruments were validated by experts. The internal consistency reliability of the two instruments were established and the reliability indices were calculated using Cronbach Alpha formula using SPSS version 26 and the reliability indices were found to be 0.84 and 0.888. The data collected were analyzed using mean, SD, scattered plot and regression analysis. The hypothesis was tested at 0.05 level of significance. The findings of the study revealed that the risk-taking propensity of pre-service university science teachers had significant moderate positive relationships with their entrepreneurial intention. Hence, the researchers therefore concluded that risk-taking propensity is major predictors of pre-service university science teacher's entrepreneurial intention. It was recommended among other that, policymakers should pay attention to risk-taking propensity as important factors in stimulating and entrenching entrepreneurship among the undergraduates and developing policies and programmes that would further ingrain entrepreneurship spirit in students is also an important plausible option. The existing compulsory entrepreneurship education strengthened with practical contents could thereby create opportunities for students to pitch business ideas and access start-up grants.

Keywords: Entrepreneurial Intention, Pre-service University Science Teachers and Risk-Taking Propensity.

Introduction

In recent times, entrepreneurship has become a budding area of interest to both researchers as well as policymakers and governments across the globe (Do Paço *et al.*, 2015). The major reason for this development is that entrepreneurship has been perceived to be a key solution to socio-economic growth and development challenges confronting many nations, including Nigeria (Adelowo *et al.*, 2018). Recent study, through the collaborative effort of Small and Medium Enterprise Development Agency (SMEDAN) and National Bureau of Statistics (NBS), has demonstrated that micro, small and medium enterprises (MSMEs) contribute to employment and gross domestic product more than any other sector of the economy (SMEDAN-NBS, 2019). In fact, entrepreneurship has been argued to promote rapid economic growth as well as reduce the rate of unemployment (Adelowo *et al.*, 2021; Ezeh *et al.*, 2020). Unemployment is a major problem in Nigeria. The current figure shows that over 33% of Nigerians are unemployed (Statista, 2022). The more worrisome situation is the huge number of youth who are without a job, creating a breeding ground for social vices such as kidnapping, banditry, internet frauds and insurgence (Ezeh *et al.*, 2020; Adelowo *et al*., 2021a). Nigerian population structure has shown that the country has the largest youth population in the world with a median age of 18.1 years while about 70% of the population are actually under 30 years of age (Akinyemi & Mobalaji, 2022). Thus, with a huge population and fewer institutions to absorb them in full-time employment, the government need to change its strategy and approach to education for national development. Adelowo *et al*. (2015) and Olofinyehun *et al*. (2022) have clearly identified the need to bolster existing entrepreneurship education programs in the country to stimulate job and wealth creation among the youth. For instance, from 2017 to date, the national budget has consistently placed emphasis on creating an enabling environment for businesses to thrive while also improving existing infrastructure to guarantee new business

development. One of these strategies as earlier noted is the need to promote entrepreneurship culture among youth, particularly from the undergraduate levels.

The entrepreneurship education was introduced to grow a critical mass of entrepreneurs among undergrads such that they become job creators rather than job seekers after graduation (Adelowo *et al*., 2021a). However, Entrepreneurship education is understood as a key competence for students (including pre-service university science teachers) whose development, as well as that of the series of sub-competences that comprise it, will contribute to their personal and professional development as active citizens in a society in constant change; specifically, as facilitators of the comprehensive training of these citizens, especially undergraduates. Entrepreneurial intention is considered the best predictor for entrepreneurial behavior that translates into entrepreneurial action and without it, any further entrepreneurial steps will not exist (Akinwale *et al*., 2019). It is pertinent to find out if changing the orientation of students from seeking employment to becoming self-employed could help in addressing the problem of unemployment in Nigeria. Therefore, eliciting their entrepreneurship intention in the first place is paramount.

Entrepreneurial intention is a relevant subject of study, as it defines the intention that individuals have to initiate their business (Lopes *et al*., 2020). Entrepreneurial intention reflects the person's degree of willingness, desire, and readiness to pursue entrepreneurship as a career choice and to get involved in entrepreneurial activities (Alammari *et al.,* 2019). Hence, entrepreneurial intention has received considerable attention from scholars to investigate the factors that can trigger a person's intention to start an entrepreneurial venture (Ali *et al*., 2019), and many factors have been examined. Entrepreneurial intention among pre-service university science teachers is another factor that would influence them to apply the skills after graduation. Despite the career guidance through entrepreneurial courses and seminars for undergraduates, it is not clear whether some of them will engage in entrepreneurship after graduation. Therefore, the study of entrepreneurial intention is a rapidly developing area of research (Liñán & Fayolle, 2015) and research suggests that entrepreneurial intention is an important precursor to becoming an entrepreneur (Zhao *et al.*, 2010). The intention is a key antecedent of action, and the study of entrepreneurial intention can deepen people's understanding of entrepreneurial cognition and behavior patterns. The formation of entrepreneurial intention is the product of the interaction between individuals and the environment. Consequently, there several factors that could influence entrepreneurship; some of the factors could include: cognitive environment, psychological and psycho-social among others. Some scholars apply the decision-making model to the study of entrepreneurial intention. However, for pre-service university science teachers to venture into a business must be ready to accept risk. A risk-taking propensity is an individual's personality trait which is considered to be important in selecting the project and the decision-making involved in the entrepreneurship profession (Sharaf *et al*., 2018). The risk-taking ability helps pre-service university science teachers sustain an open innovation journey and foster competitiveness. Entrepreneurs know how to react in uncertain situations when he/she incorrectly evaluates the risks that were associated with certain operations. The accurate assessment of the risk-taking return leads to reduced errors and improves business strategies to achieve the goal confidentially (Butt *et al*., 2015). Therefore, this study examined entrepreneurial intention and risk-taking propensity available for venture creation among pre-service university science teachers in Niger state, Nigeria.

Statement of the Research Problem

The essence of education is to produce human resource that is self-reliant and employed to contribute positively to the socio-economic development of the society. However, Nigeria is plagued with high levels of unemployment and underemployment which could have resulted to banditry, kidnapping, and all forms of social vices. To address the problem of unemployment's, government of several countries in the world have turn to entrepreneurship and this can be seen in the introduction of entrepreneurship in the university. This innovation probably seeks to stimulate entrepreneurship intention among graduates of university. Nonetheless, other factors could also influence entrepreneurial intention such as creativity, government support, attitudes, risk taking propensity, perceive behavioral control and family background, among others. A study by Hunjra *et al.,* (2011) has shown that many factors that can influence entrepreneurial intentions. Include entrepreneurial attraction, networking support, capabilities, self-independence, self-reliance, age, gender, experience, family background, creativity,

perception of risk, government support, perceived behavior control and administrative difficulties among others.

Research has been conducted on the determinants of entrepreneurial intentions, a study by Margret (2021), aimed at assessing the psychosocial determinants of entrepreneurial intention among final-year students of the Faculty of Education, University of Calabar which the findings showed that their propensity to take risks influenced significantly the students' entrepreneurial intention. However, family background and locus of control did not have any significant influence on their entrepreneurial intention. George (2017) investigates and explains factors that influence entrepreneurial intentions among university students in Kenya which the findings of the study concluded that among the three factors of social norms, perceived barriers, and risk-taking, it is only the propensity to take risks that significantly influenced entrepreneurial intentions among students. The other two did not determine the entrepreneurial intentions of the students.

There seems to be scarcity of evidence that shows that pre-service university science teachers in Nigeria and particularly in Niger state possess entrepreneurial skills and the intention to become entrepreneurs and self-reliant. If this gap is not bridged, the Nigerian quest for sustainable economic development and graduates becoming self-employed and self-reliant could be a mirage. Therefore, this study seeks to determine factors influencing entrepreneurial intention among pre-service university science teachers.

Objectives of the Study

The main aim of the study is to assess whether risk-taking propensity predicts entrepreneurship intentions among pre-services university science teachers of some selected tertiary institutions in Niger state. The specific objectives were to:

1. Determine the level of entrepreneurial intention of pre-service university science teachers
2. Determine the level of risk-taking propensity of pre-service university science teachers
3. Determine the relationship between the risk-taking propensity and entrepreneurial intention of pre-service university science teachers

Research Questions

The following research questions were raised to guide the study:

1. What is the level of entrepreneurial intention of pre-service university science teachers?
2. What is the level of risk-taking propensity of pre-service university science teachers?
3. What is the relationship between risk-taking propensity and entrepreneurial intention of pre-service university science teachers?

Research hypotheses

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

HO_1 There is no significant relationship between the risk-taking propensity and entrepreneurial intention of pre-service university science teachers.

Research Methodology

A correlational research design was adopted for this study to determine the relationship between entrepreneurial intention and risk-taking propensity among pre-service university science teachers in Niger State, Nigeria. The population of the study comprises 1,820 pre-service university science teachers in the Federal Universities of Technology, Minna in Niger State.

A simple random sampling was adopted in selecting respondents from three universities that were used for the study. The sample size was determined using a guidelines given by krejcie and Morgan (1970), which proposed that Three hundred and fifty-one (351) participants are considered for a population of 4500 to 4999 in a research. A well-structured questionnaire based on individual student entrepreneurial perceptions. The instrument is named the Determinant of Entrepreneurial Intention Questionnaire (DEIQ). The instrument is divided into three (3) sections which are as follows: Demographic Data/information section (A), section (B) is Entrepreneurial Intentions (EI) with fifteen (15) items and section (C), Risk Taking Propensity with fifteen items (15). The questionnaire was developed on a five-

point Likert scale questions ranging from strongly agree, undecided to strongly disagree will be adopted (strongly agree = 5, Agree = 4, undecided =3, Disagree = 2, strongly disagree=1).

The instrument was given to three (3) experts, one from the Department of Science Education and two (2) from the Department of Industrial and Technology Education, School of Science and Technology Education, the Federal University of Technology Minna who after going through the instrument made some observations and corrections which includes; modified some items, added some items and removes some items from the instrument. A pilot study was conducted using the designed instrument to establish its reliability as well as the internal consistency index of the instrument. The pilot test was carried out on forty-four (44) pre-service university science teachers selected from Usman Danfodio Federal University affiliated with College of Education, Minna and the reliability of 0.880 and 0.712 for EI and RTP were found respectively. This result is supported by Sekaran and Bougie (2010) who reported that the reliability coefficient of 0.6 is considered as poor, 0.7 is considered acceptable and 0.8 is considered as good.

First week, an introductory letter was collected from the head of the department (H.O.D) which was used to obtain permission from the various institutions. The second week, the researcher visited all the three (3) institutions for briefing on the study. Third week, the researcher administered the questionnaire with the help of a research assistant. The copies of the questionnaire were administered and collected from the respondents through direct delivery and recovery method to achieve a high rate of return. The data collected were analyzed using scattered plots to answer research question and linear regression analysis to test research hypotheses.

Analysis of Result

Research Question One: What is the level of entrepreneurial intention of pre-service university science teachers?

Table 1: Mean and SD of Entrepreneurial Intention of Pre-Service University Science Teachers

S/N	Items	N	Mean	SD	Decision
1	Starting a business is much more desirable to me than other career opportunities I have	91	4.31	.915	Agree
2	I would rather have many businesses than pursue another promising career	91	3.95	1.159	Agree
3	There is no limit as to how long I would give maximum effort to establish my own business	91	4.24	.935	Agree
4	my philosophy is to do whatever it takes to establish my own business	91	4.42	.857	Agree
5	Having my own business would entail great satisfaction for me	91	4.41	.869	Agree
6	I have confidence that my family member would approve of my decision to start my own business	91	4.43	.701	Agree
7	I am planning to start a business after acquiring the theory of entrepreneurship courses through the program	91	4.38	.840	Agree
8	Choosing a career as an entrepreneur is better than the labor force in others.	91	4.19	.977	Agree
9	I would want to have full control of my business	91	4.43	.979	Agree

10	I would be more respected if I had my own business than if I were employed	91	4.35	.947	Agree
11	My skills and abilities will help me start a business	91	4.27	.920	Agree
12	My experience will be very valuable in starting a business	91	4.24	1.036	Agree
13	I have confidence that I can put in the effort needed to start a business	91	4.23	1.096	Agree
14	If I try to start with a firm, I would have a high chance of succeeding	91	4.07	1.063	Agree
15	Starting a firm and keeping it working would be easy for me	91	4.00	1.011	Agree
16	My professional goal is to establish my own business	91	4.29	.873	Agree
17	I will make an effort to start and run my own business in the future	91	4.37	.902	Agree
18	I have seriously thought about starting a business someday	91	4.29	.946	Agree
19	There is a strong probability that I will start my own business in the next 3 years	91	4.23	.831	Agree

Table 1 shows the analysis of Mean and SD of Entrepreneurial Intention of Pre-Service University Science Teachers in Federal University of Technology Minna. The result revealed that respondent agree with statements for all item (one to nineteen) on entrepreneurial intention of pre-service university science teachers (N=91, Mean≥ 3.95, SD≥ 0.701) with a decision Mean of 3.0. Thus, pre-service undergraduate university students possess high level of entrepreneurial intention.

Research Question Two: What is the level of risk-taking propensity of pre-service university science teachers?
To answer research question two mean and SD was used and presented in table 2.

Table 2: Mean and SD of Risk-Taking Propensity of Pre-Service University Science Teachers

S/N	Items	N	Mean	SD	Decision
1.	I am open to new experiences and challenges	91	4.43	.519	Agree
2.	I am ready to accept the entrepreneurial risk	91	4.34	.542	Agree
3.	I enjoy taking daring actions by doing precarious activities	91	4.13	.819	Agree
4.	I enjoy taking daring actions by doing precarious activities	91	3.63	1.267	Agree
5.	I can look out for every possible risk	91	4.05	1.047	Agree
6.	I like to invest money and time in projects that might provide a higher return	91	4.23	.804	Agree
7.	I have confidence in my ability to recover from mistakes when venturing into business	91	4.30	1.005	Agree
8.	I tend to tolerate ambiguity and unpredictability in establishing Business	91	4.00	1.000	Agree

9. I can take bold steps in risky conditions when establishing a business Agree	91	4. 40	4.219
10. I can go for new and uncommon businesses which are not certainly risky Agree	91	3.93	.998
11. I am cautious about unpredictable situations Agree	91	3.98	1.064
12. I accept whatever situations involving personal risk that will yield great rewards Agree	91	3.96	1.074
13. I am ready to take chances regardless of the risk Agree	91	4.02	.856
14. I view risk in a business as a situation to be avoided at all cost Agree	91	3.99	.983
15. I would never make a high-risk investment Agree	91	4.13	.957

Table 2 shows the analysis of Mean and SD of Risk-Taking Propensity of Pre-Service University Science Teachers in Federal University of Technology Minna. The result revealed that respondent agree with statements for all item (one to nineteen) on entrepreneurial intention of pre-service university science teachers (N=91, Mean≥ 3.63, SD≥ 0.542) with a decision Mean of 3.0. Thus, pre-service undergraduate university students possess high level of entrepreneurial intention.

Research Question Three: What is the relationship between risk-taking propensity and entrepreneurial intention of pre-service university science teachers?

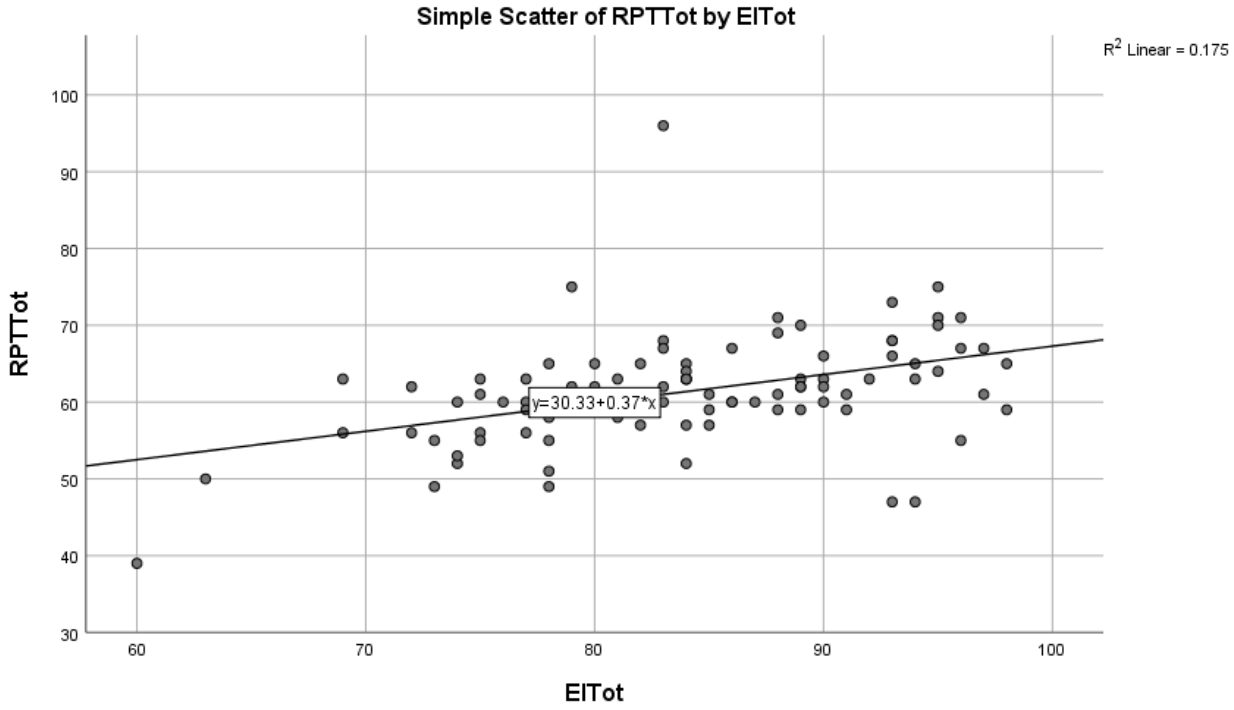

Figure 1: Scattered Plot of Risk-Taking Propensity and Entrepreneurial Intention of Pre-Service University Science Teachers

Figure 1 shows the graph of simple scattered plot of risk-taking propensity and entrepreneurial intention of pre-service university science teachers. From the graph above, it was revealed that there was a moderate positive relationship between risk-taking propensity and entrepreneurial intention of pre-

service university science teachers with a coefficient of determination of 0.175 indicating 17.5% of variation in pre-service university science teacher's entrepreneurial intention is predicted by their risk-taking propensity. This means that there was a positive relationship between risk-taking propensity and their entrepreneurial intention. Hence, the more students developed positive risk-taking propensity, the better they will perform in establishing a business.

Null Hypothesis Testing

HO_1 There is no significant relationship between the risk-taking propensity and entrepreneurial intention of pre-service university science teachers.

Table 3: Linear Regression Analysis of Students' risk-taking propensity and entrepreneurial intention of pre-service university science teachers

Model	R	R Square	df	P-value
Risk-Taking Propensity	0.419	0.175	89	0.000

Dependent Variable: Entrepreneurial Intention
Predictors: (Constant), Risk-Taking Propensity

Table 3 shows Linear Regression Analysis of students' risk-taking propensity and entrepreneurial intention of pre-service university science teachers. The result revealed that there is significant a strong positive relationship between risk-taking propensity and entrepreneurial intention of pre-service university science teachers (N=89, R = 0.419, R^2 = 0.175, $p<0.05$). Thus, null hypothesis 1 is hereby rejected at $p < 0.05$ and concluded that there is significant relationship between risk-taking propensity and entrepreneurial intention of pre-service university science teacher's science. Hence, risk-taking propensity is a predictor of pre-service university science teachers' entrepreneurial intention.

Discussion of the Result

The finding of this study revealed that there was a significant positive relationship between risk-taking propensity and entrepreneurial intention of pre-service university science teacher's science. This means that risk-taking propensity is a predictor of pre-service university science teachers' entrepreneurial intention. This finding is in agreement with Zhang *et al*., (2015) who asserted that risk-taking preference is significantly and positively associated with entrepreneurial intention. Also, the findings of this study were consistent with those of Uddin and Bose (2012) that indicated that risk-taking tendency, the need for achievement, job security, the environment for starting a business and education are significant factors in determining the intention of business students to become entrepreneurs.

Conclusion

The findings of the study revealed that the risk-taking propensity of pre-service university science teachers had significant moderate positive relationships with their entrepreneurial intention. Hence, the researchers therefore concluded that risk-taking propensity is major predictors of pre-service university science teacher's entrepreneurial intention. In other words, that the higher the risk-taking propensity of an individual is, the higher the chances of thinking about being an entrepreneur and eventually becoming one. Thus, risk-taking propensity of pre-service university science teacher's entrepreneurial intention should not be disregarded in their ability to achieve higher entrepreneurial intention.

Recommendations

Based on the findings of this study, the researchers made the following recommendations.

1. Policymakers should pay attention to risk-taking propensity as important factors in stimulating and entrenching entrepreneurship among the undergraduates. One of the ways support the entrepreneurship behavior of the students is to familiarize parents and stakeholders with the overall goals of entrepreneurship education and solicit their support. This support could help deepen students' commitment to the course and enhance their readiness for venture creation after graduation.
2. Developing policies and programs that would further ingrain entrepreneurship spirit in students is also an important plausible option. The existing compulsory entrepreneurship education

strengthened with practical contents could thereby create opportunities for students to pitch business ideas and access start-up grants.

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EFFECT OF JIGSAW II LEARNING STRATEGY ON THE ACADEMIC PERFORMANCE OF SECONDARY SCHOOL STUDENTS IN THE MENSURATION ASPECT OF GEOMETRY IN GOMBE, METROPOLIS

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Abstract
Mathematics occupies an important part of secondary school level curriculum all over the globe, due to its significant role in scientific and technological development. The performance of this level students in menstruation aspect of Geometry as a branch of Mathematics is annually poor in external examinations and there is need to look for appropriate method of teaching to improve their performance. Therefore, the study puts into consideration the Effect of Jigsaw II Learning Strategy on the Academic Performance of Secondary School Students in Menstruation Aspect of Geometry in Gombe Metropolis. Four (4) intact classes from four (4) Secondary Schools were selected using purposive and simple random sampling techniques out of which two (2) intact classes with ninety-two (92) students was randomly assigned to experimental group and the other two (2) classes with eighty-eight (88) students was randomly assigned into control group. Data collected using Geometry Achievement Test (GAT) from one hundred and eighty (180) SS II students analyzed using Mean and Standard Deviation to answer the research questions and Analysis of Covariance (ANCOVA) to treat the research hypotheses of the study. The results revealed among other that, there is significant difference between the means performance scores of students taught mensuration aspect of geometry using Jigsaw II cooperative strategy and those taught the same concept using conventional method of teaching and there is no significant difference between the mean academic performance scores of male and female secondary students taught mensuration aspect of geometry using Jigsaw II cooperative learning strategy. Recommendations were given based on the findings of the study, if taken will bring about good performance of secondary school students in Mathematics and other secondary schools subjects.

Keywords*:* Jigsaw II Learning Strategy, Academic Performance, Secondary School Students, Menstruation, Geometry.

Introduction

The best-known kind of teaching and the most highly organized, although not the most important, is done in primary school, colleges, technical institutions and universities (Abdullahi, 2005). He further stresses that, the school is a powerful agency where learners are given concentrated experiences of life and established to disseminate bulk of needed information, show the direction in which knowledge can be achieved. It is a place where learners are held together for the purpose of acquiring knowledge and have the opportunity to achieve the objective of education as stated by the New National Policy on Education (2012).

Mathematics is goal oriented, mental in character and dynamic in nature. The subject is also abstract, sensitive and controversial. Thus, for a better and conducive teaching and learning situation, the teacher should apply simultaneously different approaches which should be skillful for goal attainment. Mathematics is primarily concerned with ideas, processes and reasoning leading to the solutions of problems. It is widely recognized as a necessary tool for achieving the developmental goals of any society in terms of innovation and entrepreneurship. This is because the development goals of any

nation depend on her scientific and technological development. However, there cannot be science and technology without mathematics, (Musa, 2006).

The applications of Mathematics cut across all the areas of science, technology, agriculture, commerce, health, etc. It is in the recognition of this importance that mathematics is made one of the core subjects that must be studied at primary, junior and senior secondary levels of education. Mathematics education therefore, is indispensable to both individual and national development (Abdullahi, 2014). The study of mathematics originated in an attempt to exercise mastery over the environment. The contents of mathematics are being reversed to meet the minimum standard at any level of education in line with the objective of that specific level of education for the learners.

The general contents of mathematics in secondary school level curriculum are under Number and Numeration; Algebra; Plane Geometry; Trigonometry; Statistics and Probability, (FGN, 2012). It is hoped that every child that passed through and passed the contents of mathematics education at any level should be able to cope with changes in the environment, be competent in the basic skills and understanding for dealing with numbers and figures. There should be development in the habit of effective thinking and critical analysis of data and communication through symbolic expressions and graphs, having passed through the contents of mathematics as contained in that level of educational curriculum and passed.

Geometry has been described by different scholars and mathematics experts depending on the angle they looked at it. According to Abdullahi (2014), geometry is the branch of mathematics that deals with spatial relationships that exist between numbers, letters and lines. Geometry as a branch of mathematics that deals with measurements and relationships of lines, angles, surfaces and solids in a particular object or shape. It is concerned with questions on shapes, size, and relative position of figures and properties of space.

An aspect of geometry is "mensuration" which deals with measurements of an object for the purpose of comparing its size with some standard units (Odili, 2006). Furthermore, Musa and Bolaji (2015), in their write-up, defined mensuration as a science of numerical representation of geometrical magnitudes. These measurements can be linear such as length, area and volume. The study of mensuration is very important because most of the objects dealt with by human beings have some shapes that possess either area or volume. Therefore, it can be concluded that mensuration is the backbone of geometrical study.

Despite the fact that mathematics is the bedrock of scientific and technological developments of any nation, its application cuts across human activities, a core and compulsory subject in primary and secondary levels of education, a basic requirement for gaining admission into any tertiary institutions, and a subject that must be taken and passed under general studies by any student in tertiary institution, the performance of secondary school students in internal and external examinations is becoming low. For instance, Eniayeju and Azuka (2010), lamented that statistics from West African Examination Council (WAEC) indicated that from 2013 to 2018, less than 40% of Nigerian Students obtained credit pass in mathematics in each of the years Senior School Certificate Examinations (SSCE).

Poor performance in mathematics is also evident among Gombe state senior secondary school students. Data collected from Gombe State Educational Resource Centre revealed that unprecedented number of students persistently performed poorly in Senior School Certificate Examination (SSCE) in mathematics. The implication is that the state students that qualified for science and technical courses in Nigeria tertiary institutions is approximately 30%, this is because of lack of credit pass in mathematics and this is quite alarming.

Specifically, researchers reported poor academic performance in menstruation aspect of geometry due to the perceived difficulty in the teaching and learning of the area by both the students and the teachers (WAEC, 2015). Musa and Bolaji (2015), cited WAEC Chief Examiners' Reports (2010-2015), which consistently indicated lack of skills in answering questions in geometry 2-diamensional and 3-dimensional shapes by the candidates. On the part of teachers, Idehen (2012), showed that teachers had misconception about the differences between a cube and a cuboid and seemed not to understand the

best description of a cube. It is this misconception that the teachers pass to the students in geometry class that lead to wrong solutions of geometry problems; this shows that menstruation aspect of geometry remains a difficult area among senior secondary school students.

Many factors are responsible for the poor performance and retention of students in geometry in particular and mathematics in general have been identified by researchers in sciences and mathematics education to includes lack of enough and qualified teachers; inadequate instructional materials; large class-size, school-location; inadequate text books; background of the students and teachers' methods of teaching. However, the most important from the findings is the teaching strategy adopted by the teachers teaching the students mathematics, (Obioma, James and Taiwo, 2011,).

From the empirical evidences, Abdullahi, (2014), indicated that, traditional lecture method still remains popular among secondary school mathematics teachers. In this method, the teacher dominates the class with little or no opportunity for the learners to participate including the teaching and learning of menstruation aspect of geometry in this regard. This proves that much is required in the area of teaching and learning in order to actualize the desired goals by applying and exploring other innovative methods. Some of these innovative teaching methods include discovery method, project method, group method, individual method and of course Jigsaw II co-operative learning strategy.

There are various versions of co-operative teaching methods; one of them is Jigsaw II cooperative strategy. This is an instructional strategy in which the class is divided into small groups; each group consists of students with different ability levels, and the teacher uses variety of learning activities to improve their understanding of a lesson. The Jigsaw II cooperative strategy is an efficient way for students to learn classroom materials. The process encourages students to listen and be engaged in a group setting. Just like Jigsaw puzzle, each member of the group plays an essential role, in their group. What makes this teaching strategy effective is that group members work together on a team to achieve a common goal. Students are not able to succeed unless everyone works together (Chan,2004). Therefore, every learner in the group must contribute to their group success in every lesson development.

In this method, each student is a member of two (2) different groups, (a Jigsaw or home group and an expert group). In Jigsaw or home groups, learners are assigned different portion of the learning materials. Each member of the group is asked to focus on reading one portion of the materials, upon finishing the reading, the learners who read the same portion of the materials come together to form expert group to discuss their assigned portion. After the discussion, group members go back to their home group to teach what they have learnt in their expert group to the other members. After mastering all the sub-topics taught by each expert, individual group members take a short quiz. Individual's score is compared with the based score to calculate the improvement score of the individual, based on which a group average improvement score is worked out. The group having the highest average group improvement score is given group recognition by getting a group reward. Alternatively, a group which has its average improvement score reaching a predetermined level can receive a group reward. Thereby, each member learns and helps his members to learn since the success of a group member is the success of all members.

As regard to the report of scholars from their observation on gender disparity and performance of students in geometry and general mathematics. Gambari, Olumorin and Yusuf (2013), attributed gender performance differences in mathematics to the instructional strategies employed by teachers

Researches on Jigsaw II co-operative learning have been conducted in various subject areas, as well as conducting one in Kano, but none of these studies was conducted in Gombe state, despite the fact that performance in mathematics has been consistently low in the area.

Therefore, the present study was designed to find the impact of Jigsaw II co-operative learning strategy on the academic performance of secondary school students in Gombe metropolis, for possible improvement in academic and gender performance in menstruation aspect of geometry in Gombe state.

Statement of the Problem

The researchers observed that the performance of secondary school students in mathematics internal (mock) and external (WAEC and NECO) examination has been consistently poor in Gombe state. As it was observed by one of the examiners in Senior School Certificate Examination (SSCE) that the students rarely answer or totally avoid attempting questions on menstruation aspect of geometry. They failed or performed very low where they even made attempts.

Because of the identified difficulties of students in menstruation aspect of geometry, the researchers are of the view that most teachers failed to teach geometry content as it is expected because of the use of inappropriate and irrelevant teaching method which contributes to the poor performance of secondary school students in geometry among other factors. There is need to explore and apply other effective instructional strategies that can bring improvement on the improvement of secondary school students' performance not only in mathematics but other school subjects in general.

Therefore, this study investigates the impact of Jigsaw II co-operative learning strategy in order to determine the effect on the students and gender performance difference in menstruation aspect of geometry at senior secondary school in Gombe metropolis.

Purpose/Objective of the Study

The study is to investigate the impact Jigsaw II co-operative learning strategy on the performance of secondary school students and gender performance differences in menstruation aspect of geometry at senior secondary school in Gombe state. Specifically, the study is to:

i) investigate the impact of Jigsaw II co-operative learning strategy on the performance in mensuration aspect of geometry among senior secondary school students in Gombe state
ii) Determine the effect of Jigsaw II co-operative learning strategy on gender performance in menstruation aspect of geometry among senior secondary school student in Gombe state.

Research Questions.

The following research questions were formulated to achieve the objectives of the study:

1) What is the difference between the mean performance scores of students taught menstruation concept using Jigsaw II co-operative learning strategy and those taught using conventional method?
2) What is the difference between the mean performance scores of male and female students when taught menstruation concepts using Jigsaw II co-operative learning strategy?
   Research Hypotheses

The following hypotheses were postulated and tested at 0.05 level of significance to guide the study:
HO_1: There is no significant difference between the mean performance of the secondary school students taught menstruation by Jigsaw II method and those taught the same topic using conventional method of teaching.

$H0_{2:}$ There is no significant difference in the mean performance scores of male and female students taught menstruation by Jigsaw II co-operative learning strategy.

Research Design

The study adopted the quasi-experimental non-randomized pretest-post-test control group design using two (2) intact classes each as experimental and control groups.
Population, Sample and Sampling Techniques

The population of the study consisted of all the secondary school teachers and students in Gombe state. However, the target population of the study will be all SSII students of public secondary school in Gombe metropolis. Four (4) intact classes from four (4) schools were selected using purposive and simple random sampling techniques. Two intact classes with ninety-two (92) students were randomly assigned to experimental group and the other two (2) classes with eighty-eight (88) students were assigned to control group. Thus, the sample size was one hundred and eighty (180) SSII students which

is considered viable for the study since the central limit theorem recommended thirty (30) subject for experimental studies, (Sambo, 2008).

Instrumentation
The instrument used for the study was Geometry Achievement Test (GAT) constructed by the researchers contain forty (40) multiple choice items which were administered to both the experimental and control groups after being taught mensuration concept of area and volume of 2-dimensional and 3-diamensional shapes using Jigsaw II co-operative teaching strategy and conventional method respectively for six (6) weeks.

Validity and Reliability of the Instrument
The instrument was made of forty (40) multiple choice items consist of questions from the menstruation aspect of geometry, therefore, meeting the face content validity of the instrument.
Using split-half method, the reliability of Geometry Achievement Test (GAT) using Pearson-Moment-Coefficient was 0.78 which is appropriate to be used for the study.

Procedure for Data Collection
After the experimental group were being taught menstruation concept for six (6) six weeks by using Jigsaw II co-operative learning method while the control group were being taught the same topic for the same period using conventional lecture method. Geometric Achievement Test (GAT) was taken by both the experimental and control groups administered by the researchers themselves in each school.

Data Analysis
After given the experimental and control groups the Geometry Achievement Test (GAT) and finished, their sheets were collected, short out school by school, group by group and gender by gender, by the researchers. After marking, the results were analyzed using frequency counts, mean, standard deviation and Analysis of Covariance (ANCOVA) to answer the research questions and to test the research hypotheses at 0.05 level of significance respectively.

Results
After the administration of post-test by the researcher in order to find out the effect of Jigsaw II learning strategy on the academic performance of secondary school students in mensuration aspect of geometry in Gombe metropolis, Nigeria the students scripts were collected and sort out school by school, gender by gender and method by method by the researchers. Frequency counts, mean, standard demotion and analysis of covariance (ANCOVA) were used to answer the postulated research questions and hypotheses testing.

Treating Research Questions
The two (2) postulated research questions guiding the study were answered one by one.

Research Question I
What is the difference between the mean performance of students taught mensuration concepts using Jigsaw II cooperative learning strategy and those taught using conventional method?

Table I: Mean performance scores of post-tests of students in experimental and control groups

Group	m	mean	SD	MD	STD. error mean
Experimental	92	21.23	2.46	2.24	45945
Control	88	18.99	1.90		33868

From the table I above, it could be observed that the students exposed to Jigsaw II learning strategy (experimental group) have the mean performance score of 21.23 and standard deviation of 2.46. while those exposed to conventional (control group) have mean performance of 18.99 with standard deviation of 1.90. The mean difference (MD) between the groups is 2.24, this clearly indicated that students mean performance scores of those exposed to Jigsaw II strategy performed better than those exposed to the

conventional method of teaching. Hence, there is significant difference between the mean performance of the students taught using Jigsaw II learning strategy and conventional method.

Research Question 2

Is there any difference between the mean performance scores of male and female students when taught mensuration concepts using Jigsaw II cooperative learning strategy?

Table II: Post-test mean performance scores of male and female taught mensuration concepts using Jigsaw II cooperative learning strategy.

Gender	N	mean	S D	M D	Std Error mean
Male	100	22.34	2.88	0.89	.52674
Female	80	21.95	2.36		.51527

Looking at the above table II, it can be seen that the mean performance scores of male mensuration concept is 22.34 with standard deviation of 2.88 while that of female students is 21.45 and 2.36 mean and standard deviation respectively. The mean deviation of both male and female students is 0.89, the result shows that the male and female have approximately the same performance scores when given instruction om mensuration aspect of geometry using jigsaw II cooperative learning strategy. Therefore, there is no any significant difference between the mean performance scores of male and female students taught mensuration concepts using Jigsaw II cooperative learning strategy.

Hypotheses Testing.

The two (2) null hypotheses of this study were tested using Analysis of Covariance (ANCOVA) at 0.05 level of significance. Therefore, to test the hypotheses, the academy performance of students taught mensuration aspect of geometry using Jigsaw II cooperative instructional strategy and those taught using the conventional instructional strategy were analyzed using Analysis of Variance as shown in the table III below.

Table III: Analysis of Covariance Result of the Effect of the Treatment (Jigsaw II cooperative) on the Academic Performance of Students in Mensuration Aspect of Geometry.

Source	Type III sum of squares	df	mean square	f	Sig	partial Eta squared
Corrected model	191.435	4	257.480	8.00.000	.283	
Intercept	2385.194	1	2756.218	85.64	.000	.514
Pre-test	190.759	1	745.035	23.149	.000	.222
Jigsaw II	196.635	1	196.635	6.110	.016	.070
Gender	123.486	1	123.486	1.852	.003	.000
Error	2606.881	81	32.184			
Total	336581.000	86				
Corrected Total	3636.802	85				

Hypothesis I

There is no significant difference between the mean performance of secondary school students taught mensuration by Jigsaw II cooperative strategy and those taught same using conventional method of teaching.

Looking at the above table III, it can be observed that the result of the Analysis of Covariance (ANCOVA) performed to determine the significant difference between the performance the students taught mensuration aspect of geometry using Jigsaw II cooperative strategy and those taught using conventional method, the calculated F (1,86) – value = 6.110 and P- value of. 0.016 in which P- value is greater than the 0.05, the null hypothesis of no significant difference is there by rejected, hence, there is significant difference between the performance of secondary school students taught mensuration aspects of geometry using Jigsaw II cooperative strategy and those taught using conventional method of teaching.

Hypothesis II
There is no significant difference in the mean performance scores of male and female students taught mensuration by Jigsaw II cooperative learning strategy.

From the table III above, the result of the Analysis of Covariance (ANCOVA) performance on the effect of Jigsaw II cooperative learning strategy on the academic performance difference based on gender in the mensuration aspect of geometry can be seen. As indicated in the table, calculated F (1,86) =1.85 and p-value of 0.003 and 0.003 is less than the significance value of 0.005, therefore, the null hypothesis of no significant difference is hereby, accepted. This result means that there is no significant effect of Jigsaw II cooperative learning strategy on the academic performance of secondary school students based on gender. Both male and female students performed almost all the same.

Summary of the Results
The followings are the major findings of this study based on the outcome of treating the research questions and testing the hypotheses at 0.05 level of significance.

1. There is significant difference between the means performance scores of students taught mensuration aspect of geometry using Jigsaw II cooperative strategy and those taught the same concept using conventional method of teaching.
2. There is no significant difference between the mean academic performance scores of male and female secondary students taught mensuration aspect of geometry using Jigsaw II cooperative learning strategy.

Discussion on the Findings of the Study

The findings of this study revealed that, there is significant difference between the means academic performance scores of secondary school students exposed to mensuration aspect of geometry using Jigsaw II cooperative learning strategy and conventional method of teaching, in favor of those learnt mensuration concepts of geometry through Jigsaw II learning strategy. This indicates that using Jigsaw II learning strategy in teaching mensuration aspects of geometry enhances better academic performance of students in the subject.

This finding is in agreement with the finding of Abdullahi (2022), whose finding shows that students learning activities based on Jigsaw II cooperative learning strategy have higher achievement than students who learned through the conventional method of teaching. This could be as a result of the nature and process involved in the teaching strategy, it is a gender friendly approach and in the course of the lesson, the students are given equal opportunity and allowed to manipulate the learnt materials in each lesson. The lesson is always more of interactive class where students are allowed to contract knowledge on their own, since individual differences were taken into consideration during the lesson'

In addition, it has observed in this study that, there is no significant difference in the mean performance score of male and female secondary school students exposed to mensuration aspect of geometry learning activities using Jigsaw II cooperative learning strategy.
The finding is in line with the findings of Abdullahi (2014) who ascertained that, there is no significant difference in the performance of male and female students when exposed to learning activities since their ability to learn and performance until be based on the individual's level of understanding, home background, age and availability of learning materials. Both male and female students have learning equal opportunity.

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

1. Teachers, most especially mathematics and science teachers should prepare learning materials in line with Jigsaw II learning strategy and teach their students to ensure better performance in the school subjects not only mathematics but other secondary school subjects.
2. Both male and female students should be given equal opportunity towards learning outcomes and not to be gender bias in the frame of teaching.

3. The school authority should provide enough learning materials and accommodation so as to enable the teachers use series of methods to teaching and create conducive teaching and learning environment.
4. Parents should provide enough learning materials for their children /wards and develop interest in their school work. Students will be motivated to work hard to impress their parents when they realize that their parents are interested in their progress and school work.

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CONNECTED LEARNING INITIATIVE: A NOVEL TOOL FOR TEACHER CAPACITY DEVELOPMENT IN NIGERIA

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Abstract

All three tiers of education in Nigeria (primary, secondary, tertiary) lay emphasis on STEM subjects. The methods and strategies employed by STEM teachers in most Nigerian schools have remained teacher-centered and textbook-oriented. This paper has brought together some elements of the innovation achieved in the Connected Learning Initiative (CLIx) to address the identified challenges in STEM education in Nigerian junior secondary schools through the CL4STEM project to build processes for long-term systemic dialogues and networking. CLIx was seeded by the Tata Trusts and led by TISS and MIT, USA, to strengthen secondary STEM learning, pedagogic content knowledge of teachers and their practice at scale in four states in India. The program's interactive STEM OERs, subject teacher CoPs on mobile devices, tech design for under-resourced context, and participatory and localized ecosystem approach to adoption and scaling, are identified as innovative and scalable models. Data were collected in three phases, baseline, midline, and end line. The findings from interviews indicate that teachers' understanding of CL4STEM innovation seems to improve from baseline to end line. At the baseline, 2 teachers were still learning how to effectively navigate CL4STEM modules and Telegram groups (CoPs) while none was at the end. There is an increase in the number of teachers exploring ways of improving CL4STEM teaching strategies through further refinement of the modules and CoP participation and/or alternative ways of achieving better results from 1 at midline to 5 at end line. There is a decrease in the number of teachers who are exploring ways of collaboration with other teachers and educators to help impact student learning using CL4STEM teaching strategies from 11 at the midline to 3 at the end. Other changes from baseline through midline to end line, generally positively, with respect to perception, voluntariness, relative advantage, compatibility, image, ease of use, research demonstrability, and visibility have been recorded here-in.

Keywords: Connected Learning, STEM, CLx, OER, CoP, Teacher capacity development

Introduction

Science and technology constitute the cornerstone of national development. For Nigeria, the provisions of the National Policy on Education (Maduabum, 1990) support the scientific development and the utilization of science and technology-based programs at all levels of the Nigerian education system. These provisions are evident in the recognition of the role played by STEM education in national, scientific, and technological development serving as a gateway to socio-economic advancement, industrial development, and self-reliance (Mustapha, 2009). All three tiers of education in Nigeria (primary, secondary, tertiary) lay emphasis on STEM subjects. The quality and standard of the national STEM curricula being used in Nigerian schools are locally relevant, globally accepted, and among the best in the world (NERDC, 2009). However, the teaching of STEM in Nigerian schools has been generally described as ineffective and students' achievements in terms of knowledge and skills are yet to meet expectations (Maduabum, 1990; Ayeni, 2021). Science teachers and the manner in which science is taught have been identified as part of the problems (Olawuwo, 2015; Ayeni, 2021).

The methods and strategies employed by STEM teachers in most Nigerian schools have remained teacher-centred and textbook-oriented (Mustapha, 2009; Olawuwo, 2015). This is contrary to the recommended inquiry-based teaching strategies recommended by the national STEM curriculum that emphasizes learner-centered and inquiry-based teaching strategies and methods that involve hands-on and minds-on learning activities. Furthermore, a good number of teachers and support staff in the

Nigerian school system are far from being computer literate and are incapable of applying technology in teaching science. Researchers have reported that most teacher education courses do not provide meaningful contexts for applying ICT to enhance teaching and learning and even though ICT is included in the teacher education program, teachers are not sufficiently trained to use ICT in the instructional setting (Bello, 2018). In moving the Nigerian situation forward, the Global Partnership for Education's Knowledge and Innovation Exchange (KIX) thematic group has identified three key challenges in improving teaching and learning processes in the context of developing countries.

1. The poor quality of support to teacher development, including weak initial teacher education and subsequent professional development programs leaving teachers with weak content and pedagogical knowledge and classroom skills (including instructional practices).
2. Inadequate teaching methods and learning materials**,** particularly in local languages and accessible to learners, including in terms of being aligned with their current level of understanding.
3. Lack of robust systems for recruiting, managing and engaging teachers, in terms of attracting and retaining the most qualified individuals to the teaching profession, teacher deployment to underserved and difficult areas of the country, reducing unauthorized teacher absences and maximizing instructional time, and engaging teachers in policy dialogue and reform.

This paper has brought together some elements of the innovation achieved in the Connected Learning Initiative (CLIx) to address the identified challenges in STEM education in Nigerian junior secondary schools through the CL4STEM project to build processes for long-term systemic dialogues and networking. The Connected Learning for STEM (CL4STEM) project is piloting and researching the innovation for professional development, the Connected Learning Initiative (CLIx), developed and implemented as an innovation to address quality of secondary education in India (www.clix.tiss.edu), and now taken to new country contexts of Bhutan, Nigeria, and Tanzania through a South-South collaboration of higher education institutions engaged in Teacher Education. Attention in this paper is on the impacts in Nigeria. CLIx was seeded by the Tata Trusts and led by TISS and MIT, USA, to strengthen secondary STEM learning, pedagogic content knowledge of teachers and their practice at scale in four states in India. CLIx was awarded the UNESCO-King Hamad Prize for the Use of ICTs in Education in 2018 and the OER award for Excellence in Collaboration-2019 (www.clix.tiss.edu). The program's interactive STEM OERs, subject teacher CoPs on mobile devices, tech design for under-resourced context, participatory and localized ecosystem approach to adoption and scaling, are identified as an innovative and scalable model.

Methodology

Connected Learning for STEM (CL4STEM) as a project consists of one major research study--the Innovation Diffusion Study--which was used to generate knowledge on the processes and aspects that support adapting the innovation for specific local contexts, and practice and conditions to support scaling in these contexts. This was done using qualitative research methods and through process documentation and reporting. In Nigeria, an impact study was conducted on learning outcomes on NQT/ITE teachers - the CLIx innovation impact study, following a common design and tools customized to Nigerian context. The impact study generated evidence of the effect size of the intervention for the intended design using mixed methods and quasi-experimental design. Analyses were done Nigeria-specific yielding knowledge relevant for improving teacher quality at scale in developing context. The study focused on developing the capabilities of STEM teachers and emphasizes the pedagogical and techno-pedagogical content knowledge requirements of STEM teachers in Nigeria. The implementation of the innovation took place in 3 stages:

Stage 1: knowledge transfers of the CLIx approach to TPD; Stage 2: adaptation and development of contextually relevant design of innovation; Stage 3: development of a contextually relevant implementation and plan for roll-out.

Knowledge transfer

The knowledge transfer process under Stage 1 was led by the faculty of TISS in Mumbai, India. Teacher educators of the three collaborating universities participated in virtual workshops and created 13

modules for teacher professional development based on the program's theory of change. The workshops focused on the following elements:

1. Mathematics and science PCK
2. Beliefs regarding inclusion, active and hands-on learning
3. Skills to integrate hands-on learning into the classroom, to integrate ICT (where available) into the classroom, to use resources to enhance student talk and quality of questions asked to develop higher-order thinking and adopt inclusive practices.
4. Management of a subject-based online CoP to share experiences and build contextual pedagogical content knowledge collaboratively.
5. Use of ICT in education, and its role in peer-learning and the professional development of teacher educators.

In total 13 modules were collaboratively developed, contextualized and implemented in all three participating countries- Bhutan, Nigeria and Tanzania. Each participating teacher was enrolled in four modules on the Moodle platform; one Common Pedagogy Module and 3 modules from one of the subjects (Mathematics, Biology, Chemistry and Physics). They had to respond to the designed assignments embedded in the modules. Following are the list of modules.

Subjects	**Mathematics**	**Science**		
		Biology	**Chemistry**	**Physics**
Topics	Proportions	Genetics and Heredity	Atomic Structure	Electromagnetism
	Algebra	Introduction to Ecology	Chemical Bonding	Force and Motion
	Geometry	Cell Structure & Organisation	Organic Chemistry	Work, Energy and Power

Table 1. CL4STEM subject specific modules

Communities of Practice (CoP) was an essential element of CL4STEM TPD model as they offer a social learning space for all the participating teachers, the principals of their schools, and the teacher educators to interact and discuss their experiences with the modules. All of these participation activities lead to a greater likelihood of reflective classroom practice. One common Telegram Group was created for all subject teachers (80) and 4 separate subject groups. Each participating teacher was connected in two groups; common CoP and subject specific CoP. Teacher Educators were assigned as the Course Instructor for each of the twelve subject modules and the common module. This implied that respective teacher educators were responsible for the teacher's participation in their modules. Adequate access to online modules and an online CoP were ensured for all participating teachers. This implied installing Moodle and Telegram on their smartphones and also making them accessible through their laptops/desktops whenever feasible.

The associated research focused on two broad areas. First, the Impact analysis, focused on the impact of innovation on teachers' Knowledge, Attitudes and Practice (KAP) for higher-order thinking, teaching and learning of Science and Mathematics inclusively and equitably. Second, the Innovation Diffusion research generated knowledge on the processes of adoption of the innovation for specific local contexts and the conditions that support scaling. Results generated from the different stages were disseminated to stakeholders in federal/provincial ministries of education and relevant regulatory and professional bodies to seed it into the policy agenda of the respective countries.

The HOTIE rubric explicitly presented the different levels of teachers' KAP to evaluate the impact of the intervention. Stages of Concern and Levels of Use were used to capture the varying needs and concerns of participants during the pilot implementation. These insights led to the development of the scaling and sustainability strategies. Along with CBAM, Moore and Benbasat's innovation diffusion framework (1991) was also used to understand the teachers' perceptions. This framework comprised of 7 characteristics:

1. Voluntariness: the perceived degree to which participants voluntarily participate.
2. Relative advantage: the extent to which the teachers perceived CL4STEM suggested strategies to be better than the existing ways of teaching.

3. Compatibility: the degree to which CL4STEM is compatible with the existing context of the teachers.
4. Image: it focuses on how does participating in this project affect the teachers' social or professional status.
5. Ease of Use: this characteristic focused on the teachers' ability to successfully participate in CL4STEM modules and CoPs, as well as, implement the lesson plans.
6. Results Demonstrability: the degree to which the results from participation in CL4STEM could be tangibly demonstrated and communicated to others.
7. Visibility: the extent to which the results of participation in CL4STEM would be observable in the schools

Data Collection

Data were collected in three phases, baseline, midline, and end line. Each of these phases had two specific foci- to study the impact of the implementation on change in teacher knowledge, attitudes and practice, and to study teachers' perceptions of CL4STEM as they evolved overtime. Teachers were the main participants in the implementation. There were 80 teachers in total (20 each from Physics, Chemistry, Maths, and Biology) who participated in the pilot intervention. Out of these 80, 20 teachers (5 each from Physics, Chemistry, Math, and Biology) were in the focus group. The only difference between focus group and other teachers was that focus group teachers were interviewed at every stage of data collection (baseline, midline, and end line). Table 2 shows how many participants responded to each research instrument.

Baseline Tools	Teacher Profile	Teacher Perceptions Survey	Subject Impact Survey	Interviews
Focus Group	5	5	5	5
Others	15	15	15	0
Total per subject	20	20	20	5
Total (all subjects)	**80**	**80**	**80**	**20**

Table 2. Overview of Baseline data

Baseline tools consisted of

1. Teacher and school profile surveys to collect the demographic data about the participants and understand the context in which teachers would be working in.
2. Teacher perception surveys to capture the expectations of teachers before they participated in CL4STEM. This tool was designed on the Moore and Benbasat's characteristics of innovations (1991). Stages of Concern and Levels of Use from CBAM were not used in Baseline data collection as the participants were not exposed to the intervention at all at that time frame.
3. Subject impact surveys that assessed teachers' existing subject matter knowledge, pedagogical content knowledge, and general pedagogical knowledge for their subject. This survey was based on the HOTIE framework described earlier.
4. And Interviews, to complement the subject impact and teacher perception surveys data. Interview questions focused on understanding the teacher's conceptual understanding of Science/ Mathematics, knowledge and attitudes towards general pedagogical knowledge, pedagogical content knowledge, equity and inclusion, ICT based teacher professional development, online communities of practice, and perceptions towards implementation of CL4STEM.

Baseline data collection happened in June and July 2022. As indicated in the table above, Baseline survey data was collected for all sets of teachers, newly qualified teachers, experienced teachers, and as well as control group teachers. However, interview data was collected only from focus group teachers. Data was collected from control group teachers, even though it has not been analyzed in this report. Midline data collection focused on capturing the qualitative aspects of the implementation. A key component of the midline data was classroom observations. Research fellows conducted classroom observations for 2 teachers per subject (8 teachers in total), and 3 observations per teacher– 24

observations in total, while also interviewing the same teachers. Table 3 shows how many teachers were observed, and how many times.

During the classroom observations, the research fellows wrote detailed descriptions of the lesson+ that they observed. They also conducted a pre and post observation interview with the teacher to understand the context of the lesson. Along with classroom observations, qualitative interviews that focused on their knowledge and attitudes towards SMK, PCK and GPK, participation in online Telegram CoPs, and the teacher's perceptions of CL4STEM. The perception questions also included questions on Levels of Use and Stages of Concern from the Concerns Based Adoption Model (CBAM), along with Baseline questions on adoption. Midline data collection went on from September 2022 to November 2022.

Midline Tools	Classroom Observation	Interviews
Total per subject	6 (2 teachers x 3 observations)	5
Total (all subjects)	24	20

Table 3. Midline data overview

Lastly, the End line tools consisted of the following:

1. Subject survey, which was a repeat of the baseline subject impact survey and measured teachers' knowledge and attitude towards high order teaching and learning with equity and inclusion by assessing their subject matter knowledge, pedagogical content knowledge, and general pedagogical knowledge.
2. Innovation diffusion survey, which was also a repeat of the innovation diffusion survey conducted in baseline. It also included questions on the Stages of Concern and Levels of Use with regards to CL4STEM, as asked in the midline data collection phase.
3. Interviews with the same set of teachers who were interviewed in baseline and midline. These interviews focused on innovation diffusion, by capturing teachers' perceptions about the innovation after the completion of implementation. The interviews also focused on capturing teachers' knowledge, attitudes and practices around higher order teaching and learning for equity and inclusion, to supplement the survey data. These interviews also captured teachers' experience in the project, as well as their reflections on participating in the module and online CoPs.

End line data collection happened between November 2022 to January 2023. An overview of the End line data collected is shown in the Table 3 below:

Endline Tools	**Innovation Diffusion Survey**	**Subject Impact Survey**	**Interviews**
Focus Group	5	5	5
Others	15	15	0
Total per subject	25	25	10
Total (all subjects)	**80**	**80**	**20**

Table 4. Overview of Endline tools

Results and Discussion

The findings from interviews indicate that teachers' understanding of CL4STEM innovation seem to improve from baseline to end line. This suggests that teachers' participation seems to enhance their understanding. Levels of Use and Stages of Concern surveys come from the Concerns Based Adoption Model (CBAM) developed by Hall (1974). These surveys focus on understanding the practices and attitudes of participants towards a particular intervention. As discussed in the methodology section, Levels of Use focuses on the different levels of engagement and practice of participants with the CL4STEM model (Modules and CoPs).

In CL4STEM, interview participants (n=20) shared their responses for SoC and LoU questionnaires at both midline and end line. At the end line, along with focus group participants, all the participants in the intervention group participated in the SoC and LoU survey. Analysis of these surveys are hereby presented below.

Levels of Use

Levels of Use (LoU) identifies 4 levels of engagement for participants with an innovation— non-use, orientation, preparation and full use. In CL4STEM, 7 statements were used to capture these different levels of engagements.

Overall Levels of Use	**Focus group (20)**	
	Midline	**End line**
Non- Use		
Little or no knowledge of CL4STEM, No involvement and/or no intention to be involved	-	-
Orientation		
Trying to know more about CL4STEM	-	-
Not yet assessed CL4STEM modules and Telegram groups (CoPs) but plan to do so soon	-	-
Preparation		
Still learning how to effectively navigate CL4STEM modules and Telegram groups (CoPs)	2	0
Comfortable with CL4STEM online module and Telegram groups (CoPs)/ Able to implement the teaching strategies in my class as per instructions given in the modules and discussions in Telegram groups (CoPs)	7	6
Full use		
Have adopted CL4STEM teaching strategies to meet the different needs of my students (without diluting the core objectives of CL4STEM-PCK+UDL/Higher order teaching with inclusion and equity)	3	1
Having internalized the CL4STEM teaching strategies, able to collaborate with other teachers around CL4STEM teaching strategies to meet the different needs of students	7	9
Having internalized the CL4STEM teaching strategies, now in a position to suggest well thought out modifications and alternatives to the present innovation	1	1
Total	**20**	**17**

Table 5. Results on level of use from the baseline to the end line surveys

The table reveals that none of the teachers at both the midline and end line interviews were yet trying to know more about CL4STEM and none also were yet to access the module at the midline and end line. At the baseline 2 teachers were still learning how to effectively navigate CL4STEM modules and Telegram group (CoPs) while none was at the end line. On the number of teachers that have internalized the CL4STEM teaching strategies, able to collaborate with other teachers around CL4STEM teaching strategies to meet the different needs of students, the number of teachers has moved from 6 at baseline to 9 at endline. The number of teachers at the baseline of those who are comfortable with CL4STEM online modules and telegram groups (CoPs)/able to implement the teaching strategies in class as per instructions given in the modules and discussed in the Telegram groups (CoPs) was 7 at baseline but decreased to 6 at the endline. The number of those teachers that have adopted CL4STEM teaching strategies to meet the different needs of students without diluting the core objectives of CL4STEM (PCK+ UDL/Higher order teaching with inclusion and equity) was 3 at the baseline but decreased to 1

at the endline. Seven teachers reported that, 'Having internalized the CL4STEM teaching strategies they are able to collaborate with other teachers around CL4STEM teaching strategies to meet the different needs of students. Teachers choosing this level of use increased to 9 in the endline.

Only 1 teacher chose at both the baseline and endline that they had internalized the CL4STEM teaching strategies and was in a position to suggest well thought out modifications and alternatives to the present innovation at both the baseline and endline. It can be deduced that the teachers have improved from the low level of use of the modules at the midline to higher level of use revealing a trend towards higher order of engagement in the table. The reasons the teachers gave for their choice of the categories of the level of use are more of expression of positive perception for the project and which reflected the experiences the teachers have had in the implementation of the modules. The reasons given by the teachers reflect that they find the modules easy to understand, more capable of organizing group work and employ the other CL4STEM teaching strategies, capable of engaging students in learning activities, well used to UDL principles and ensuring equity and inclusiveness in class, have capacity in adopting the UDL principles and other teaching strategies to teach other topics in the curriculum, capability to accessing online module more easily, and being able to implement the modules even when needed apparatus are not available, etc. The trend of teachers' level of concern from midline towards higher levels of concern at the end line and their positive perception as reflected in the reasons given could be associated with the teachers' participation in the implementation of the modules over the time. From the end line survey, the highest percentage of teachers (36%) reported that they are comfortable with the CL4STEM model and able to implement the teaching strategies in their class. Thirty percent (30%) of teachers reported that they have adopted CL4STEM teaching strategies to meet the different needs of their students. About 14% of teachers reported that they were able to collaborate with other teachers around CL4STEM strategies.

3.1 Stages of Concern

Stages of Concern (SoC) is another part of the concerns based adoption model. It focuses on the teachers' attitudes towards the CL4STEM model. These various stages are: unconcerned, informational, personal, management, consequence, collaboration and refocusing. The original 35 item questionnaire from CBAM was adapted into a 7-item survey for meeting the practical constraints of implementation. The stages of concern analysis are presented next.

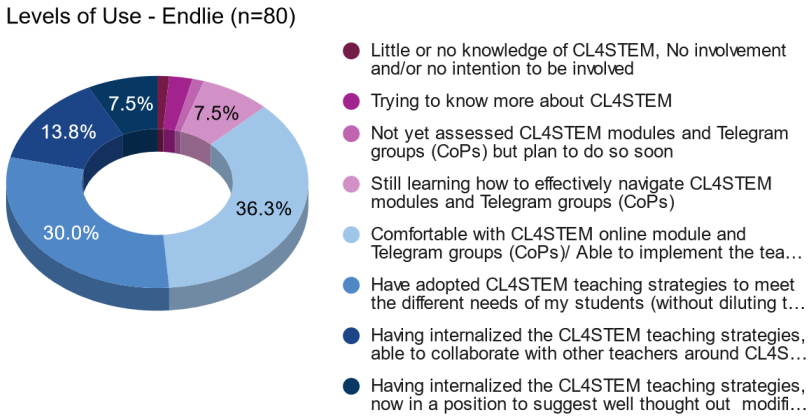

Figure 1. Percentage distribution of level of use at Endline

Overall stages of concern	**Focus group (20)**	
	Midline	**Endline**
Not interested to participate in CL4STEM	-	-
Know about CL4STEM, and would like to use at some point in time	-	-
Concerned about the demands of CL4STEM vis-a-vis existing workload and how it fits in the existing working conditions	3	7

Grappling with how to effectively navigate the online modules and participate in the Telegram groups of CL4STEM	4	2
Evaluating how CL4STEM teaching strategies impact/help in student learning	-	-
Exploring ways of collaboration with other teachers and educators to help impact student learning using CL4STEM teaching strategies	11	3
Exploring ways of improving CL4STEM teaching strategies through further refinement of the modules and CoP participation and/or alternative ways of achieving better results	1	5
Total	**19**	**17**

Table 6. Counts of level of use between Midline and End line

Table 6 reveals that there is an increase in the number of teachers exploring ways of improving CL4STEM teaching strategies through further refinement of the modules and CoP participation and/or alternative ways of achieving better results from 1 at midline to 5 at end line. There is a decrease in the number of teachers that are exploring ways of collaboration with other teachers and educators to help impact student learning using CL4STEM teaching strategies from 11 at the midline to 3 at the end line. None of the teachers at the end line was still grappling with how to effectively navigate the online modules and participate in the Telegram groups of CL4STEM compared to 4 at the midline. At the midline and end line none of the teachers would want to know about CL4STEM, and would like to use it at some point in time. No teacher at both the midline and end line indicated not having interest in participation in CL4STEM. The teachers have chosen to be more concerned about the demands of CL4STEM vis-à-vis existing workload and how it fits into the existing working condition as this number increased from 3 at baseline to 7 at the endline. The reasons given by the teachers for their various choices of stages of concern are generally centered on the following challenges they experienced while implementing the modules at both the midline and end line;

i) High workload resulting in number of classes taught and large number of students.
ii) ICT facility and internet challenges.
iii) None alignment of the module with the school sessional calendar and the schools' time table

Consequently, the teachers have often scheduled separate lesson time for the teaching of the CL4STEM topics with this further compounding their workload.

The survey conducted with all 80 participating teachers shows that the highest percentage of teachers (37.5%) reported that they are exploring ways of collaboration with teachers and teacher educators to help impact student learning using CL4STEM teaching strategies. Exploring how CL4STEm is impacting students' learning (23.8%), followed by ways of improving CL4STEM strategies (18.8%). In total 80% of participating teachers have selected sophisticated stages of concerns and it indicates a nuanced understanding of the CL4STEM model of professional development.

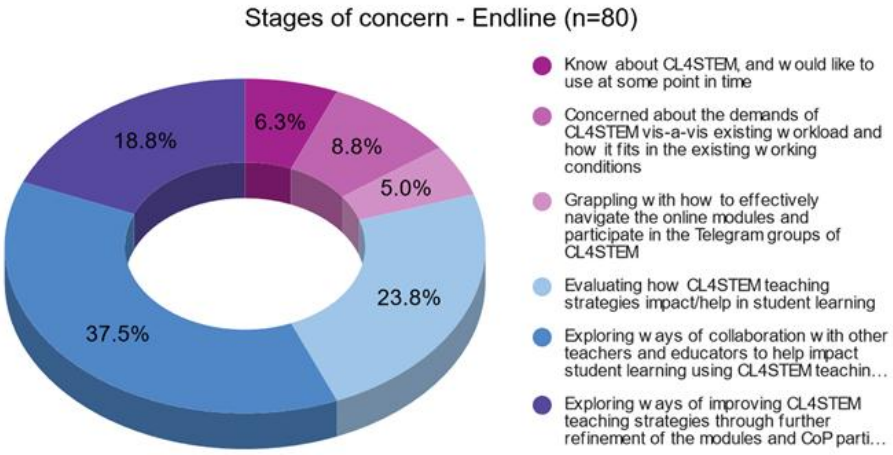

Figure 2. A pie-chart showing the percentages of stages of concern at the endline survey

*3.2 **Perceptions***

Perception survey was designed based on the Moore and Benbasat (1991) instrument to measure the perceptions of adopting an information technology innovation. The survey had 23 items on seven themes. The changes from baseline to end line on these seven themes are presented below.

Voluntariness

In the context of CL4STEM, voluntariness seeks to ascertain whether the participating teachers freely joined and participated in the project or were compelled by their principals or head of their schools to participate in the CL4STEM project. Data from interviews on voluntariness indicated that most teachers were nominated by their principals but they were not compelled by the principals to stay in the project. Ten of the respondents in the baseline simply indicated "voluntary participation". There seems to be an increase in teachers' (15 teachers in the end line compare to 12 in the baseline) voluntariness. It is logical to conclude that even though the teachers were selected by their principals or school management, they generally agreed to participate. One of the teachers highlighted that we filled a consent form therefore, he was not compelled to participate. These findings could have implications for scaling of this project in Nigeria. Only 15% of teachers agreed that the school principal did not require them to participate in CL4STEM project in baseline and it decreased by 8% in the endline. Forty-six percent (46%) of teachers agreed that participation is not compulsory and it increased by 9% in endline. This indicates that principals' permission was required for participation but it was not compulsory. Voluntariness was on average 31% in the baseline and there was no change in the endline.

When the data was sliced[3] based on gender, female teachers have shown a positive change of 6% towards voluntariness; there is negative change (-2%) reported by male teachers. Teachers with five or lesser years of experience have shown negative change (-4%) while more experienced teachers have reported 3% increased towards voluntariness. When the responses were compared between state and federal government school teachers, there was no change in federal government school teachers while teachers from state school reported slight increase in voluntariness (1%). Chemistry and physics teachers have shown 5% increase but biology (-5%) and mathematics (-3%) teachers have reported negative change.

Relative Advantage

Relative Advantage is the degree to which science and mathematics teachers perceive CL4STEM or the innovation associated with CL4STEM instructional practices as better than their existing classroom practices which are mostly characterized by traditional classroom practices. Interview data on the relative advantage of CL4STEM indicates that teachers' responses clearly indicated that the project has relative advantages over their usual classroom practices. Generally, all the twenty focus group teachers indicated that CL4STEM has helped them to teach their students better. In the baseline itself the average agreement to the five statements was 88%. And there was a 6% average increase in agreement with all statements in the endline. This shows that teachers perceive the CL4STEM model of TPD as more advantageous than the existing ones. Change from baseline to endline for male and female teachers with regards to relative advantage of cl4stem was same (+6%). Female (96%) teachers had slightly more agreement than male (92%) teachers in the endline. Teachers with five or less than five years of experience have reported more positive change (+13%) than more experienced teachers (+2%). Federal (-18%) government school teachers have shown a negative change towards relative advantage while teachers from state government schools reported a positive change of 8%. Amongst the subject teacher mathematics (12%) and physics (+17%) teachers reported positive change in agreement. There is no change amongst chemistry teachers. Biology teachers have shown negative change (-6%).

Compatibility

Compatibility in this study indicates the extent to which CL4STEM innovation is perceived as being consistent with teachers' instructional experiences in the classroom. In the context of this study, it could be seen as a state in which the innovation and teachers' everyday classroom are able to exist or occur together without conflict. The interview data seems to indicate that the innovation is very compatible

with their experiences. A teacher believes that CL4STEM is compatible with his classroom activities but has reservations about its implementation on a large scale. Overall, teachers believe that the CL4STEM is compatible with their everyday classroom experiences. These findings seem to collaborate the results of the quantitative data. The perception survey had three 7-point Likert statements that aim to assess the compatibility, which according to Moore and Benbasat (1991) is the degree to which CL4STEM (the innovation) is perceived as being consistent with existing values and past experiences of teachers. Average of 83% of teachers agreed that CL4STEM is compatible with their teaching. This agreement increased by 8% in the endline.

At the endline survey an average of 91% of both male and female teachers reported agreement with statements regarding CL4STEM compatibility with their existing teaching practice. It was 1% increase for female teachers and 11% increase for male teachers from baseline. Teachers with 0-5 years of experience (+11%) and more experienced teachers (+6%) showed an increase in agreement with the statements in the endline. There is a decrease in percentage of federal government school (-13%) teachers in the endline while there is positive change in state government school teachers (+10%). Except for biology teachers (-2%) other subject teachers reported increased agreement ranging from 5-22% in the endline.

Image

Image refers to deploying the CL4STEM practices that can enhance the image of the teacher. Interview data indicate that participating in the project by the teachers enhances their image and the image of their school. The teachers admit that the project has improved their image among their colleagues. The trends in the data show that 7 teachers at the baseline sample indicated that the project enhance their image but in the midline and endline, 14 teachers indicated that CL4STEM enhance their image and the image of the school. These findings which enhanced the image of teachers and the school have implications for CL4STEM project acceptability and scaling. Average of 76% of teachers indicated that participating in CL4STEM gives more prestige and is a status symbol. The percentage of teachers increased slightly to 78% in the endline. There was no change in percentage of female teachers while male teachers increased by 3% in the endline. Teachers with 0-5 years of experience showed a 12% increase while the percentage of experienced teachers decreased (-3%). Again, like with relative advantage and compatibility federal government teachers (-17%) percentage decreased in endline and state government teachers' percentage increased (4%). With regards to subject teachers, biology (-7%) and chemistry (-2%) teachers decreased while maths (+2%) and physics (+15%) teachers increased in the endline.

Ease of use

Ease of use refers to CL4STEM practices that require a manageable physical and mental effort on the part of teachers to implement. Interview data was collected to explore teachers' perceived ease of use of the CL4STEM innovation. Ease of use could be a strong determinant of the adoption of the innovation. The findings seem to indicate that at the beginning the participating teachers did not find the module very easy to use or navigate which could be attributed to their level of ICT proficiency and other factors. Most of the respondents in the midline and end line perceived the module to be easy to use. In the baseline survey an average 84% of teachers agree to four statements on ease of use, that CL4STEM modules and CoPs are easy to use. This percentage increased by 7% and the average was 92% in the endline. So, overall teachers perceived that the CL4STEM model is easy.

When the data was sliced based on gender both male and female teachers' agreement increased, but not much difference. Teachers with 0-5 years of teaching experience (+10) had more positive change than more experienced teachers (+7%). Again, federal government school teachers have decreased in agreement (-13%) and state government teachers increased by 10%. Mathematics (+13%) and physics (+21%) teachers' percentage increased while there was a slight decrease in biology (-1%) and chemistry teachers (-2%).

Result Demonstrability

According to Moore and Benbasat (1991), result demonstrability means the tangibility of the results of using CL4STEM modules and CoPs, including their observability and communicability. It refers to the

extent to which implementing the CL4STEM innovation produces positive outcomes or benefits or the degree to which the use of the innovation is perceived to enhance the teaching and learning of science and mathematics. Results demonstrability was observed by 3 teachers who returned to school to share their knowledge with other teachers who were not participants in the CL4STEM project. The findings from interviews on results demonstrability could have positive implications for the scaling of the innovations to other subjects or other populations. From the survey conducted, it is observed that 79% of teachers have agreed that the results of participating in CL4STEM are clear and easy to communicate in the baseline and there is an increase of 3% in the endline. Both male and female teachers' percentage of agreement did not change in the endline. Teachers with 0-5 years of experience had positive change (+8%) while more experienced teachers had a negative change (-4%). The percentage of teachers from federal government schools reported a drop of 19% while there was an increase of 2% in teachers from state government schools. All subject teachers reported a decrease in endline with chemistry teacher (-11%) at the maximum, followed by physics (-4%), biology (-2%) and mathematics (-1%).

Visibility

Visibility seeks to measure the popularity of the innovation in schools. The findings on visibility appear to be mixed. Some highlighted that CL4STEM is visible in their schools while others objected to that. In the midline 6 teachers highlighted that the innovation is visible in their school.

Many believed it was no longer a new idea to the school management and to some older science teachers. Because at the beginning of this term, they had a particular seminar to sensitize the teachers on how to use digital ways of teaching, and how to use the Internet to teach their students. There is not much change from baseline to endline survey in terms of visibility of teachers using CL4STEM in their schools. This also reflected in the interviews. Teachers mentioned that only mathematics and science teachers are involved, social science and language don't know about CL4STEM modules.

There was not much difference observed in terms of gender. In terms of teaching experience, teachers with 0-5 years of experience showed a decrease (-6%) in the endline while experienced teachers showed a slight increase (+2%). Percentage of federal government school teachers' agreement increased by 19% in the endline while state government teachers' percentage decreased (-3%). Mathematics (-25%) and chemistry (-8%) teachers reported a negative change while physics (27%) and biology (3%) teachers increased in the endline. In the baseline itself the percentage of teachers agreeing was more than 80% for relative advantage, compatibility and ease of use. Among the seven themes in the adoption of the CL4STEM TPD model, compatibility and result demonstrability had the highest increase of 8% in the endline. It was followed by relative advantage (+6%), result demonstrability (+3%) and image (+2%). Voluntariness was increased by one percentage and there was no change in visibility. There was no decrease in overall average for any of the seven themes. When the data was segregated on gender, years of experience, school type and subjects, except for teachers from federal government schools(n=8) and biology teachers every other category of teachers have shown a positive change in the endline.

Conclusions

From the situation analysis report that was written in the beginning of the project it could be seen that several government policies, programs, and interventions promote gender equity in the accessibility to education in Nigeria. However, literature has pointed out high gender inequality in terms of accessibility to education in favor of boys across all levels of education (Mustapha, 2009). Women are grossly underrepresented in terms of enrolment, participation, and achievement in science, technology, and mathematics at all levels of education in Nigeria (Ayeni, 2021). This was reflected in the CL4STEM intervention as well. There were fewer female teacher educators and teachers compared to male participants, especially in mathematics. There were more biology teachers and teacher educators. Female participation was low in research and implementation teams. So while scaling the project efforts will be made to make participation more gender inclusive. Nigeria is currently faced with insecurity that is ravaging and destroying households and destabilizing institutions. Many parents in the affected areas have withdrawn their children, especially female students, resulting in an increase in the number of out-of-school children (Bello, 2018). Female students' drop-out of school and this widens the gender difference in going to school.

The innovation involved online OER modules and mobile phone messenger application for CoP it required teachers to have access to a smartphone. Some teachers' participation was affected by deficiency. Quality of the phone affected their participation. Also, the internet is expensive. The project supported teachers and schools with internet packs and the Moodle platform was chosen as it enabled navigating modules offline. This feature was well appreciated by teachers as they could refer to the modules whenever they could without the internet. The launch of the project was very successful, it attracted critical stakeholders such as the ministry of education, professional organisations like the Science Teachers Association of Nigeria (STAN), Mathematics Association of Nigerian (MAN), and the Nigerian Union of Teachers (NUT). Other educational stakeholders include the Nigerian Educational and Research Council (NERDC) and Science and technical school Board, among others. The project was well publicized among stakeholders. The CoP was well appreciated by the participating teachers, the interaction among the teachers and between the teachers and teacher-educators was enriching and meaningful. The CoP was well accepted by the participating teachers.

Like in many projects, there were things that did not seem to work out as expected. Some of the things that did not work include the slow start by the participants attributed to the poor proficiency in the use of digital devices. Consequently, in subsequent scaling time and resources should be committed to training the participants on the basics of the use of digital devices. The findings in this study with regards to teachers' instructional practices indicate a shift from traditional classroom practices to the instructional practices embedded in the CL4STEM modules. the teachers' knowledge attitudes and perception towards engaging their students in classroom practices was enhanced. Collaboration or group work was a prominent instructional practice employed by teachers, the students were engaged in intellectual exchange of ideas among themselves and between them and the teacher to address equity and inclusion. The collaborative classroom environment during the CL4STEM activities encouraged the children to construct arguments, ask questions, justify their claims, criticize each other and make decisions; these could enhance higher Order thinking skills. The positive impact of the project with regards to instructional practices, provide a very strong basis for further scaling of the project.

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CREATIVE THINKING SKILLS OF STUDENTS THROUGH DESIGN-BASED LEARNING: A MANDATE FOR JUNIOR SECONDARY SCHOOLS IN NIGERIA

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Abstract
This paper explores the importance of equipping students with Creative thinking skills in response to the growing demand from employers in the 21st century. Specifically focusing on junior secondary schools in Nigeria, the study investigates strategies for restructuring the educational system to foster the development of Creative thinking abilities among young learners using design-based learning, 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 Creative thinking, the importance of Creative thinking to the nation, Design-Based Learning as a methods of inculcating Creative thinking skills in students specifically in junior secondary educational level. It was concluded that Creative thinking skills are critical for 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 design-based learning that are consistent with the development of Creative thinking skills in students.

Keywords; Creative thinking skills, Design-based Learning, and Secondary education

Introduction
The world is fraught with myriad of problems. These problems, created by man in his daily interactions with both his physical and social environments, are getting more and more complex by the day. According to Adeyemi (2012), in any society, human life is a series of confrontations- confrontation with oneself, with other people, with societal institutions and with one's environment. These leave man with limitless problems to battle with in the society. The person who can successfully deal with these problems and issues and that can face them squarely with self-confidence is the one imbued with the right type of knowledge, skills and competencies required to solve these problems. Education definitely has an obligation and function to equip the learners with the mechanisms of dealing with the problems and emerging dilemmas, in order to make them live a happy and fulfilled life in the society. This is 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 dynamic world and the unknown future. Obviously, current situations and problems may become obsolete when students of today face the world as adult's tomorrow. One of the tools which education (particularly higher education) can perfectly provide for these youngsters is Creative thinking which provides them with the needed skills to solve problems and issues in the environment regardless of their nature. More than ever before in Nigeria today, there is the need for commitment to the resolution of the 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, the world over, remains the most potent weapon of development. This is why in the National policy on education; it has been described as an instrument "par excellence" for effecting national development (FRN, 2013). Experts in the field of education have given various definitions to the term 'education'. Suffice it to give a simple and functional definition of the term, as it constitutes one of the key words of the title of this paper.

Angel-Fernandez and Vincze (2018), Lévesque and Clark (2018) 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".

When subjected to proper analysis, it is discovered that this definition perfectly agrees with the driving force of Nigeria's philosophy of education which are:

a. the development of the individual into a sound and effective citizen;
b. the full integration of the individual into the community; and
c. the provision of equal access to educational opportunities for all citizens of the country at the primary, secondary and tertiary levels, both inside and outside the formal school system (NPE, 2004).

However, the goals which the Nigerian nation is set to achieve through the provision of sound education to her citizens include:

a. the inculcation of national consciousness and national unity;
b. the inculcation of the mind type of values and attitudes for the survival of the individual
c. and the Nigerian Society;
d. the training of the mind in the understanding of the world around; and
e. the acquisition of appropriate skills and the development of mental, physical and social abilities and competencies as equipment for the individual to live in and contribute to the development of the society, (FRN, 2013).
f. As it can be observed, the needs and aspirations of the nation have been aptly captured by these goals. This goes to say that, any form of education provided in any country must take cognizance of the needs of its people for that education to be seen to be functional. 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.

Therefore, if education must be seen as performing 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 active and effective member of his society. One of such skills or abilities the learner is expected to be imbued with is Creative thinking, which is the focus of this paper. It is believed that the learner imbued with Creative thinking ability would be able to solve his personal problem(s), the problem(s) in his family and by extension, solve societal problem(s) in whatever sphere of life such problems may manifest (Adeyemi, 2012). This way, the learner becomes a problem – solver rather than problem – creator. And these are the kind of individuals the society desires to raise, which is in consonance with the goals of education mentioned above.

Concept of Creative thinking

Creative thinking features prominently in all the skills or abilities learners are expected to acquire through the type of education being provided. One, who cannot think, may not be able to solve even the minutest problem. We now live in a world of problems – social problem, economic problem, political problem, ethnic problem, religious problem, educational 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 or get out of the problem (Adeyemi, 2012).

Creative thinking like the concept of education has been defined in so many ways by writers and researchers. According to Oyler and Romanelli (2014) Creative thinking is regarded as a type of critical analysis has been described as "disciplined intellectual criticism that combines research, knowledge of historical context and balanced judgment: It is the ability to think logically and analytically. In other words, Creative thinking is the purposeful and reflective judgement about what to believe or what to do in response to observation, experience, verbal or written expressions or arguments. Thus, Creative 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 agrees with the one given by Bobkina and Stefanova (2016) as: "skilled and active interpretation and evaluation of observations, communications, information and argumentation". Creative thinking therefore gives due consideration to the evidence, the context of judgement, the relevant criteria for making the judgment well, the applicable methods or techniques for forming the judgment and the applicable theoretical construct for understanding the problem and the

question at hand. Creative thinking employs not only logic but broad intellectual criteria such as clarity, credibility, accuracy, precision, relevance, depth, breath, fairness and significance. In contemporary usage, the word "critical" may connote expressing disapproval, which is not always true of Creative thinking. A critical evaluation of an argument, for instance, might conclude that it is valid.

Similarly, Afsahi and Afghari (2017) has defined it as: "the intellectually disciplined process of actively and skillfully conceptualizing, applying, analyzing, synthesizing, and/or evaluating information gathered from, or generated by observation, experience, reflection, reasoning, or communication, as a guide to belief and action. In its exemplary form, the foundation claimed that it is based on universal intellectual values of clarity, accuracy, precision, consistency, relevance, sound evidence, good reasons, depth, breadth and fairness. In its simplest form, Creative thinking may be conceived of as that mode of thinking about any subject, content or problem, in which the thinker improves the quality of his thinking by skillfully taking charge of the structures inherent in thinking, and imposing intellectual standards upon them.

It may be observed from the above that Creative thinking entails those structures or elements of thought implicit in all reasoning such as purpose, problem or question – at - issue, assumptions, concepts, empirical grounding, reasoning leading to conclusions, implications and consequences, objections from alternative viewpoints and frame of reference. Creative thinking, being responsive to various subject matters, issues and purposes, is incorporated in a family of interwoven modes of thinking which include: scientific thinking, mathematical thinking, historical thinking, anthropological thinking, economic thinking, moral thinking and philosophical thinking (Afsahi and Afghari, 2017).

Creative thinking may be seen as having two components i) the skills to generate and process information and beliefs, ii) the habit of using those skills to guide behaviors, based on intellectual commitment. These components should be contrasted with:

a. the mere acquisition and retention of information alone, this is because it involves a particular way in which information is sought and treated;
b. the mere possession of a set of skills, because it involves the continual use of them; and
c. The mere use of those skills ("as an exercise") without acceptance of them

Consequent upon the foregoing, it may be summarized therefore that, Creative 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. They strive to diminish the power of their egocentric and socio-centric tendencies. They use the intellectual tools offered by Creative thinking such as concepts and principles that enable them to analyze, assess and improve thinking. They work diligently to develop the intellectual virtues of intellectual integrity, intellectual humility, intellectual civility, intellectual empathy, intellectual sense of justice and confidence in reason. They realized that no matter how skilled they are as thinkers, they can always improve their reasoning abilities and that they can at times fall prey to mistakes in reasoning, human irrationality, prejudices, biases, distortions, uncritical accepted social rules and taboos, self-interest and vested-interest. People who can think critically strive to improve the world in whatever ways they can and contribute to a more rational and civilized society. Even at that, they recognize the complexites that are inherent in doing so. They avoid thinking simplistically about complicated issues and strive to appropriately consider the rights and needs of relevant others. They also are aware of the complexities in developing as thinkers, and as such got committed to life-long practice toward self-improvement. The critical thinkers exemplify the Socratic principle: "The unexamined life is not worth living", because of their belief that many unexamined lives together result in an uncritical, unjust, and dangerous world (Achilov, 2017).

Importance of Creative thinking to the Nation

Implicit in the few definitions of Creative thinking attempted above is the importance of Creative thinking to the individuals in particular and the nation in general. No doubt, everybody thinks, and it is our nature to do so. However, thinking is often casual and informal. Most of our thinking if left to itself is biased, distorted, partial, 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. Shoddy thinking is costly, both in money and in quality of life. This fact underpins the importance of Creative thinking in the life of a nation and that of the individual (McPeck, 2016). This is because Creative 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 (Padmanabha, 2018). Creative thinking includes identification of prejudice, bias, propaganda, self-deception, distortion, and misinformation and among others. 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

Effecting Creative Thinking Skill in the Students through Basic Education

One pertinent question that comes to mind at this juncture is: "how to develop Creative thinking skills in students". It is interesting to note that Creative thinking ability can be inculcated in the learner at any point of the educational hierarchy (from primary school to tertiary institutions). What varies is the level of engagement at each level. Thus, while it is important to start developing Creative thinking in the learner right from the primary school, it is better affected in students at the tertiary level (Huang *et al.*, 2017). This is because students at this level are more mentally matured to cope with the rigors involved.

However, the question on how to develop the ability in students still remains. This is a methodological issue. What method do we adopt in order to effectively develop Creative thinking in the students? As may be observed, Creative thinking is about being both willing and able to evaluate one's thinking, and could be affected through the teaching and learning of any subject on the school curriculum.

Developing Creative thinking skills in students, involves learning the art of suspending judgement (for example, when reading a novel, watching a movie, engaging in dialogical/dialectical reasoning) (Vincent-Lancrin, 2023). To do this successfully, one should adopt a perspective rather than judgmental orientation; that is, avoiding moving from perception to judgment as one applies Creative thinking to issues. Creative 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 Creative 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; Creative thinking as a search for meaning and Creative 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. Creative thinking is highly significant to learning (Vincent-Lancrin, 2023). 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 - known as the process of application. Good teachers cultivate Creative thinking, that is, intellectually engaged thinking, at every stage of learning (Gunawardena & Wilson, 2021). The teacher questions the students often in a Socratic manner. The point here is that, the teacher who fosters Creative 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 Creative 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.

Design-based Learning

Design- based learning has been defined by so many scholars in many ways and there is no consensus in the definition of DBL. DBL has been referred to as a "model", "approach" or a "technique", or as "learning" or "teaching". Design-based learning according to Geitz and de Geus (2019) Design- based learning (DBL) is a model of instruction that exposes students' with real life, multidisciplinary problems that require Creative thinking, hands on activities and collaboration (Liang, 2022) Buck institute define DBL 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. Zhang *et al.* (2020) define design-based learning as a student centered approach that engages students' as they use the inquiry process as they are given a real world situation or problem to solve while also being aligned to content standards. In fact 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 Creative 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 (2015) pointed out the goal of DBL is to 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 DBL is inquiry, in a design-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 design- 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 (Sahin, 2015). The instructor provides the students with a list of guidelines, a time line, and helps them create a plan of action for the project (Silberman *et al*., 2021). The students' will decide how they will solve the design-based learning project through the use of the inquiry process. Due to the nature of design-based learning, the students' may arrive at a solution which is not an area of expertise for the instructor (Silberman *et al*., 2021). These situations create discussion opportunities and the possibility of a new and exciting solution to the problem (Silberman *et al*., 2021). Thus, creating a learning environment that is conducive and exciting for learners. The main focus of DBL is an emphasis on students' having autonomy to make decisions about the direction of their project (Boss & Stefanou *et al.* 2021). DBL 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 Creative 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:

a. Creative thinking is introduced as a separate subject or course in our learning institutions.
b. Teachers should be encouraged to operate more in classroom, at higher level of cognition than the lower level.
c. Teachers should adopt suitable methods of teaching such as Socratic method, Inquiry method, problem-solving method etc. that are consistent with the development of Creative thinking skill in students.
d. 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.
e. It is not just enough to acquire the knowledge and the skills involved in Creative thinking, learners should be encouraged to apply such skills in their daily lives.

In summary, according to Patton *et al.*, (2013) ability to think critically involves three things namely;

a. An attitude of being disposed (that is, the state of the mind regarding something) to consider in a thoughtful way the problems and subjects that come within the range of one's experiences;
b. Knowledge of the methods of logical inquiry and reasoning; and
c. Some skills in applying those methods

Creative 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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EFFECTS OF MOODLE PLATFORM-ENHANCED INSTRUCTION ON MOTIVATION AMONG CHEMISTRY UNDERGRADUATE STUDENTS IN TARABA STATE UNIVERSITIES, NIGERIA

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Abstract
This study investigated the effects Moodle Platform-enhanced instruction on motivation among chemistry undergraduate students in Taraba state universities. A Quasi-Experimental Pre-test, Post-test, Non-equivalent and Non-randomized groups Design was adopted. Two research questions and two research hypotheses were formulated for the study. Purposive sampling technique was adapted for the study. The sample size consists of 295 second year Chemistry universities students drawn from two Universities from Taraba State, Nigeria using an intact class, one school was assigned experimental group and the other as control group respectively. A validated Chemistry motivational inventory Scales (CMIS) was used. Cronbach alpha was used to determine the reliability of the instrument and the coefficient was found to be0.83. Data collected for CMIS was analyzed using mean rank and sum of rank to answer research question while Mann Whitney and Kruskal-Wallis were used to test the hypotheses at 0.05 alpha level of significance. The study revealed that students taught chemistry using Moodle platform enhanced instruction had significantly higher mean motivation scores than those taught using lectures method (N=295, U_{value} 5966.0, P_{value} 0.00<0.05). There was a significant difference in the mean motivation scores of male and female student in experimental and control group (N=295, df= 3 H_{value} 32.87, P_{value} 0.00<0.05). Based on the findings of the study, it was recommended among others that Universities should implement the use of Moodle platforms enhanced instruction in teaching and learning process for the purpose of developing positive motivation in students and Moodle platform should be used on single sex to improve their motivation in chemistry.

Keywords: *Motivation, Moodle Platform-enhanced instruction and Undergraduate Students.*

Background to the Study

Science education can be defined as the study of physics, chemistry, biology and Mathematics with teaching method in order to impart scientific knowledge to individuals or community. It is a field of specialization concerning with two basic aims, which are the production of scientifically interactive society and technological manpower. Science education in the area of academic and industrial activity is the backbone of industrialization and development of any nation. The science related disciplines that will enable the learner to have true knowledge of science and to be able to use it in solving problem are Physics, Chemistry, Biology and Mathematics. Science education are school subject that play an important role in life, they are important because they are the basic subject for the development of many study fields such as mechanical engineering, electronics, nuclear sciences, medicine and surgery, medical laboratory sciences, pharmacy and digital information system. Science education presents various problems, from the simplest to the complex ones, as well as from the macro to the micro ones. Science education contributes to the technological infrastructure and provides trained personnel needed to take advantage of scientific advances and discoveries (Saifullahi, 2021). It plays a major role in the area of health, economic development, energy and environment etc as much in chemistry.

To achieve and create valuable teaching e-learning environments, these learning management system platforms have provided students and teachers with better approaches to the teaching and learning processes that could enhance students' motivation (Sobowale *et al., 2019;* Gambari, *et al.*,2019). This calls for an examination of the effect of the Moodle platform on students' motivation in chemistry among undergraduate students using the Moodle platform. This platform has many capabilities, provided that they are used to their fullest. For example, interaction, feedback, conversation, and networking are some of the possible actions using the learning platforms. Furthermore, they provide a lot of opportunities to explore new methods of teaching and learning (Costa, *et al.*, 2012; Safiyeh, 2015),

which support a number of activities for course creation, administration, and delivery of lectures, as well as facilities for communication between participants through sharing information on a Moodle site.

Motivation is an internal drive that spurs one into action (Tus, 2020). It is an important psychological construct that drives a person's actions. Motivation is a strong desire or passion in a person that encourages the person to try and do something in order to succeed. Motivation affects student learning and plays an important role in directing behavior towards a certain goal, increasing effort and energy towards a goal, increasing the initiative and perseverance of an activity, and improving individual performance. Teaching science in a fun and effective manner will increase students' motivation to learn science (Saifullahi, 2021). They believe that if teachers give suitable feedback to the students on their level, initiate students' interest, make them understand the importance of the content, and have students share their ideas in classroom discussion, then the student's motivation increases as well as their achievement. Student effort toward academic achievement is controlled by motivational factors such as interest, competence, and autonomy. Gambari *et al.* (2018) opined that motivation is a state of empowerment with physiological, cognitive, and affective dimensions that makes individuals energized for a certain goal. It is also the willingness to perform an action, increasing eagerness to work, directing efforts, and directly affecting the performance of workers. It is an inner state that stimulates and triggers behavior. The two main sources of motivation identified by Gambari *et al.* (2016) are intrinsic and extrinsic motivation. Intrinsic motivation is described as the internal desires and willingness to perform a particular task, such as interest, enjoyment, and satisfaction, while extrinsic motivation refers to external factors that move an individual to carry out activities, including rewards, coercion, the threat of punishment, and so on. By applying the Moodle platform to the classroom, students may be motivated to learn in new ways or enjoy otherwise tedious tasks. Feizabadi *et al.* (2016) report that anything that aids learning should improve motivation, while things that lead to confusion or interference among learning materials decrease the speed and efficiency of learning and accelerate forgetting.

Gender inequality in science and science education in general has remained a perennial problem of global scope (Keter, 2018). Gender, according to Sobowale *et al.* (2020), is a socio-cultural construct of ascribing characters and roles to sex, such as males and females. Oludipe (2012), noted that the prevalent effects of gender bias and gender stereotypes in Nigeria affect certain vocations and professions, such that traditional professions like medicine, engineering, architecture, etc. are regarded as belonging to men while nursing, typing, catering, etc. are regarded as belonging to women. The stereotyping bias that science is a male enterprise is of great concern in the field of science education. The nation's quest for science and technological advancement will become a mirage if effective mechanisms are not put in place to incorporate innovative methods that promote active learning. Considering the importance of chemistry in all-round development, there is a need to make sure that chemistry is properly taught using innovative methods such as the Moodle platform.

Statement of the Problem

Chemistry is needed for the sustainable development of any nation, as its knowledge is important in the manufacturing of drugs, fertilizer, insecticides, food processing and storage, the management of our natural resources, the provision of food and health facilities, and a favorable living environment. Chemistry provides a natural link between home and school and is the means through which students understand the world around them and explore the wider implications of science in relation to man. Consequently, the teaching and learning of chemistry are of great concern to educators. Student's performance in the subject has not been satisfactory, and a good number of research efforts have been made to diagnose the problems associated with the teaching and learning of chemistry in order to propose solutions that could lead to better achievement. Among the factors that hinder students' achievement in Chemistry are students' background problems, students' lack of interest and/or negative attitude towards Chemistry; teacher-related factors such as poor teacher preparation, inadequately qualified Chemistry teachers, inadequate qualified Chemistry teachers, inadequate teaching and learning resources and poor teaching methods (Abudu & Gbadamosi 2014;Nur, *et al.*, 2020); lack of motivation (Gambari, *et al.*, 2018); inadequate teaching and learning resources and poor teaching methodologies (John 2017); abstract nature of chemistry (Ojoye *et al.*,2019); and inability of students to grasp the concepts in organic chemistry (Gambari *et al.*,2019). Despite the importance of chemistry

to mankind and the efforts of stakeholders to improve its teaching and learning, the achievement of students in the subject remains low in Nigeria. It is against this background that this study is aimed at finding out the effect of enhanced Moodle Platform instruction on motivation among chemistry undergraduate students in universities in Taraba State, Nigeria.

Aim and Objectives of the Study

Specifically, the objectives of this study sought to achieve the following:

1. To determine the effects of Moodle Platform enhanced instruction on Chemistry students' motivation among undergraduate students in universities in Taraba State,
2. To determine the effects of Moodle Platform enhanced instruction on Chemistry students' motivation based on gender among undergraduates in universities in Taraba State.

Research Questions

The following research questions guided the study:

1. What is the difference in the mean motivation score of students taught chemistry using the Moodle platform and those taught using lecture methods in universities in Taraba State?
2. What is the difference in the mean motivation score between male and female students taught chemistry using the Moodle platform and those taught using lecture methods in Taraba State Universities?

Research Hypotheses

The following null hypotheses are formulated to guide the study:

1. There is no significant difference in the motivation score of students taught chemistry using the Moodle platform and those taught using lecture methods in universities in Taraba State.
2. There is no significant difference in the mean motivation score between male and female students taught chemistry using the Moodle platform and those taught using lecture methods in Taraba state universities.

Theoretical Frameworks

The theoretical framework of this study is built on the constructivist theory of people knowing the world through their framework and helping them to organize as well as interpret their perceptions (Gambari, *et al.*, 2019). Constructivism in learning theory is defined as the active construction of new knowledge based on a learner's prior experience. Constructivism learning theory, which focuses on knowledge construction based on the learner's previous experience, is a good fit for online learning because it ensures learning among learners (John, 2017). A major focus of constructivists is situated learning, which sees learning as contextual. In most pedagogies based on constructivism, the teacher's role is not only to observe and assess but also to engage with the students while they are completing activities, wondering aloud, and posing questions to the students for the promotion of reasoning. Constructivists see learners as being active rather than passive, so they will be at the center of the learning, with the instructor playing an advisory and facilitating role. That will encourage the learner to arrive at his or her version of the truth, influenced by his or her background, culture, or embedded worldview (Keter, 2018).

Learning should be an active process by means of keeping learners active through high-level activities such as asking learners to apply information to practical situations, facilitating personal interpretation of learning content, discussing topics within a group, assessment, and so on (Bello & Abimbola, 2012). The constructivist classroom is an environment in which students will have enough time to develop mental models of the content, which will assist in moving that knowledge away from the primary content area so that it can be applied elsewhere (John 2017). Keter (2018) stated that the teacher is seen as a facilitator of learning, where learners are permitted to move around freely, use of time is flexible rather than structured, and evaluation compares learners to themselves rather than to peers, with a de-emphasis on formal testing. The constructivist classroom should be an environment based on inquiry, which will lead the learners to a deep understanding of the concepts under study. As a theory of learning, constructivism is relevant to this study, as the researcher wished to establish how learners learn using the Moodle platform using the constructivist theory as a framework for the study.

Methodology

The research design for this study is a quasi-experimental research design. Specifically, pre-test, post-test, non-equivalent, and non-randomized groups The design is considered suitable for this study since intact classes were used to avoid disruption of normal class lessons or activities (Gambari, *et al.*, 2019). The population for this study comprised 1198 chemistry students drawn from all the universities in Taraba State for the 2021/2022 academic session. However, a target population of 200-level undergraduate chemistry students at the two universities was used. A purposeful sampling technique was used to select the two universities. An intact class of two hundred ninety-five (295) undergraduate university students was selected for the study, consisting of one hundred and forty-six (146) males and one hundred and forty-nine (149) females.

The instruments used for data collection were Moodle Platform (MP) and the Chemistry Motivation Inventory Scale (CMIS), which were designed by the researcher. It consists of two sections. Section A dealt with the gender of the students. Section B consists of 25 positive motivational statements that are measured on a four-point Likert-type rating scale. The four-point Likert-type rating scale was used to enable students to indicate their level of motivation as follows: HM = highly motivated (4) M = motivated (3), MM = moderately motivated (2), and NM = not motivated (1) were positively scored. The instruments were validated by three experts in the Department of Science and Technology Education, Federal University of Technology, Minna, Niger State, which gives a reliability coefficient of **0.83** using Cronbach's alpha. The mean rank and sum of rank were used to answer the research questions, while the hypotheses were tested at a 0.05 alpha significance level using the Mann-Whitney test and the Kruskal-Wallis test using SPSS version 26.

Results

Research Question One: What is the difference in mean motivation score of students taught chemistry using Moodle Platform and those taught using lecture methods in universities in Taraba State?
To answer this research question mean rank and sum of rank was used and is presented in Table 1.

Table 1: Analysis of Mean rank and Sum of Rank Motivation Scores of Students taught Chemistry using Moodle Platform and those taught using Lectures Method

Group	N	Mean Rank	Sum of Rank	Mean Rank Difference
Moodle Platform	124	185.39	22988.00	64.50
Lecture Method	171	120.89	20672.00	

Table 1 reveals the analysis of the mean rank and sum rank of motivation scores of students taught chemistry using the Moodle platform and those taught using the lecture method. The mean rank scores for the experimental and control groups were 185.39 and 120.89, respectively, with a sum of ranks of 22988.0 and 20672.0, respectively. However, the mean rank difference for both groups is 64.50 in favor of the Moodle platform-enhanced instruction. Thus, there is a difference in the mean motivation scores between the experimental and control groups in favor of the experimental group. This indicates that Moodle platform group students' motivation capacity is higher than that of a lecture method in chemistry.

Research Question Two: What is the difference mean motivation score between male and female students taught chemistry using Moodle Platform and those taught using lecture methods in Taraba state universities?

To answer this research question mean rank and sum of rank was used and is presented in Table 2.

Table 2: Analysis of Mean rank and Sum of Rank Motivation Scores of male and female Students taught Chemistry using Moodle Platform and those taught using Lectures Method

Group	**N**	**Mean Rank**	**Sum of Ranks**	**Mean Rank Difference**
Moodle Platform				
Male	56	55.41	3103.00	12.98
Female	68	68.34	4647.00	

Lecture Method				
Male	90	89.77	8079.00	
				7.96
Female	81	81.81	6627.00	

Table 2 reveals the analysis of the mean rank and sum of rank motivation scores of males and females in the experimental and control groups. Males and females in the experimental group had mean rank scores of 55.41 and 68.34, with sums of rank of 3103.0 and 74647.0, respectively. The mean rank difference between male and female students in the experimental group is 12.98 in favor of female students. Males and females in the control group had mean rank scores of 89.77 and 81.81, with a sum of rank of 8079.0 and 6627.0, respectively. The mean rank difference between males and females in the control group is 7.96 in favor of the male students. Thus, there is a difference in the mean motivation scores between male and female students in both groups.

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Hypothesis One: There is no significant difference in the mean motivation score of students taught chemistry using Moodle Platform and those taught using lecture methods in universities in Taraba State.

Table 3: Analysis of Mann-Whitney U-test for Posttest Mean Rank of Motivation Scores of the Experimental and Control Group

Group	N	Mean Rank	Sum of Rank	U-value	P-value	Decision
Moodle Platform	124	185.39	22988.00			
				5966.0	0.00	Significant
Lecture Method	171	120.89	20672.00			

Table 3 presents an analysis of Mann-Whitney U-test analyses for the posttest mean rank and sum of rank of the experimental and control groups of the mean motivation score of students taught chemistry using the Moodle platform and those taught using the lecture method. The observed P-value is 0.00, and the alpha-value is 0.05 with df = 293. Therefore, the observed P-value is less than the alpha-value, and thus the null hypothesis is hereby rejected and it is concluded that there is a significant difference in the mean motivation score of students taught chemistry using Moodle platform-enhancing instruction and those taught using lecture methods in favor of the experimental group (U=5966.0, df=293 , P=0.00<0.05).

Hypothesis Two: There is no significant difference mean motivation score of between male and female students taught chemistry using Moodle Platform and those taught using lecture methods in Taraba state universities

Table 4: Analysis of Kruskal-Wallis test of Mean Rank Motivation Scores of the Male and Female students taught chemistry using Moodle Platform those taught using lecture methods.

Groups	N	df	H-value	P-value	Decision
Gender	295	3	32.87	0 .00	Significant

Table 4 presents an analysis of the Kruskal-Wallis H-test for the posttest mean rank of male and female students taught chemistry using the Moodle platform and those taught using the lecture method. The observed P-value is 0.00, and the alpha-value is 0.05 with df = 3. Therefore, the observed P-value is less than the alpha-value, and thus the null hypothesis is therefore rejected. It is concluded that there is a significant difference in the mean motivation score of male and female students taught chemistry using Moodle platform-enhancing instruction and those taught using lecture methods (H=32.87, df=3, P=0.00<0.05).

Discussion of Findings

The findings of this study revealed that there is significant difference in the mean motivation scores between students taught Chemistry using Moodle Platform enhanced instruction and those taught using lectures method in favor of Moodle platform. This finding agrees with Ahmed *et al.*, (2020) who found

that students have higher Motivation capacity when they are actively engaged in solving problems through Moodle Platform than when they become passive learners as obtained in the use of traditional method. The likely explanation for this outcome may also be connected to the fact that the use of Moodle Platform in science teaching orient students towards reflecting on, interpreting and searching for solutions to the problems themselves when compared to the Lectures method.

The finding also revealed that there is significant difference in the mean motivation scores between male and female students taught using Moodle Platform in favor of Female students. This finding agreed with the finding of Keter (2018) who found that female students' have higher motivation capacity than their male counterparts in Chemistry and also contradicts the finding of El-Seoud *et al., (*2020) who found that male students' have higher motivation capacity than their female counterparts in Science Education and with the findings of Gambari, *et al.,* (2017) who found no gender disparity in senior secondary students' motivation in Chemistry. However, the likely reason for the agreement of these findings could be that Moodle Platform method enhances greater motivation capacity of female students through lasting comprehension of things they do in comparison with the ones they only see or hear.

Conclusion

Based on the findings of this study it can be concluded that Moodle platform-enhanced instructions are more effective than the lecture method. The researcher inferred that the high mean gains achieved by the Moodle platform is as a result of student–to-student interaction, a flexible environment for online learning, a good alternative for the regular lecture, offers students instant feedback and places an emphasis on practice and mastering the information.

Recommendations

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

1. Workshops, conferences, and seminars should be organized by NUC, the Ministry of Education, and other school administrators on the need for the Moodle platform in the teaching of chemistry in order to enhance students'
2. The Moodle platform should be used by singles to improve their motivation in chemistry

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EFFECT OF EDUCATIONAL OUTCOMES ON POSTGRADUATE STUDENTS' PERSISTENCE IN ABUBAKAR TAFAWA BALEWA UNIVERSITY, BAUCHI

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Abstract
Globally, the significance of postgraduate students' persistence in higher education has been growing, but not all students manage to persist until completion. As a result, the extended duration of postgraduate studies has become a global concern, especially in ATBU. To address the issue, a cross-sectional survey design was adopted. 266 valid samples were finally obtained from an initial sample of 284, using adapted structure questionnaires. Descriptive statistics and linear regression analysis were used to analyse the collected data using SPSS 26. It was found that educational outcomes have a positive and significant influence on postgraduate students' persistence in ATBU, Bauchi. The study highlights the significant implication of educational outcomes in shaping postgraduate students' persistence at ATBU and other public universities worldwide, calling for prioritized efforts in enhancing educational outcomes and implementing support programs to promote postgraduate students' commitment to their academic pursuits.

Keywords: Educational Outcomes, Postgraduate, Students, Students' Persistence and Universities

Introduction

The importance of postgraduate students' persistence in higher education has been increasing globally over time. Student persistence, which refers to the timely completion or ongoing pursuit of a degree, has a substantial impact on institutions' financial planning. It directly contributes to institutional income through the postgraduate students' payment of tuition and fees (Burke, 2019). To increase postgraduate students' persistence, universities worldwide focused on capitalizing on staff and degree programs through measures such as offering professional development training and workshops, increasing staff reimbursement, and improving working conditions. Yet, until recently, postgraduate students' persistence and withdrawal from higher degree programs at Nigerian universities were often overlooked and not given the priority they deserved. Interestingly, the Nigeria government, specifically through the Tertiary Education Trust Fund (TETFUND), allocates more funds to postgraduate programs, particularly MSc. and PhD, due to the significant connection between research, industries, and economic development (Olufemi & Ayooluwa, 2021; Olufunmilola & Aina, 2023).

The TETFUND intervention in Nigerian universities leads to investments in modern educational facilities and innovation, fostering increased student commitment, engagement, and a collaborative teacher-student relationship (Ajayi, 2018; Dada et al., 2022). However, not all postgraduate students persist to completion. As a result, the extended duration of postgraduate studies has become a global concern (Desmennu & Owoaje, 2018). Tertiary institutions and states emphasize improving postgraduate students' persistence and graduation rates in both two- and four-year colleges and universities, but while some institutions have seen significant improvements, many others have not (Engstrom & Tinto, 2008; Tinto, 2015). As evidence, a significant proportion of postgraduate students were unable to complete their studies and graduate. For instance, less than 10% of postgraduate students admitted to Abubakar Tafawa Balewa University (ATBU) postgraduate programme from 2017/2018 to 2020/2021 academic sessions completed their studies, and the estimated overall dropout rate is more than 50%, with around 40% giving up at the thesis level. High postgraduate student withdrawal rates may result in a shortage of academic manpower, potentially disrupting the link between research and economic development (Xavier & Meneses, 2022). Understanding the factors that promote postgraduate students' academic persistence and outcomes is essential for developing effective strategies to support their success and retention in higher education.

One of the common determinants of postgraduate students' persistence is educational outcomes especially during and after their course work. The educational outcomes encompass the academic and social experiences of students in higher education, emphasizing the significance of providing a platform for students to share their perspectives, thus enhancing their First-Year Student Experience (Daniels & MacNeela, 2021). Understanding this factor can influence postgraduate students' persistence in university programs. It can also aid academic institutions in meeting postgraduate students' needs, enhancing their academic experiences, and boosting retention and degree completion rates. That is why, postgraduate students need to focus on enhancing their integration, including lifestyle, emotional competencies, and personal traits, as these factors directly influence their academic and social integration, and indirectly affect their graduation and persistence outcomes (Fortes et al., 2022). By doing so, educators can encourage postgraduate students to exert optimal effort to achieve positive educational outcomes (Ballis et al., 2022).

Unfortunately, the prolonged duration of postgraduate students remains a significant global concern and continues to increase despite several interventions (Desmennu & Owoaje, 2018). The research efforts recently put in place could not comprehensively address the issues as it keeps on persisting. There are many calls for more studies concerning postgraduate students' educational outcomes towards their persistence. One such is the suggestion for further research in diverse cultural contexts and transitional periods to investigate the connections between educational outcomes and students' persistence (Zhang et al., 2023), more especially in public universities like ATBU within Nigeria (Inuwa et al., 2023). It was based on this premise that this study examined the effect of educational outcomes on postgraduate students' persistence at Abubakar Tafawa Balewa University, Bauchi Nigeria.

Literature Review

Students' persistence and academic achievement

Students' persistence is the ability and willingness of students to continue their educational journey despite facing challenges and obstacles. It involves their determination and commitment to stay engaged in their studies, complete their courses, and achieve their academic goals. According to Gordon (2016), students' persistence is the ongoing progress towards an educational goal, typically degree attainment. It was observed that academic integration, quality of interactions with students, their feedback and students' satisfaction was found to positively influence students' persistence behaviour and differentially affected their persistence (Liu and Liu, 2000, in Ivankova & Stick, 2006; Ivins et al., 2017). In another dimension, multidimensional motivation was found to have direct and indirect effects on the intention to school dropout as mediated by academic achievement and absenteeism, even though they vary by gender (Balkis, 2018). He further revealed that low-ability beliefs do not directly predict the intention to drop out of school, but they do have a significant influence when mediated by academic achievement and absenteeism. On the other hand, variations in policies and practices may influence student retention and success (Cotton et al., 2017). Athens (2018) reported that online enrolments withdrew fewer students and have more level of student retention in comparison to face-to-face enrolments. He further reported that older students demonstrated strong statistically significant engagement and learning community scores compared to younger students with were more females motivated to complete their postgraduate studies.

Furthermore, Mamiseishvili (2011) discovered that in the university's first year, GPA, degree goals, academic integration, degree plans, and aspirations positively influenced university students' persistence, while social integration had a negative impact on their persistence. According to Rowan-Kenyon et al. (2016), low-SES students persisted from the first to the second year of higher institution, while educational expectations or rather, low or absent expectations were found to significantly predict the dropout for low-SES students in higher institutions. They further found that students persist at private four-year institutions compared to those who attended public four-year institutions. DeClou (2016) opined that being married and having children, are associated with a less likelihood of completing university studies. In another development, a research study indicated that academic achievement forms the basis of students' decisions to remain on their original university degree courses (Casanova, Cervero, & Núñez, 2018). It was also viewed that low academic achievement in their initial evaluations is a basis of stress and dissatisfaction which increases students' disconnection from their

classmates, university degree courses, and institutions (Casanova et al., 2018). That is to say, low academic performance by students at a higher level of learning affects their persistence in school.

Educational outcomes

Educational outcomes refer to the initial academic and social experiences of students entering higher education, highlighting the importance of creating a platform for students to share their perspectives, which can aid in improving their First-Year Student Experience (Daniels & MacNeela, 2021). It has been suggested that wealth may have a greater impact on the educational outcomes of children than the educational attainment of their parents. Children from underprivileged families may have to leave their studies early to support their families financially (Alcaraz, 2020). Financial investments, on the other hand, have been shown to have a linear relationship with children's educational outcomes. For instance, a hundred-dollar increase in investment is associated with a measurable improvement in children's outcomes, a trend that persists across the funding spectrum (Bailey et al., 2020). In addition, it underscores the importance of providing students with a forum to share their specific, personal perspectives on their first year as a means of improving higher education outcomes (Daniels & MacNeela, 2021). A crucial area that remains less understood is how genetic variations among individuals influence their educational outcomes.

Educational Outcomes and Postgraduate Students' Persistence

Recent studies have investigated various factors that can predict academic persistence and success in higher education. As a result, studies have explored various educational outcomes that predict academic persistence and success in higher education. In particular, Won and Lee (2023) found that grit among Korean adolescent students was fairly stable over one year, with parents' grit and educational expectations being significant predictors of longitudinal changes in students' grit. Similarly, Pusztai et al. (2021) found that engaging in volunteer work during higher education studies, along with having close relationships with parents, professors, and peers, and being individually well-off from objectively less affluent families, predicts academic progress and persistence. Conversely, Janelli and Lipnevich (2021) found that pre-tests and feedback did not affect learning outcomes for all students, and negatively affected persistence. However, among those who completed the course, pre-tests positively affected learning outcomes, and among those who took pre-tests, persistence positively affected learning outcomes.

Additionally, Huerta-Manzanilla et al. (2021) evaluated co-enrolment density (CeD) as a predictor of retention in 4-year bachelor of science programs in engineering, showing that students in denser co-enrolment clusters tended to graduate more than their classmates in less dense neighbourhoods. The SDE model tested by Fortes et al. (2022) with 400 diverse nursing students showed that social determinants, emotional intelligence, and lifestyle explained a significant portion of academic integration and persistence, with the SDE Framework offering targeted factors for faculty and administrators to consider when providing resources for students to succeed in college and their careers. Finally, Alcaraz (2020) found that increases in parental education decrease the likelihood of children dropping out of upper secondary school in Mexico, even when controlling for financial resources and other family- and household-level characteristics. The findings from these studies suggest that multiple factors play a role in academic persistence and success, including personal characteristics such as grit, social and environmental factors such as social determinants and co-enrolment density, and familial factors such as parental education. These findings can inform interventions and resources aimed at promoting academic success and persistence in higher education. Based on these findings, a possible hypothesis was developed:

***H_{a1}**: Educational outcomes positively and significantly influence postgraduate students' academic persistence.*

Methodology

A cross-sectional survey design will be used for this study. A cross-sectional survey design warrants data collection at one point in time (Creswell & Creswell, 2018). This type of survey design describes a population's trends, attitudes, behaviour or opinions by studying a population sample and using structured, open questionnaires or interviews data collected over time for generalisation (Gruszczyński, 2020). Hence, the cross-sectional survey design was appropriate for this study. The area of the study is

ATBU, Bauchi, including both Yelwa and Gubi Campus all situated in Bauchi Local government of Bauchi state Nigeria. The study focused on 5,088 postgraduate students admitted to ATBU between 2017 and 2021. From this population, a convenience sample of 203 students at the thesis/dissertation stage was chosen using GPower to ensure statistical validity but was later increased to 284 based on the 40% recommendation by Salkind (2018).

Moreover, 13 educational outcomes and 23 persistence measurement items were adapted from previous Bond and Cason (2014); Fortes et al. (2022). The structured questionnaires were distributed to postgraduate students from different faculties, and a total of 266 responses were finally collected, representing a high response rate of 95% of the initial 284 respondents. The collected data underwent thorough data cleaning and screening processes. The 95% valid response rate exceeds the minimum acceptance rate of 30%, as recommended by Sekaran and Bougie (2016). The survey instrument was administered and collected with the help of six research assistants, one from each faculty at ATBU. Data analysis involved descriptive statistics and linear regression analysis using SPSS version 26 to examine the study's constructs.

Results

Table 1 presents the demographic information of postgraduate students at Abubakar Tafawa Balewa University (ATBU) in Bauchi. The data were categorized into four main aspects: gender, educational level, faculty, age at first enrollment, and undergraduate CGPA. Regarding gender distribution, the majority of students are male, accounting for 76.7% of the total sample, while female students represent 23.3%. In terms of educational level, the majority of postgraduate students are pursuing a Master's degree, comprising 86.1% of the sample, while those enrolled in a PhD program make up 13.9% of the total. The data on faculties reveal the distribution of students across different academic areas. The Faculty of Technology Education (FTE) has the highest number of students, making up 48.1% of the total. Other faculties, in descending order of student representation, are the Faculty of Agriculture and Agricultural Technology (FAAT) with 12.0%, the Faculty of Management Science (FMS) with 12.8%, the Faculty of Science with 12.0%, the Faculty of Engineering & Engineering Technology (FEET) with 6.0%, and Faculty Environmental Technology (FET) with 9.0%.

Regarding the age at which students enrolled in their postgraduate programs, the majority of students (85.0%) were over 25 years old at the time of enrollment, while the remaining 15.0% were under 25 years old. Lastly, the table provides data on students' undergraduate CGPA. A significant portion of the students (80.5%) had a CGPA higher than 3 points during their undergraduate studies, while 19.5% had a CGPA lower than 3 points. Largely, the table shows that the majority of postgraduate students at ATBU, Bauchi are male, pursuing master's degrees, are from the Faculty of Technology Education, were over 25 years old when they first enrolled, and had an undergraduate CGPA of over 3 points.

Table 1: Demographic Information of the Postgraduate Students in ATBU, Bauchi

Gender	**Frequency**	**Per cent**
Female	62	23.3
Male	204	76.7
Total	**266**	**100**
Educational Level	**Frequency**	**Per cent**
Master’s Degree	229	86.1
PhD	37	13.9
Total	**266**	**100**
Faculty	**Frequency**	**Per cent**
Faculty Environmental Technology (FET)	24	9.0
Faculty of Agriculture and Agricultural Technology (FAAT)	32	12.0
Faculty of Engineering & Engineering Technology (FEET)	16	6.0
Faculty of Management Science (FMS)	34	12.8
Faculty of Science	32	12.0
Faculty of Technology Education (FTE)	128	48.1
Total	**266**	**100**
Age at first enrollment	**Frequency**	**Per cent**

> 25 years	226	85.0
< 25 years	40	15.0
Total	**266**	**100**
Undergraduate CGPA	**Frequency**	**Per cent**
> 3 points	214	80.5
< 3 points	52	19.5
Total	**266**	**100**

Table 2 presents the descriptive statistics of educational outcomes and postgraduate students' persistence at ATBU, Bauchi. The table shows that the mean for the educational outcomes for the sample was 3.93 (SD = 0.797), which is slightly above the midpoint of the scale. The skewness of the distribution was -1.276. The kurtosis of the distribution was 2.503. According to experts, in a normally distributed dataset, the acceptable range for skewness is between -2.0 and +2.0, and for kurtosis, it is between -3.0 and +3.0 (Cheng et al., 2021). The mean postgraduate students' persistence for the sample was 3.42 (SD = 0.633), which is slightly below the midpoint of the scale. The skewness of the distribution was -1.374. The kurtosis of the distribution was 2.540. Thus, the data suggests that the participants, on average, report higher educational outcomes (mean = 3.93) than postgraduate students' persistence (mean = 3.42).

Table 2: The descriptive statistics of educational outcomes and postgraduate students' persistence in ATBU, Bauchi

Constructs	N	Mean	SD	Skewness	Kurtosis
Educational Outcome	266	3.93	.797	-1.276	2.503
Postgraduate Students' Persistence	266	3.42	.633	-1.374	2.540

Table 3 shows the results of a linear regression analysis examining the influence of educational outcomes on postgraduate students' persistence in ATBU, Bauchi. The results show that educational outcomes have a significant positive influence on postgraduate students' persistence ($\beta = 0.558$, $p < 0.001$). The t-value of 10.919 suggests that this relationship is statistically significant. The F-value of 119.227 with 265 degrees of freedom also confirms the significance of the overall model. The 95% confidence interval for the coefficient of β is [0.363:0.523], which means that we can be 95% confident that the true value of β is between 0.363 and 0.523. Scholars suggest that a statistical hypothesis is considered significant at the 95% confidence level only when values of 0 or 1 are not present (Tibbe & Montoya, 2022). This means that there is a statistically significant relationship between educational outcomes and postgraduate students' persistence. The outcome indicates that the hypothesis (H_{01}) is accepted, meaning that there is a positive and significant influence of educational outcomes on postgraduate students' persistence. This implies that educational outcomes have a positive and significant influence on postgraduate students' persistence in ATBU, Bauchi.

Table 3: The influence of educational outcomes on postgraduate students' persistence in ATBU, Bauchi

Construct	β	*T-value*	*F*	*df*	*Sig.*	95.0% CI	Remark
Postgraduate Students' persistence	0.558	10.919	119.227	265	0.000	[0.363:0.523]	H_{a1} accepted

Note: CI: Confidence Interval

Discussion of Finding

The finding from the current study shows that educational outcomes have a positive and significant influence on postgraduate students' persistence in ATBU, Bauchi. The finding sheds light on the significance of educational outcomes in influencing postgraduate students' persistence at ATBU, Bauchi. The finding conforms with that of Won and Lee (2023) who found that educational expectations have a significant influence on students' determination to persist in their studies. Similarly, Janelli and Lipnevich (2021) also found that test outcomes significantly affected persistence for some students, as it positively influenced learning outcomes for those who completed the course. The role of educational outcomes in fostering learning and persistence across various contexts is evident.

In another study by Alcaraz (2020) at secondary school, he discovered that higher parental education levels decreased the likelihood of children dropping out of upper secondary school in Mexico, even after considering financial resources and other family-related characteristics. That was why Pusztai et al. (2021) note that students who engaged in volunteer work during their higher education were more likely to persist in their academic progress. This highlights the importance of fostering a supportive environment and engaging students in extracurricular activities to enhance their academic persistence. The current finding as distinct from the previous studies provides valuable insights into educational outcomes as one of the factors that contributes to students' commitment to their academic pursuits towards completion in a public university within the African institutional context. Thus, these studies collectively support the notion that educational outcomes play a critical role in shaping postgraduate students' persistence at ATBU, Bauchi.

Conclusion

In conclusion, the findings of this study strongly indicate that educational outcomes have a positive and significant influence on postgraduate students' persistence at Abubakar Tafawa Balewa University, Bauchi. The results align with previous research demonstrating the importance of educational outcomes in fostering students' commitment to their academic pursuits. By recognizing the critical role of educational outcomes in shaping students' persistence, the university can implement targeted interventions and support systems to enhance student success rates and create an environment that nurtures academic perseverance.

These findings contribute to the broader understanding of the factors affecting postgraduate students' persistence and provide valuable insights for educational institutions seeking to promote student retention and success. The study's implications for ATBU and other public universities worldwide emphasize the importance of educational outcomes in influencing postgraduate students' persistence. Institutions should prioritize efforts to enhance educational outcomes and provide support programs to foster students' commitment to their academic pursuits. By understanding the role of educational outcomes' contribution to postgraduate students' persistence, educators and policymakers can develop targeted interventions and support systems to enhance students' commitment and success in their academic journeys.

Limitations and suggestions for future studies

This study has a few limitations. Firstly, it only focused on postgraduate students' persistence at ATBU, Bauchi, limiting the generalizability of the results to other institutions and regions. Future research should consider conducting multi-institutional studies. Secondly, the study did not explore potential moderating or mediating factors that could influence the relationship between educational outcomes and postgraduate students' persistence. Future studies should look into other constructs like socio-economic background, mentorship, and institutional support that could provide deeper insights into the complexity of this relationship and enhance the overall understanding of the factors influencing postgraduate students' persistence.

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IMPACT OF SCIENCE, TECHNOLOGY, ENGINEERING AND MATHEMATICS (STEM) AND TECHNICAL AND VOCATIONAL EDUCATION TRAINING (TVET) IN ALLEVIATING HUNGER AND POVERTY FOR SUSTAINABLE SOCIO-ECONOMIC DEVELOPMENT IN NIGERIA

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Abstract
Writing of this article was undertaking to find out the impact of STEM and TVET in combating hunger and poverty in Nigeria. Development of a nation needs to be sustained in such a way that the enjoyment of today's generation in a society does not lead to suffering of tomorrow's generation. Every type of education functions in a way to support the socio-economic development of a nation. Among the determinant of nation's socio-economic development is peace, happiness and rest of the mind. All these require a nation to be poverty, hunger and crime free in the society. STEM and TVET types of education possess potentials for socio-economic development of a nation that are required to be explored. There is need to direct STEM and TVET types of education in a sustainable way to combat hunger and alleviate poverty. This paper intends to critically find out those potentials in STEM and TVET that should be integrated into Nigeria economy system to combat hunger and alleviate poverty. The paper discusses the concepts of Science, Technology, engineering and Mathematics (STEM) in relation to Technical and Vocational Education and Training (TVET); attributes and challenges of TVET in Nigeria; STEM and the society; and the prospects the Prospects and challenges of TVET in the economic growth of a nation. Among the suggestion are: that Nigeria government should increase the vote for STEM and TVET in the budgetary allocations to reduce or eliminate the factors combating the proper implementation of the programs; to make private sectors more involved in sponsoring programs of STEM and TVET at higher institutions of learning and to give special allowances for the teachers in the areas of STEM ad TVET.

Keywords: Science. Technology, Engineering and Mathematics; Technical and Vocational Education and Training; Poverty; Hunger; Sustainable Development and Economy**.**

Introduction

The bedrock of development is every society is the level at which the technology and science have been able to advanced. Science, technology, engineering and mathematics (STEM) and Technical and Vocational Education and Training (TVET) are very important tools of economic development of a nation because of their impact in the well-being of the society. STEM education is an area of career choice that is open to every individual (both male and female) to pursue in a society. Science, Technology, Engineering and Mathematics (STEM) education have often been perceived as the driving force behind economic development in the industrialized countries (Ugwu, Nwokocha & Ozioko, (2011). This implies that if STEM education can be well supported in a nation, it would go a long way to improve the socio-economic status and alleviate poverty. TVET on the other hand has been seen in so many ways as education or employment generation and means of poverty alleviation. Pavlova (2014) viewed Technical and Vocational Education and Training (TVET) as a tool for productivity enhancement and poverty reduction. The above clearly shown the importance of TVET as a type of education for productivity and poverty reduction. Both STEM and TVET are interrelated in a way because each of the two complements the other. Fosen (2016) describes TVET as the study of technologies, related sciences, and the acquisition of practical skills, attitudes and understanding. These above definitions project TVET as multi-directional type of education which has encompasses STEM education. The implication is that STEM and TVET types of education require special attention in a society in order to enhance their importance in socio-economic development. This explained the reason why the writers of this paper considered it necessary to find out the impact of STEM and TVET in alleviating poverty for sustainable socio-economic development.

Concepts of Science, Technology, Engineering and Mathematics (STEM) in Relation to Technical and Vocational Education and Training (TVET)

STEM and TVET are interrelated in the sense that different subject areas in STEM feature in the training process of TVET. There are TVET programs that embrace all STEM subject areas as core subject areas. This shows that STEM is the bedrock of TVET and vice versa. STEM possesses different professional subject areas and educational subjects/courses. Each of the educational areas of STEM is self-independent in the academic realms. Just as we have science education, we have Technology/Technical education, when all the subjects under STEM are interrelated. According to Ugo and Akpoghol (2016), Science is concerned with search for and understanding of knowledge about nature while Technology is concerned with the application of knowledge (science) in solving practical problems of everyday living. This expression implies that Science and Technology enable progressive cultural activities in a society. Thus, the ability of a society to improve on her Science and Technology determines the economic development of such society. Merritt (2009) described technology as a general term for the processes by which human beings fashion tools and machines to increase their control and understanding of the material environment. Ramsden (2012) also sees Technology according to the dictionary as the science of the industrial arts, from which it follows that a technologist applies scientific principles and imagination to the creation of useful products required by society. Ramsden concluded that engineering may safely be taken as a synonym for technology.

Technical and Vocational Education and Training (TVET) is the type of education under which technology and engineering education originate. Federal Republic of Nigeria (FRN) (2014) describes TVET as a comprehensive term referring to those aspects 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 relating to occupations in various sectors of economic and social life. The definition present science and technology education applied science, as it incorporated science and practical skills. Stark (2009) describes engineering as a term applied to the profession in which a knowledge of the mathematical and natural sciences, gained by study, experience, and practice, is applied to the efficient use of the materials and forces of nature. Engineering in this case is interrelated with technology. Therefore, engineering and technology are tools used in the same direction for the economic development at different stages. However, mathematics commonly features in science, technology and engineering.

Mathematics plays very significant roles in science, technology and engineering. It is not possible to remove Mathematics from any of science, technology or engineering activities. DeAngelis (2017) stated that, although mathematics may represent the last letter in STEM, it ranks first in importance. DeAngelis described mathematics as a subject that is very relevant in all activities of live. This implies that mathematics is common and fundamental in the group of STEM education and beyond. Mathematics also reflects favourably in all TVET programs. It is a subject that cut across every endeavour in life.

On a general not, STEM education is the basis of industrial growth in any nation. The above analysis shows that STEM subjects are interconnected and directly related to TVET. Invariably, STEM and TVET are very vital in the growth and stability of sustainable economic development. For this reason, STEM and TVET require better attention of government towards economic growth and sustainable development.

Attributes and Challenges of Technical and Vocational Education and Training (TVET) in Nigeria

Technical and vocational education and training (TVET) has been described in so many ways that showcased that it is a very important type of education in the socio-economic development of a nation. Okoro (2006) stated that Technical Vocational Education and Training (TVET) is the type of education that prepares individuals for work in an occupation. The main aim of TVET is to equip individuals with the necessary skills required to provide goods and services in a society. Ukachi and Ejiko (2018) described vocational and technical education (VTE) as the type of education that prepares people to work in various jobs, such as trade, craft or technician. Thus, TVET focus the need to equip individuals in the society with the needed skills and knowledge to work in an occupation or establish a business to

earn for leaving and generate employments. Due to the attributes of TVET, different agencies and government believed that TVET is a base for industrialization and self-reliance.

Nigerian government embraces TVET and has been making efforts towards raising the standard of TVET for the betterment of the nation. In the National policy on education, the Federal Republic of Nigeria (FRN) (2014) describes TVET as the type of education meant to give training and impact the necessary skills to individual who shall be self-reliant economically. This shows that Nigerian government believes that through TVET, individuals can be prepared to establish industries that would lead to industrialization and the economic growth of the country. The definition in the National policy on education also shows that STEM is very important in the pursuit of TVET. The aftermath effects of TVET in a society include the reduction of hunger and poverty alleviation if it can be well embraced.

Among the TVET based programs set up by Nigerian government towards generation of employments and alleviate poverty was the N-Power program in Nigeria. The issue of N-Power program in Nigeria was also discussed by Study4free (2016) who stated that Nigerian government has designed the N-Power program to provide young graduates and non-graduates with the skills in the areas that include agriculture and technology. The implication of this was that Nigeria government recognizes TVET as useful means towards industrial growth and economic development of the nation. Despite the facts that TVET is known as education for poverty alleviation and socio-economic development; the education sector is still facing some challenges that are hindering its proper functioning in many parts of the world including Nigeria.

TVET involves the teaching of theories and practical which are very vital as they depend on each other. Lucas, Spencer, and Claxton (2012) submit that, vocational skills/education needs to be taught in the context of practical problem-solving, and that high quality vocational education always involves a blend of methods. This depicts through the definition that TVET is practically oriented in the preparation of individuals for work in the real-world of occupation. TVET institutions of learning also combine both theories and practical in TVET methods as specified in its curriculum at various levels. Kilbrink (2012) submits that, TVET involved learning of theory and practice, and while the theory basically takes place in school, the practice is at work place. This is a replica method of TVET that cut across Nigeria, where TVET students learn theories with samples or practical models at school, and later go for industrial practical experiences at different work places to develop more of the practical skills in their chosen career. Since the students do not go to the same work place for industrial experience, there cannot be equal opportunity to the same practical skills; hence, the reason why there are differences in practical knowledge acquired by TVET graduates. Eniola and Iyiola (2017), James and Jone (2018) retreated that the available human and material resources at their places of attachment determine the level of experiences they will gain within the period assigned.

Technical and vocational education and training (TVET) possesses attributes that make it a distinct type of education with distinct challenges that range from lack of enough fund, inadequate facilities and poor image. The aftermath effect of challenges faced by TVET is worrisome as it causing poor level of indigenous technology development in the country. Ukachi and Ejiko (2018) mentioned that the poor level of technological development of Nigeria is too much comparing to advance nations of the world. Ukachi and Ejiko further stated that Nigeria is regarded as a consumer nation whose citizens are not employable due to lack of skills. This fact is obvious as most of the constructions and some services are foreign based. If TVET and STEM education can be favourably lifted up in Nigeria, there would be drastically reduction in the poor state technological development in the country.

Fosen (2016) also stated that TVET is the study of technologies, related sciences, and the acquisition of practical skills, attitudes and understanding. These above definitions project TVET as multi-directional type of education. TVET is the type of education that integrates other types of education. This is because the knowledge of general education is needed in its process; the requirement of technology, mathematics and sciences makes TVET to have direct link with STEM and it is practical oriented. Technical and vocational education and training (TVET) has some implementation challenges, which centred on the effective teaching and learning process.

Science, Technology Engineering and Mathematics (STEM) and the Society

The importance of STEM in economy and the industrial growth of a nation cannot be overemphasized. The importance of STEM in a society also requires high number of individuals to engage in STEM education towards reducing hunger and poverty in the society, there is need to pay better attention to STEM education. This would enable to build an industrial society and become independent in most areas of industrial needs. Ugo and Akpoghol (2016) mentioned that STEM is a tool for economic, social, and political development of a nation and its contribution to social, industrial and economic life of the world in general and Nigeria in particular have been felt on all phases of human life. It is therefore necessary for researchers in the area of STEM to keep researching for how STEM can be boosted to enhance industrial growth for sustainable economic growth of the nation. This would go a long way in creating peace, alleviating hunger and poverty in a society. United Nations (2016) stated the following about sustainable development:

> *"Sustainable Development Goal 9 addresses three important aspects of sustainable development: infrastructure, industrialization and innovation. Infrastructure provides the basic physical facilities essential to business and society; industrialization drives economic growth and job creation, thereby reducing income inequality; and innovation expands the technological capabilities of industrial sectors and leads to the development of new skills"*

The above shows what a country stand to gain if the STEM is well embraced and directed in such country. Thus, It is necessary to find out the impact of STEM education towards showcasing how it could be made accessible to individuals in the nation in order to enhance socio-economic growth of the nation.

Prospects of Technical and Vocational Education and Training in the Economic Growth of a Nation

Prospects of TVET are not hidden, as it is widely known as the basis for securing employment and becoming self-reliance. Amedoeme and Fiagbe (2013) stated that no country can develop without quality TVET sector. Therefore, TVET should not just be in existence in a society but should be utilized effectively for economic development. UNESCO (2022) recognized TVET as an aspect of education that play critical roles in helping the youths and adults to acquire skills needed for employment, fulfilling work and entrepreneurship. This implies that the expectation of TVET is to equip individuals with the sellable skills that make employment easy in different sectors of the economy. Thus, TVET equally possesses the attribute of preparing individuals for self-employment; the result of which is the expansion of the established businesses and industries for socio-economic growth of a country. The establishment of businesses mostly started on a small scale by the TVET graduates that chose to be self-employed, the result of which is the creation of more employment opportunities in the society and industrial growth. The growing of established businesses in a society results to rapid industrial development of a nation; which is a major factor of socio-economic growth. The above clearly disclosed the prospects of TVET as a means to enhance socio-economic development in a society. Despite the prospects of TVET to the economic growth of a nation, there are still problems hindering the effective productivity of TVET in Nigeria socio-economic growth.

Conclusion

Generally, the impact of STEM and TVET cannot be over emphasized in the economic growth of a nation. It is very obvious that the types of education that lead to so many wonderful occurrences in world today are that of STEM and TVET. STEM and TVET are units of education that practically hold the economic growth of a nation. This is because the two types of education are dynamic; it is through STEM education that new sciences and technology feature in a society which referred to as advance technology. When science deals with investigation of ideas, technology and engineering make use of the ideas at different industries in a society. Mathematics is a vital tool used every area of STEM and TVET. Being that TVET is the type of education for work; it actualizes the ideas brought about through investigation in STEM. TVET is also regards as the type of education that provides skills and knowledge for gainful employment in a chosen occupation. It is the TVET that directly responsible for skills needed for industrial expansion through the acquired skills for the establishment of businesses. Government embraces TVET and STEM as the type of education that can be used to equip unemployed

youths for employment opportunities. STEM and TVET are very important in every society for industrial growth and economic development. Every nation stands to gain a lot if STEM and TVET are well embraced and directed in such a way that they are productive. It is therefore necessary to visit STEM and TVET educational programs at all levels to come up with a better implementation strategy of the programs. This would go a long way in the socio-economic growth and sustainable development. There are needs for fruitful inputs of Nigerian government into STEM and TVET as a type of education recognized for socio-economic development and gainful employment spurred. The attributes of STEM and TVET in a society spurred the writer of this paper to carry our investigation on the impact of STEM and TVET on alleviation of hunger and poverty for sustainable socio-economic development.

Suggestions

The following suggestions were considered necessary to enable the utilization of the available opportunities of STEM and TVET programmes to alleviate hunger and poverty for socio-economic development

1. Nigeria government should increase the vote for STEM and TVET in the budgetary allocations to reduce or eliminate the factors combating the proper implementation of the programs
2. To make private sectors more involved in sponsoring programs of STEM and TVET at higher institutions of learning
3. To give special allowances for the teachers in the areas of STEM ad TVET.
4. To introduce special scholarship for students I the areas of STEM and TVET
5. To organize re-orientation program for the school counsellors on the needs to enlightening learners o the importance and prospects of STEM education in the society

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CHALLENGES OF EFFECTIVE TEACHING AND LEARNING IN NIGERIAN SCHOOLS IN THE TWENTY-FIRST CENTURY: THE WAY FORWARD

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Abstract
The paper explore the challenges of effective teaching and learning in Nigerian schools in the twenty-first century: The way forward. The challenges identified in this paper as barrier to effective teaching and learning include, poor planning, inadequate funding, school location and environment, unqualified teachers, non-usage of information, communication and technology (ICT) devices such as computers, internet connectivity, moderns etc. Other constraints are epileptic power supply, poor monitoring of schools, non- motivation of teachers in terms of prompt payment of salaries and benefits. The way forward is to reflect on current relevant understandings related to the challenge areas especially funding for purchase and distribution of modern learning infrastructures to schools and monitoring by stake holders in education to ensure effectiveness among others. The authors noted that, for teaching and learning activities to be effective, there is need for improved budgetary allocation to education of 26% as recommended by UNESCO. This will assist in the purchase and supply of learning facilities, stable electricity to enhance the use of the devices in line with global best latest practices in education and a paradigm shift to massively train good quality teachers on ICTs applications to update their knowledge and skills through seminars and workshops and routine monitoring of schools by stake holders in the education sector.

Keywords: Challenges, Effective, Schools, Twenty-first century, Teaching and Learning, Nigeria, Way forward

Introduction
Promoting teaching and learning effectiveness has globally been an issue of great concern in the education sector. Although this problem has been properly addressed in the western world, it has however, remain a challenging one in the Nigerian education sector. The 21st century education is driven by Information, Communication and Technology (ICT). Hence educational reforms call for paradigm shift in instructional approach i.e. from theory to practice. This is a deviation from chalk and talk method of teaching or lecture method where learners sit or remain passive in the class to receive lectures and take down notes to constructivist learning theory, this is based on the idea that learners must construct and reconstruct knowledge in order to learn effectively (Attard et al, 2010). Contemporary studies in the 21st century has shown that the use of ICT devices such as computers, internet and moderns, etc, stimulate students and enable them participate actively in the classroom teaching and learning process for enhanced learning outcomes (i.e. achievement, retention and recall of concepts or material learnt).

Komolafe (2016) defined teaching as the process through which tasks and material content are being imparted on the learners in an organized setting such as the classroom. In the same light Aniah, (2022) stated that teaching is a planned activity carried out under the guidance and supervision of a teacher intended to bring about expected change in the learner or student's behavior. Ngwoke (1995) sees

learning as a process which cause a change in the behavior of an individual, this change in behavior results from experience or interaction between the individual and the environment. The author posits that the teacher must come up with engaging activities that keep students interested and participating aimed at improving their communication skills. Blicker(2020) defined learning - effectiveness as the degree to which the learning outcomes are achieved. He explained that learning outcomes are statement of what a learner is expected to know, understand or be able to demonstrate after completion of process of learning. Constructivist learning theory defines learning as an active process in which learners are active sense makers who seek to build coherent and organized knowledge (Mayer, 2004). It implies that teaching and learning are inseparable and are aimed at a desired behavioral change in the individual or learner through planned effective teaching and learning strategies (Aniah, 2022).

Challenges of Effective Teaching and Learning in Nigerian Schools

It is important to note that challenges are sometimes good catalysts for change. Where there is no challenge, there may be little or no change. However, if change comes, there will be healthy, strong, good quality educational system and manpower to benefit Nigeria as giant of Africa (Okebukola, 2002; Mogbo, 2014).

One of the most important challenges (principle of good teaching) is the need for planning. Planning provides a structure and context for teachers and students as well as a frame work for reflection and evaluation (Spencer, 2003). Spencer (2003) gave four fundamental questions that teachers should ask themselves when planning a teaching session, they include;

(i) Who am I teaching? The number of learners and their study level or stage of training;
(ii) What am I teaching? The topic or subject matter, the type of expected learning (knowledge, skills, behaviors);
(iii) How will I teach? Teaching and learning methods, length of time available, location of teaching session, internet resources, SGL skills models, etc, and;
(iv) How will I know if the students understand? Informal and formal assessments, questioning techniques, feedback from learners.

School location and environment - if schools are located in a noise environment e.g. motor parks, markets or polluted environments such as industries and refuse dumping sites, teaching and learning will not be effective. Classrooms that are not well ventilated, no good lighting system could also affect teaching and learning effectiveness.

Issue of Unqualified Teachers – The issue of unqualified teachers that are employed to teach in our schools is worrisome to a large extent and responsible for students' poor academic achievement as a result of lack of desired knowledge, skills, poor orientation or sound background training in the field of teaching.

Absent of Modern Teaching and Learning infrastructures (ICTs) in Schools –

The greatest technological challenge in Nigeria institutions is how to establish a reliable cost effective internet connectivity. Issue of access to ICT networks. Some institutions have Campus Area Network (CAN) backed by wireless narrow band while others have only internet café with grossly insufficient computers based with 50:1 ration (fifty students to one computer). High student enrollment, inadequate funding of university and lack of budget to exacerbate the problems of ICT infrastructure.

Power Supply- A major source of worry in education industry in line with technology application in our classrooms is inadequate electricity supply to enhance the operation and maintenance of available instructional media in our institutions of learning in Nigeria. Inspite of late president UmaruMusa Yar'adua (2007) assurance to lunch a national emergency programme on power supply in 2007, the sector has not witnessed any meaningful change to this moment considering it position as giant of Africa, and 6th largest producer of crude oil in the organization of petroleum exporting countries (OPEC) and 5th largest US (United States) source of imported oil and 8th worldwide crude oil producer. It is indeed pathetic and even more disturbing because Nigeria cannot boost of stable and affordable power supply to put to use the available technological media that aid or support teaching and learning in our classrooms and also take care of other economic activities that enhances development.

Funding- Poor funding of education by successive government is responsible for most problems in the sector today. Nigeria as a developing nation requires quality education to raise the manpower need that will lead to development and advancement of its citizen and the nation at large. The world is knowledge-driven, hence, there is a world demand for quality education to bridge the information gap between developed and developing nations like Nigeria using ICTs platforms or devices in our classrooms and schools. Inspite of the huge human and material resources deposited in the country, there is no evidence of change as a giant of Africa.

The Way Forward

Planning is an important issue for effective classroom teaching and learning. The following will help the teacher if adhered to;

1. Device a lesson plan for each teaching.
2. The lesson plan may be very detailed or simple broad – brush plan.
3. The lesson plan should define learning outcomes or objectives to be achieved.
4. Timing of activities.
5. Decide on the best teaching and learning method to achieve the outcomes (pedagogy).
6. Identify learning resources and support materials
7. Finalized any linked assessment or evaluation to ascertain students' achievement (Quality Assurance and Productivity Unit (QAPU), Fut, Minna, 2012).

Funding – Adequate funding of education will minimize most challenges such as adequate facilities provision, inadequate infrastructural facilities, classrooms etc. The Holy Bible says that money answereth all things even though it is the root of all evils. Ecclesiastes 7: 12; Isaiah 55: 11; 1Timothy 6: 10. If Nigeria wants meaningful and quality education, the budgetary allocations to education should be more than the proposed 26% by UNESCO. This will enhance provision of basic learning infrastructures for effective teaching and learning, also motivate teachers and make them more committed. It concluded that the current fund allocation of less than 10% is not adequate. (UNESCO, 2004; UNESCO, 2006).

The School Climate and Environment – The school represents an important social environment that influences students' development and their self-image. Understanding different individual need of all its students is one of the main tasks of a school (Allodi & Rydelius, 2008). Teachers are key participants in the process since they can directly influence those differences in their classroom and in every day communication with students. Classroom climates constitute an important component of effective teaching. Classroom climate according to Isaiah and Azanor (2016) refers to the social climate (relationship and interaction) and the emotional climate (feelings for each other) of the classroom. Isaiah and Azanor (2016) further explained that classroom climate is determined by such factors as teacher – students' interaction, student-students interaction, communication, discipline and well ventilated classrooms.

Qualified Teachers – The challenges of quality education in Nigeria are inseparable from good professional teachers who are saddle with the responsibility of routine classroom teaching and learning. It is good to note that for effective teaching and learning to take place in our schools, the teachers need to be qualified, skilled and well trained in the act of teaching. To improve the image of teachers in the learning and teaching profession in Nigeria, We may consider adopting the Japan's International Project Education Achievement (IEA) model. This model focuses on the following critical areas:

(i) Teacher preparation institution programmes;
(ii) In- service Education and Teacher Centres.
(iii) Supervision of classes for effective teaching and learning.
(v) Provision of relevant standard learning textual materials and equipment.
(vi) Periodic monitoring and evaluation of the curriculum etc (Mogbo, 2014).

Absent of Modern Teaching and Learning infrastructures (ICTs) in Schools:

Nigerian government need to collaborate with NETWORK service provider in the country to extend their services to both urban and rural areas for access to ICT network and for effective internet

connectivity to enhance media application in the classroom. Issue of access to ICT networks need urgent attention to break this crippling access barrier confronting education in Nigeria. School leadership that values technology and education reform activities should use reward structure to influence or motivate teachers that excel in classroom technology application.

Technical support is needed in schools where all or most teachers are using technology, particularly if new or experimental systems are involved or extensive use is made of computer networks. At least five kinds of technical support assistance are necessary:

1. Help in planning for technology uses and acquisitions.
2. Training on how to use new hardware and software.
3. Demonstration and advice on how to incorporate technology into instruction
4. On-demand helps when software problems or hardware failures arise.
5. Low-level system maintenance (Aniah and Nsofor, 2015).

Stable Power Supply to Schools - When technology is discussed, power must be mentioned as source of energy to enhance uninterrupted operation of the media. It therefore holds that our classrooms should be provided with alternative energy source by making available stand-by generators in both urban and rural schools in order to maintain stable operation of technological media during classroom instruction whenever there is electricity power outrage.

Conclusion

The paper identified certain peculiar factors that hinders effectiveness of teaching and learning in the Nigerian educational system and provides the way forward. The authors strongly stressed that Nigerian educational authorities should learn from experience of western countries such as Japan, United States and Canada by investing significant resources to train both teachers and students in seminars and conferences through adequate funding of the sector. Also, it is important that the general learning environment, classroom structures, ICT based facilities and other resources be well established to enhanced effective teaching and learning in Nigerian schools.

Recommendations

If the following recommendations are adhered to, the quality of teaching and learning in Nigerian schools will significantly improve:

There is an urgent need for improved funding of education sector to cover provision of basic teaching and learning facilities i.e. ICTs, improve on teachers' welfare to boost their moral as it is with other parastatals in Nigeria like Nigeria National Petroleum Cooperation (NNPC), Federal Inland Revenue Services (FIRS) just to mention a few.

Nigeria should learn from experience of developed nations like Japan, USA, Ghana and Canada etc. and invest significant resources to train both teachers and students through seminars and conferences.

Adopt the Japan's International Project Education Achievement (IEA) model as shown in this paper.

Learning environment/ good classroom structures and quality planning are critical to effective teaching and learning especially in this 21st century where emphasis is based on the ICT application.

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CHEMISTRY TEACHERS' EMOTIONAL INTELLIGENCE FACTORS AS CORRELATES OF CHEMISTRY STUDENTS' PERFORMANCE IN KWARA STATE SENIOR SECONDARY SCHOOLS

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Abstract

The study investigated chemistry teachers' emotional intelligence factors as correlates of chemistry students' performance in Kwara State Senior Secondary Schools. The population of the study was made up of two hundred and seventy-four (274) chemistry teachers. Simple random sampling technique was adopted in selecting One Hundred and Fifty-Nine (159) chemistry teachers with equal numbers of chemistry students' using hat draw method. The study adopted a correlational research design. The study was guided by two research questions with corresponding null hypotheses. The research instrument used was adapted questionnaire titled Emotional Intelligence Questionnaire (EMIQ) with 5-point scale and already students' performance scores of the chemistry students were used through expo facto design. The instrument was pilot-tested using Cronbach Alpha which yielded a reliability coefficient of 0.92. Scatter plots were used to answer research questions and inferential statistics of linear regression was used to test the hypothesis at a 0.05 level of significance. Results of the hypotheses revealed that there was no significant relationship between chemistry teachers' social awareness and performance of students' in chemistry. The study also revealed that there was no significant relationship between teachers' self-motivation and students' performance in Chemistry. Among others, the study recommended that curriculum planners' should incorporate related contents of emotional intelligence in order to improve academic performance of students' in chemistry.

Keywords: Social-awareness, Self-motivation and Academic performance

Introduction

Education is an essential tool for human and national development. The education given to citizens of a country especially at the secondary school level must be of good quality to teach the skills for self-development and survival. Quality education is a necessity to build responsible citizens who can drive the nation's economy and compete favourably in the knowledge-based world of today. This requires effectiveness and efficiency of the school administrators and teachers during teaching and learning (Chidobi & Eze, 2016). To achieve this quality, teachers' application emotional intelligence is fundamental.

The quality of education given in schools should be of great concern to all stakeholders especially in the light of declining performance of students in both the West African School Certificate (WAEC) and the National Examination Council (NECO) coupled with the continued decline in the number of Credit passes in Science subjects, especially in Chemistry. The continuous decline in science subjects, especially performance in Chemistry, raises issues of quality education among stakeholders in education and members of the public in Kwara State (James, 2018). Organizing classroom activities and managing the behaviour of students are the essential responsibilities of teachers. This means that teachers are the major implementers of the school curriculum and as an individual or group of individuals they hold a crucial position in the educational sector. Therefore, they need emotional intelligence to enable them to manage student behaviour and ensure the maintenance of high standards in schools since effective teaching and learning cannot be achieved in a mismanaged classroom.

The classroom is an environment where teaching and learning occurs and also where the success or failure of the teaching-learning process is measured (Obineme, 2018). It is also a learning environment

where all the factors conducive for learning are put in place such as physical- sensory elements like lighting, colour, sound, space, furniture, among others. This also includes laboratories, workshops and so on (Obineme, 2018). The anticipation and objectives of formal education are typically accomplished in the classroom using a well-planned curriculum through effective classroom management practices and teachers' emotional intelligence.

The ability of the classroom teacher to exercise a reasonable degree of control over student's behaviours in the classrooms depends on the teachers' emotional intelligence and level of classroom management skills. Teachers' involvement and cooperation in classroom activities help to foster and establish a productive class environment.

Emotional intelligence is one of the psychological constructs that helps an individual understand their emotion and the emotions of others. Teachers' emotional intelligence is therefore, the ability to monitor, access, express and regulate their own emotions. Still, it also has to do with their ability to understand and manage their feelings during the teaching and learning process. MacChann *et al.* (2020) defined teachers' emotional intelligence as the capacity of teachers to recognize their feelings and that of others. Emotionally Intelligent teachers are stable and have control over their emotions. They are also able to manipulate their environment to achieve their desired goals. Some of these constructs of emotional intelligence include considered for this study are; self-motivation and social awareness.

Self-motivation plays a vital role in every sphere of life and various phases of activities. Teachers' success and achievement in life depend on their self-motivation which is said to be the 'heart of teaching'' the golden road to teaching' and 'a potent factor in teaching' (MacChann *et al.*,2020). Adequate self-motivation by teachers' results in reflection, attention, interest and effort in teaching and hence fosters learning by students. Self-motivation has become a central construct in educational and psychological research and plays a significant role in several theories of human development and learning. Teachers' self-motivation is concerned with the inculcation and stimulation of learner's interest in the learning activities (Linsell *et al.*, 2015).

Lastly, Social-awareness is the ability to enter and sustain satisfactory interpersonal relationships. According to Sarrionandia *et al.* (2018), social awareness emphasizes social relationships and social influence. Teachers with good sociability have better social interaction. They have good listening skills and can communicate clearly and confidently with students from diverse backgrounds. Teachers with social awareness empathize with others, comprehend and accept the emotions of others as well as see things from another person's point of view and therefore develop a stronger bond and understanding with them. High self-motivation, self-awareness and social awareness can therefore contribute positively to a teachers' teaching process. However, teachers' with low self-motivation, self-awareness and social awareness would find failure more challenging to deal with thus undermining their performance in the classroom. For instance, Jain *et al.* (2018) believe that teachers who lack emotional intelligence show some adjustive challenges or in some ways, fail to handle the demands of school work effectively. It may not be out of place to notice that such teachers having little or no emotional intelligence and as such would not attain personal goals in the classroom activities.

The underlying principle here is that secondary schools teachers' should prepare their students' for advantageous living within the society and higher education. The expectations and objectives of secondary education are generally accomplished in the classroom using a well-planned curriculum through effective classroom management skills and teacher`s emotional intelligence. To maintain appropriate standards in secondary schools, there is a need to effectively manage classrooms by using relevant classroom management skills and emotional intelligent teachers. This being the case, one may ask whether the expectations and objectives of secondary education in Nigeria are undermined by unskilled teachers or mismanaged classrooms.

Statement of the Research Problem

As much as skills and ability are essential, Chemistry teachers need to possess certain qualities that will allow them to deliver curriculum content effectively and assist students in developing their basic traits through the teaching and learning processes. The poor performance in Chemistry in West African Examination (WAEC) and those of National Examination Council (NECO) have 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. Abidoye (2022) asserted that in an effort to reverse the trend, the Kwara State government adopted several interventions such as Seminars, Conferences, and Workshops targeting students, teachers and despite these interventions, the poor academic performances in Chemistry persist with lower grades below the national average grades being recorded year after year.

The Kwara State Ministry of Education, researchers and public stakeholders attributed this low performance in Chemistry to some factors which include: Lack of positive students' attitude towards Chemistry, teachers' emotional intelligence when working with students, inadequate classroom management practices, inadequate learning resources and poor use of teaching methodologies (Abidoye, 2022). However, teachers' emotional intelligence is critical because it could have both positive and negative effects on students. If classroom teachers positively utilize emotional intelligence, it will result in high academic performance for the students. Still, if it is negatively employed, it will lead to low academic performance (Amalu & Okon 2018). Suffice it to say that many chemistry teachers include those in Kwara State may not be aware of how their level of emotional intelligence inhibit students' participation in classroom activities and hence jeopardized their academic performances in the classroom. Based on the forgone therefore, this research sought to investigate chemistry teachers' emotional intelligence factors as correlates of chemistry students' performance in Kwara State senior secondary schools.

Aim and Objectives of the Study

The aim of this study was to investigate two constructs of emotional intelligence as correlates of chemistry students' performance in Kwara State Senior Secondary Schools. Therefore, the objectives of the study were to:

1. Determine the relationship between chemistry teachers' social-awareness and chemistry students' performance in Kwara State Senior Secondary Schools.
2. Investigate the relationship between chemistry teachers' self-motivation and chemistry students' performance in Kwara State Senior Secondary Schools.

Research Questions

The following research questions were formulated for the study.

1. What is the relationship between chemistry teachers' social-awareness and chemistry students' performance in Kwara State Senior Secondary Schools?
2. What is the relationship between chemistry teachers' self-motivation and chemistry students' performance in Kwara State Senior Secondary Schools?

Research Hypotheses

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

H_{O1}: There is no significant relationship between chemistry teachers' social-awareness and chemistry students' performance in Kwara State Senior Secondary Schools

H_{O2}: There is no significant relationship between chemistry teachers' self-motivation and chemistry students' performance in Kwara State Senior Secondary Schools.

Scope of the Study

The geographical scope of this study was Public Senior Secondary Schools in Kwara State, which fall within the latitude of 8.9848'N and longitude 4.5624'E. Participants in the study include chemistry teachers in Public Senior Secondary Schools who are currently teaching chemistry in Kwara State and their students. The variables considered for this study was three constructs of Emotional intelligence (Self-awareness, Social-awareness and Self-Motivation) which were the predictor variables and academic performance of the Students as the criterion variable and the time scope for the study was four (4) weeks.

Research Methodology

The research design for this study was correlational design using the descriptive survey research method. The correlational design is considered appropriate because correlational research is used to determine how two or more variables are related among a single group of people. Examination scores of already existing performance of chemistry students' in Kwara State who were taught by the teachers' were accessed and surveyed for this study. Hence, correlational research design can be used to determine whether and how these variables (predictors and criterions) are related. The study was guided by two research questions with corresponding hypothesis. The population of chemistry teachers is two hundred and seventy-four (274) as at 2019/2020 academic session. Simple random sampling technique was used to select one hundred and fifty nine (159) chemistry teachers which were obtained using Krejcie and Morgan table as the sample size of the teachers. Similarly, in a correlational research design, equal numbers of subjects (respondents) from each group are required. Hence, the sample size for the students is also one hundred and fifty nine (159) using the hat draw method. The research instrument used for this study is a structured questionnaire titled Emotional Intelligence Questionnaire (EMIQ). The instrument were adapted by the researcher and validated by two Senior lecturers in the School of Science and Technology Education from the Federal University of Technology Minna. Scattered plots and standard deviation were used to answer the research questions raised and Simple linear regression was used to test the null hypotheses at 0.05 level of significance using Statistical Package for Social Science (SPSS) version 21.0

Results

Research question one:

What is the relationship between chemistry teachers' social-awareness and chemistry students' performance in Kwara State Senior Secondary Schools?

This research question was answered using scatter plot as shown in figure 1hvhvhjk

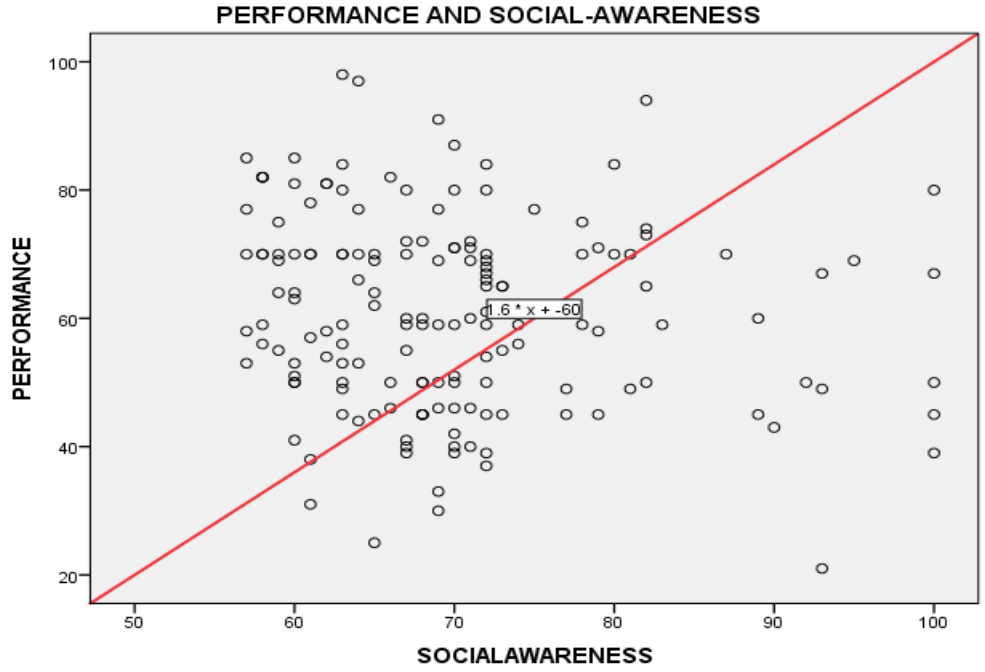

Figure 1 : Scatter plot relationship between chemistry student's performance and teachers' Social-awareness.

Figure 1 is a Scatter plot of the relationship between chemistry student's performance and teachers' social-awareness. The scatter plot indicates that there was a positive relationship between the two constructs as indicated by the trend line. This finding was supported by the mean and standard deviation of the two constructs as shown in table 1

Table 1: Mean and Standard Deviation of Social-awareness and Chemistry Students' Performance

Variable	N	$\bar{x}$	SD
Performance	159	60.87	15.079
Social-awareness	159	69.91	10.032

Table 1 shows the mean and standard deviation of chemistry students' performance and teachers' Social-awareness. The findings show a computed mean score of 60.87 with and Standard Deviation of 15.079 for students' performance in chemistry and a Mean score of 69.91 with a Standard Deviation of 10.032 for chemistry Teachers' social-awareness.

Hypothesis One (H_{O1})**:** There is no significant relationship between chemistry teachers' social-awareness and chemistry students' performance in Kwara State Senior Secondary Schools.

This formulated hypothesis was tested using linear regression and the summary of the results is presented in Table 2

Table 2: Linear Regression Coefficient on the relationship between Chemistry Teachers Social-awareness and Students Performance

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
1	Constant	75.891	8.385		9.051	.000
	Social-awareness	-.215	.119	-.143	-1.809	.072

Dependent Variable: performance

Table 2 shows the regression coefficient of teachers' social awareness and students' performance. The result shows that teachers' social-awareness was not a significant predictor of Student's performance (B = -.143, t = -1.81, p (0.07) >0.05). The findings indicated that the standard Beta coefficient for teachers' social-awareness was negative and statistically not significant. Therefore, the hypothesis was retained. The regression coefficient indicated that for any increase in one units of teachers' Social-awareness will not predict any units of Secondary School Student's Performance in chemistry when all other factors are constant.

Research question two:

What is the relationship between chemistry teachers' self-motivation and chemistry students' performance in Kwara State Senior Secondary Schools?

This research question was answered using scatter plot as shown in figure 2



Figure 2 Scatter plot relationship between student's performance and Teacher's Self-Motivation.

Figure 2 is a Scatter plot of the relationship between chemistry students' performance and teachers' self-motivation. The scatter plot indicates that there was 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 3

Table 3: Mean and Standard Deviation of Self-Motivation and Chemistry Students' Performance

Variable	N	$\bar{x}$	SD
Performance	159	60.87	15.079
Self-Motivation	159	69.53	10.174

Table 3 shows that the mean and standard deviation of chemistry students' performance and teacher's self-motivation. The findings show a computed mean score of 60.87 and Standard Deviation of 15.079 for students' performance and a Mean score of 69.53 with a Standard Deviation of 10.174 for self-motivation.

Hypothesis Two (H_{O2})**:** There is no significant relationship between chemistry teachers' self-motivation and chemistry students' performance in Kwara State Senior Secondary Schools.
This formulated hypothesis was tested using linear regression, and the summary of the results is presented in Table 4

Table 4.: Linear Regression Coefficient on the relationship between Chemistry Teachers Self-Motivation and Students Performance

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
1	Constant	76.329	8.218		9.288	.000
	Self-Motivation	-.222	.117	-.150	-1.901	.059

Dependent Variable: performance

Table 4. Shows the regression coefficient of chemistry teachers' self-motivation and students' performance in chemistry. The result shows that chemistry teachers' self-motivation was not a significant predictor of student's performance (B = -.150, t = -1.901, p (0.06) >0.05). The finding indicated that the standard Beta coefficient for teachers' self-motivation was negative and statistically not significant. Therefore, the hypothesis was retained. The regression coefficient indicates that for

any increase in one units of chemistry teachers' self-motivation will not predict any units of Secondary School Student's Performance in Chemistry when all other factors are constant.

Discussion of the Findings

There was no significant relationship between Social-awareness of chemistry teachers on students' performance. This agrees with Ebinagbomi and Nzam (2016) findings that examined social awareness's impact on students' academic performance. The results revealed that social awareness is not a good predictor of students' academic performance. Contrarily, there is a disagreement with Udo and Ukpong (2016) finding, who investigated the influence of social awareness on the students' academic performance. The result revealed a significant relationship between social awareness on the students' academic performance.

There was no significant relationship of chemistry teachers' self-motivation on Students' Performance. This supports the findings of Kashani *et al.* (2012) that investigated whether there is a relationship between self-motivation and academic performance of diploma and degree students. The results revealed that self-motivation is not a good predictor to students' academic performance. Contrarily, this opposes Joibari and Mohammadtaheri (2011) findings who investigated the relationship between self-motivation and students' academic performance. The result showed that there was a significant correlation between self-motivation and the academic performance of the students.

Conclusion

From the finding of this study, it was concluded that chemistry teachers' emotional intelligence constructs (social awareness and self-motivation) does no predict the academic performance of chemistry students in Kwara State Senior Secondary Schools. Hence, the emotional intelligence of chemistry teachers' in Kwara State does not affect the students' academic performances during teaching and learning processes.

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SURVEY OF BASIC SCIENCE AND MATHEMATICS TEACHERS'S READINESS TO ADOPT MOTHER TONGUE LANGUAGE AT BASIC EDUCATION GRADE LEVEL IN MINNA METROPOLIS

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Abstract
The paper was a survey research design that investigated the readiness of Basic Science and Mathematics Teacher's Readiness to adopt the Mother Tongue Language Language in teaching at Basic Education Grade Levels in Niger State. The population of the study are Basic Education Teacher teaching Science and Mathematics in Minna Metropolis. A sample size of 68 Basic education mathematics Teachers teaching in both public and private secondary schools was selected using a convenient (purposive) sampling technique. A researcher prepared a questionnaire titled "Basic Education Science and Mathematics Teacher's Readiness to Adopt Mother Tongue Language Questionnaire" (RAMTOQ). The instrument was validated by experts in Science Education (SED) from the Department of Science Education, Federal University of Technology, Minna. A reliability coefficient of 0.89 was determined using KR20 (Cronbach alpha). The data collected were subjected to descriptive statistical tools of Mean (X) and Standard Deviation (SD). Descriptive charts were used to describe the analysed data and ANOVA wsa used to test the hypotheses at 0.05 level of significance. The findings revealed that Basic Science and Mathematics Teachers' are readiness to adopt the Mother Tongue Language language to teaching Basic Science and mathematics at Basic Education levels in Minna Metropolis. The result also showed that female teachers are more disposed to use to Mother Tongue Language with a Mean ($\bar{x}$) difference of 2.99. It was concluded that, Mathematics Teachers' Readiness to adopt MTL is not influenced by their gender differences; the basic Level of the teaching of Mathematics Teachers did not significantly affect their Readiness to adopt MTL while Readiness to adopt MTL amongst Mathematics Teachers is affected by the school type they are teaching. Based on the findings of the study, it was recommended among others that; government must make a deliberate effort to see to the adoption of the Mother Tongue Language in teaching Mathematics are both primary and junior secondary education levels in Niger State.

Keywords: Basic Science and Mathematics Teachers, Readiness, Mother Tongue Language, Basic Education

Background to the Study

The choice of language of instruction has been a recurrent issue in the enhancement of quality education in Nigeria. United Nation Educational, Scientific and Cultural Organistion (UNESCO) declared in 1958 that it is axiomatic that the best medium for teaching a child is using his mother tongue. However, in Nigeria and many other African countries, the adoption of this recommendation has not received the required attention and implementation thus, investment have not been sufficient enough in ensuring attainment of this regulation. In Nigeria, the role of Mother Tongue or first language of instruction was clearly stated in the National Policy on Education and many papers advocate that states in Nigeria should implement the National Policy of teaching in Mother Tongue and put in machinery for training of Mathematics teachers to develop the skills, cognition and attitude for the implementation of the National School Curriculum at the Basic education level using the Mother Tongue in Nigeria. In addition, Basic Science and Mathematic teacher's readiness to teach using the mother tongue language at basic education grade levels should be investigated.

Language is generally used for interaction among people in the society. It is also used to differentiate people by sex, age and social status within a particular society. Language could also be a tool for cultural development and societal manifestations. Language is used in the development of nations or society's cultural artefacts and for the advancement of a nation's sociocultural goals. The languages that a person uses can be differentiated into L1 and L2, that is first and second languages. Many researchers have asserted that young children acquire their Mother Tongue Language with no major difficulties

(Shormani, 2014). Independent Hypothesis suggests that in the process of second language (L2) learning, some first language (L1) information may be positively transferred. For the development of corresponding skills in the L2, the L1 linguistic awareness and abilities that a child possesses may be highly instrumental (Englis & Boholano, 2022). The first language is also known as Mother Tongue Language meaning our language or the language a child first comes in contact with depending on the environment, in which he/she is born and raised while the second language is a language that is later learnt in the adult stage or school such as English in Nigeria. Thus, it is critical to understand the language of instruction policy and linguistic context of a country when trying to improve learning outcomes in the early grades, as this can be a potential barrier to gains in pupils' achievement (Tackie-Ofosu et al. 2015) in Karikari et. al, (2022).

The importance of language in the development of education in any nation cannot be overemphasized. The use of the appropriate language in teaching greatly contributes to academic performance and success in schools. As such the language of instruction can play a vital role in the learning process of the elementary learner (Basic Education). Concerning this fact, the Federal Government of Nigeria made special provisions for the teaching of language across the educational levels in the country's educational system. Nigeria has a National Language Policy which highlights that "instruction in primary schools; the first six years of learning will be in the Mother Tongue Language". The Minister of Education asserted that apart from improving the quality of instruction at the primary school level, the new language policy might have been informed by the need to prevent these languages from going into extinction (Adamu, 2022).

Mathematics concepts involve the instructor using the English language to convey its meaning and application. Studies conducted have shown that there is a high correlation between mathematics achievement and that language skills greatly influence the learner's ability to comprehend and solve mathematical problems (Llantos, et al., 2022). It is reported that in Ghana pupils' mathematics performances in rural schools are low and decrease annually due to the concentration of studies on urban schools. Policy makers do not rely on empirical research to develop teaching strategies in remote schools (Karikari et. al. 2022). Thus, similar empirical data are required in Nigeria to evidence the determination of a workable policy framework that is implementable towards actualizing the Mother Tongue Language policy.

In Nigeria, there is research evidence by researchers on Mother Tongue Language emphasising using Yoruba, Igbo and Hausa to teach in schools. Alimi et al., (2020) stated that the use of the Yoruba Language in South Western Nigeria has attracted much research attention across the fields of Literature, culture as well and Yoruba Language Education. Thus, making the Yoruba feature prominently from primary to tertiary levels has been made compulsory.

Walberg's theory of academic productivity indicates that individual pupils' psychological characteristics and their immediate psychological environments impact educational performance (cognitive, psychomotor and attitude) Englis and Boholano (2022). Students think more efficiently and perform better when they are taught in their Mother Tongue Language. Walberg's research identified nine main variables that influence educational outcomes; students' ability/previous achievement, motivation, level of age/development, amount of instruction, quality of instruction, the atmosphere in the classroom, peer group, and exposure to mass media outside of school. This does in any way exclude the child's language which is part of the atmosphere or environment of learning. Another variable is the teacher's knowledge of the implementation of the Mother Tongue Language language as a strategy of instruction.

The study of Basic Science and Mathematics Teachers' readiness to use the Mother Tongue Language Language in teaching will provide insight to policy makers and implementers on how to attain predetermined goals and objectives set out. The data collected can serve as feedback to teachers to mathematics teachers in their formulation of learners' home tasks and guide to learning. In addition, the study provides more knowledge on the strengths and weaknesses of the Mother Tongue Language in teaching Basic Science and Mathematics at the elementary education level

Statement of the Research Problem

Over the years, there has been growing concern about students' performances in Basic Science and Mathematics at external and internal examinations in Niger State. This cannot be unconnected with the language of teacher instruction in the classroom. Nigeria is a country with over 250 ethnic groups that speak different languages. Children attending schools at their early developmental stages are expected to be taught in the language of their Mother Tongue Language for better communication and understanding. Basic Science and Mathematics may be assumed to be difficult because of the language used in teaching but because it is difficult. Therefore, the paper sought to find out amongst the teachers of Basic Science and Mathematics whether there is a readiness to change the language of instruction at basic education levels in Niger State when the government makes the policy on Mother Tongue Language usage compulsory for teaching Basic Science and Mathematics.

Aim and Objectives of the Study

The paper aims to determine the Basic Science and Mathematic Teacher's Readiness to teach using the Mother Tongue Language at Basic Education Grade Levels in Minna, a Metropolis of Niger State. Specifically, the paper achieved the following objectives:

I. to determine whether Basic Science and Mathematics Teachers have the Readiness to adopt Mother Tongue Language in teaching mathematics at Basic Education Grade levels in Minna Metropolis
II. to find out whether the Readiness to adopt a Mother Tongue Language differs amongst Male and Female Basic Science and Mathematics Teachers at Basic Education Levels in Minna Metropolis
III. to find out whether the Readiness to adopt a Mother Tongue Language differs amongst Public and Private schools Basic Science and Mathematics Teachers at Basic Education Levels in Minna Metropolis
IV. to determine whether Basic Science and Mathematics Teachers' qualifications influence their Readiness to adopt Mother Tongue Language
V. to find out whether Basic Science and Mathematics Teachers' years of teaching experience influence their Readiness to adopt Mother Tongue Language

Research Questions

The following research questions were formulated:

1. Do Basic Science and Mathematics Teachers have the Readiness to adopt Mother Tongue Language in teaching mathematics at Basic Education Grade levels in Minna Metropolis?
2. Is there any difference in the Readiness to adopt the Mother Tongue Language amongst Male and Female Basic Science and Mathematics Teachers at Basic Education Levels in Minna Metropolis?
3. Is there any difference in the Readiness to adopt the Mother Tongue Language between Basic Science and Mathematics Teachers due to the Basic level of study in Minna Metropolis
4. Is there any difference in the Readiness to adopt the Mother Tongue Language differences among Public and Private schools Basic Science and Mathematics Teachers at Basic Education Levels in Minna Metropolis?
5. Do Basic Science and Mathematics Teachers' Qualifications Influence Their Readiness to Adopt Mother Tongue Language?
6. Do Basic Science and Mathematics Teachers' years of teaching experience influence their Readiness to adopt Mother Tongue Language?

Research Hypotheses

Four null hypotheses were raised and analysed at 0.05 alpha level:

HO_1: There is no significant difference in the Readiness to adopt Mother -Tongue between Males and Females Basic Science and Mathematics Teachers at Basic Education Levels in Minna Metropolis

HO_2: There is no significant difference in the Readiness to adopt Mother Tongue Language Language between Basic Science and Mathematics Teachers due to the Basic level of study in Minna Metropolis

HO_3: There is no significant difference in the Readiness to adopt Mother Tongue Language

differences amongst Public and Private Schools Basic Science and Mathematics Teachers at Basic Education Levels in Minna Metropolis

HO_4: There is no significant difference in Readiness to adopt Mother Tongue Language due to Basic Science and Mathematics Teachers qualifications

HO_5: There is no significant difference in Readiness to adopt Mother Togue due to Basic Science and Mathematics Teacher's years of teaching experience

Research Methodology

A descriptive survey research design was used for the study. The population of the research are all Basic Science and Mathematics Teachers teaching at Basic Education levels i.e., from Primary 1 - 6 and in Junior Secondary School sections (JSS1-3). A total of 87 Basic Science and Mathematics Teachers were selected using convenient (purposive) sampling techniques. This is because of inadequate resources to cover all the major locations of schools in Minna Metropolis such as Chanchaga, Maitumbi and Tunga-Low-cost Schools. A researcher-prepared questionnaire entitled "Basic Education Basic Science and Mathematics Teacher's Readiness to Adopt Mother Tongue Language Questionnaire (RAMTOQ)" was used for data collection. The instrument was validated by experts in experts in Science and Mathematics Education at the University. The reliability coefficient of 0.89 was obtained for the instrument using KR20 (Cronbach alpha) because the instrument was not scored YES versus No. The data collected were subjected to Students Package for Social Science (SPSS) Version 23.0 for descriptive statistical of Mean ($\bar{x}$) and Standard Deviation (SD). In addition, descriptive charts such as Bar Charts and Line Graphs are used to further provide vivid explanations of the data analysed.

Results and Discussion

Analysis of Research Questions

Research Question One: Do Basic Science and Mathematics Teachers have the Readiness to adopt Mother Tongue Language in teaching Basic Science and Mathematics at Basic Education Grade levels in Minna Metropolis?

Table 1.0: Analysis of Basic Science and Mathematics Teachers' Readiness to Adopt Mother Tongue Language

S/N	Items on Readiness	Mean Scores ($\bar{x}$)	Standard Deviation SD	Remarks
	MOTIVATION CATEGORY			
1	Would you be ready to teach using MT?	4.45	1.06	
2	Would students be ready to learn using MT?	4.47	0.90	
3	Would you be committed to teaching using MT?	4.44	0.97	
		4.45	**VERY READY**	
	MATURITY CATEGORY			
4	Would you be ready to take responsibility for teaching MT?	4.13	1.11	
5	Are you aware of the National Policy on MT?	3.86	1.22	
6	Are you mentally and emotionally disposed to the use of MT?	4.17	1.09	
		4.05	**VERY READY**	
	PERSONALITY CATEGORY			
7	Would you be ready to learn how to utilise the MT for teaching Mathematics?	4.61	0.61	
8	Are you sincere in your opinion of the use of MT?	4.40	0.94	
9	Would you be ready to give useful insight to MT where necessary?	4.43	0.82	
		4.48	**VERY READY**	
	ORGANIZATIONAL AWARENESS			
10	Are you ready to accept the MT Policy when it comes into effect?	4.35	0.96	
11	Are you ready for the MT Policy directive in Teaching Mathematics?	4.30	0.99	
12	Are you ready to obey the Policy regulations on MT?	4.49	0.79	
		4.38	**VERY READY**	
	TECHNICAL STRENGTH			
13	Are you ready for training on MT?	4.55	0.64	
14	Do you possess confidence in readiness for MT?	4.40	0.77	
15	Would you be ready for task management of the MT structure?	4.29	0.84	
		4.41	**VERY READY**	
	INTERPERSONAL ORIENTATION			
16	Are you ready to communicate in the Language of your School Community using children's MT?	4.27	0.79	
17	Are you ready to collaborate with the Local School Community for the success of MT?	4.27	0.93	
18	Do you possess the social skills to relate with children in their local MT?	4.27	0.85	
	ATTITUDE TO WORK	**4.27**	**VERY READY**	
19	Are you optimistic that we're ready for MT?	4.21	0.91	
20	Do you think that your community is ready to use MT and that is achievable?	4.25	0.96	
21	Would you be humble to learn the MT of children of your school's immediate community?	4.26	0.89	
		4.24	**VERY READY**	
	PROBLEM-SOLVING ABILITY			
22	Are we ready to solve our school learning problems using MT?	4.27	0.90	
23	Is MT Policy wise and ready now?	4.14	0.97	
24	Would the MT Policy bring good student performance to school?	4.22	0.88	
		4.21	**VERY READY**	
	ADAPTABILITY			

25	Do you the Ministry of Education is ready for MT Policy adaptation?	4.00	1.05	
26	Would Parents and other Stakeholders be ready for the adaptation of the MT Policy?	4.18	0.91	
27	Can our ethnic diversity be ready for the change the MT Policy will bring?	4.16	0.93	
		4.11	**VERY READY**	
	RESILIENCE			
28	Do we have the resources to withstand the challenges of using the MT Policy?	4.03	1.11	
29	Do you think our policy makers can withstand the pressure on MT?	4.09	1.45	
30	Do you think your school management will support the use of MT in this modern era of the 21st century?	4.19	0.97	
		4.10	**VERY READY**	

Table 1.0 shows Basic Science and Mathematics Teachers' Readiness to adopt the Mother Tongue Language language to teaching Basic Science and mathematics at Basic Education levels in Minna Metropolis. This readiness was acceptable to Basic Science and mathematics teachers in both public and private schools. The Grand Mean ($\bar{x}$) for all the categories of Readiness (i.e., Motivation, Maturity, Personality, Organizational Awareness, Technical Strength, interpersonal relation, Attitude to Work, Problem-solving Ability, Adaptability & Resilience) indicated a Mean ($\bar{x}$) value greater than 4.00. This shows a greater acceptance of teachers to use of the Mother Tongue Language for teaching Basic Science and Mathematics amongst Basic Science and Mathematics Teachers in Minna Metropolis.

Research Question Two: Is there any difference in the Readiness to adopt the Mother Tongue Language differences amongst Male and Female Basic Science and Mathematics Teachers at Basic Education Levels in Minna Metropolis?

Table 2.0: Analysis of Differences between Male and Female Basic Science and Mathematics Teachers' Readiness

Groups	NO	Mean ($\bar{x}$)	Standard Deviation SD	% of Total Sum	Mean Diff ($\bar{x}$)
Male	34	126.27	19.41	43.6%	
Female	43	129.40	13.36	56.4%	2.99
Total	77			100%	

Table 2.0 shows the differences between the Mean ($\bar{x}$) Scores of the male (126.27) and female (129.40) Basic Science and Mathematics Teachers' readiness to teach using the Mother Tongue Language language. The result shows that female teachers are more disposed to use to Mother Tongue Language with a Mean ($\bar{x}$) difference of 2.99.

Research Question Three: Is there any difference in the Readiness to adopt the Mother Tongue Language Language between Basic Science and Mathematics Teachers due to the Basic level of study in Minna Metropolis

Table 3.0: Analysis of Differences between Primary and JSS Basic Science and Mathematics Teachers' Readiness

Category	NO of Teachers	Mean ($\bar{x}$)	Standard Deviation SD	% of Total Sum	Mean ($\bar{x}$) Diff
Prim (1-6)	54	128.41	14.68	70.3%	
JSS (1-3)	23	127.39	19.84	29.7%	1.02
Total	77			100%	

The result of Table 3.0 indicates that Basic Science and Mathematics Teachers at the Primary (1-6) school level have a Mean ($\bar{x}$) of 128.41 and a deviation of 14.68 while Mathematics Teachers at Junior Secondary 1-3) level a Mean ($\bar{x}$) of 127.39 and 19.84 deviation respectively. The Mean ($\bar{x}$) of the two was 1.02 in favour of teachers in the Primary School Level. This implies that Primary School (1-6) Basic Science and Mathematics Teachers have a higher readiness to adopt Mother Tongue Language.

Research Question Four: Is there any difference in the Readiness to adopt the Mother Tongue Language differences based on Public and Private school Basic Science and Mathematics Teachers at Basic Education Levels in Minna Metropolis?

Table 4.0: Analysis of Basic Science and Mathematics Teacher's Readiness to Adopt Mother Tongue Language Based on School Type

Schools' Type	NO of Teachers	Mean ($\bar{x}$)	Standard Deviation (SD)	% of Total Sum	Mean ($\bar{x}$) Diff
Public	38	136.29	12.19	53%	
Private	39	120.13	15.87	47%	16.16
Total	77			100%	

The result of Table 4.0 indicated that there is a difference in the Mean ($\bar{x}$) Scores of Basic Science and Mathematics Teachers to Adopt Mother Tongue Language Language in Public and Private Schools in Minna Metropolis. In public Schools, Mathematics Teachers had a Mean ($\bar{x}$) of 136. 29 the private schools' Basic Science and Mathematics Teachers recorded a lower Mean ($\bar{x}$) value of 120.13. This meant that the public schools' mathematics Teachers had a greater readiness to adopt the Mother Tongue Language language to teaching Basic Science and Mathematics.

Research Question Five: Do Basic Science and Mathematics Teachers' Qualifications Influence Their Readiness to Adopt Mother Tongue Language?

Table 5.0: Analysis of Basic Science and Mathematics Teachers' Readiness Based on Their Qualifications

Qualification Type	NO of Teachers	Mean ($\bar{x}$)	Standard Deviation SD	% of Total Sum
NCE	29	129.14	16.64	38.4%
Degree	31	128.03	16.06	40.2%
Masters	6	132.67	10.80	8.1%
PhD	1	120.00	0.00	1.2%
Others	10	123.14	19.95	12.5%
Total	77			100%

Table 5.0 shows the analysis of Mother Tongue Language due to Basic Science and Mathematics Teachers' qualifications in Minna Metropolis. Basic Science and Mathematics Teachers with Master's degrees have the highest Mean ($\bar{x}$) (132.67) with 8.1% total in the distribution of respondents. Teachers with NCE were next in readiness to adopt their Mother Tongue Language Language and then those with first degrees in this order. This meant that teachers' qualification was not a determinant of readiness to teach Basic Science and Mathematics using the Mother Tongue Language Language.

Research Question Six: Do Basic Science and Mathematics Teachers' Years of teaching experience influence their Readiness to adopt their Mother Tongue Language?

Table 6.0: Analysis of Basic Science and Mathematics Readiness to MTL Based on Years of Teaching Experience

Years of Teaching Experience	NO of Teachers	Mean ($\bar{x}$)	Standard Deviation SD	% of Total Sum	
Below 1 Year	15	105.73	10.43	19.1%	
1 – 5 Years	17	122.47	15.95	21.1%	
Above 5 Years	45	131.02	17.51	59.8%	
Total	77			100%	

Table 6.0 shows the Mean ($\bar{x}$) values of Basic Science and Mathematics Teachers' response on Readiness to adopt their Mother Tongue Language based on their years of teaching Basic Science and Mathematics at the basic education level in Niger State. Basic Science and Mathematics Teachers who have more than 5 years in the teaching service recorded a higher Mean($\bar{x}$) score of 131.02 and a deviation of 17.51. this is closely followed by teachers who are between 1-5 years in service with a Mean ($\bar{x}$) score of 122.47 and a deviation of 15.95 while those below 5 years expectedly recorded a Mean ($\bar{x}$) score of 105.73 and a deviation of 10.43. this meant that the years of teaching experience had a higher readiness response to teaching Basic Science and Mathematics using the Mother Tongue Language.

Analysis of the Null Hypotheses

Four researcher formulated hypotheses were tested at 0.05 alpha significance levels :

HO_1: There is no significant difference in the Readiness to adopt Mother Tongue Language between Male and female Basic Science and mathematics Teachers at Basic EducationLevels in Minna Metropolis

Table 7.0: ANOVA Analysis of Differences between Male and Female Basic Science and Mathematics Teacher's Readiness to Adopt MTL

Groups		Sum of Squares	*df*	Mean Square	($\bar{x}$) F_{value}	Sig.
	Between Groups	162.419	1	162.42	0.61	0.44
	Within Groups	19934.750	75	265.80		
	Total	20097.169	76			

Sig: NS ($F_{value}(76) = 0.61, P > 0.44$)

The result of Table 7.0 shows ANOVA analysis between male and female Basic Science and Mathematics Teachers' Readiness to adopt MTL at the Basic Education Levels in Minna Metropolis. The Table shows $F_{value}(76) = 0.61$, $P > 0.44$ which means that the P_{value} is greater than the 0.05 alpha level. Therefore, the hypothesis is not rejected which implies that there is no significant difference between male and female Basic Science and Mathematics Teachers' Readiness to adopt MTL at the Basic Education Levels in Niger State.

HO_2: There is no significant difference in the Readiness to adopt Mother Tongue Language Language between Basic Science and Mathematics Teachers due to the Basic level of study in Minna Metropolis

Table 8.0: ANOVA Analysis of Readiness to Adopt MTL Based on Basic Level of Study

		Sum of Squares	*Df*	Mean Square	$(\bar{x})$	F_{value}	Sig.
1	Between Groups	16.654	1	16.65		0.06	0.80
	Within Groups	20080.515	75	267.74			
	Total	20097.169	76				

Sig: NS (F_{value} (76) = 0.06, P > 0.80)

Table 8.0 shows the ANOVA analysis of Readiness to adopt the Mother Tongue Language between Basic Science and Mathematics Teachers due to the Basic level of study in Minna Metropolis. The result shows an F_{value} (76) = 0.062, P> 0.05. This meant that the P value was greater than 0.05. thus, the hypothesis is not rejected. Therefore, there is no significant difference in Readiness between Basic Science and Mathematics Teachers at the Basic Levels of study in Minna Metropolis.

HO_3: There is no significant difference in the Readiness to adopt Mother Tongue Language Language amongst Basic Science and Mathematics Teachers in Public and Private Schools at Basic Education Levels in Minna Metropolis

Table 9.0: ANOVA of Readiness to Adopt MTL Based on Basic Science and Mathematics Teachers' School Type

	Sum of Squares	*Df*	Mean Square	$(\bar{x})$	F_{cal}	Sig.
Between Groups	5026.994	1	5026.994		25.02	0.00
Within Groups	15070.175	75	200.936			
Total	20097.169	76				

Sig: Significant (F_{value} (76) = 25.02, P < 0.00)

Table 9.0 shows an analysis of the Readiness to Adopt MTL based on school Type among Basic Science and Mathematics Teachers in public and private schools at the Basic Education level in Minna. Metropolis. The results show a F_{cal} (76) = 25.018, < 0.05 which is found to be significant i.e. the P value is less than 0.05. this meant that there was a significant difference between Basic Science and Mathematics Teachers' Readiness to Adopt MTL at the Basic Education level. The hypothesis is therefore rejected.

HO_4: There is no significant difference in Readiness to adopt Mother Tongue Language due to Basic Science and Mathematics Teachers qualifications

Table 10.0: ANOVA of Basic Science and Mathematics Teachers' Readiness to Adopt MT Based on the Qualification

	Sum of Squares	*Df*	Mean Square	$(\bar{x})$	F_{value}	Sig.
Between Groups	443.019	4	110.755		0.41	0.80
Within Groups	19654.149	72	272.974			
Total	20097.169	76				

Sig: NS (F_{value} (76) = 0.41 > 0.80)

Table 10.0 shows the ANOVA result of Basic Science and Mathematics Teachers' Readiness to Adopt their Mother Tongue Language at the Basic Education Level in Minna Metropolis. The result of the

analysis based on qualification F_{value} (76) = 0.41, P > 0.05 shows that there are no significant differences in their Readiness to adopt MTL due to teaching qualifications. This implies that the hypothesis is not rejected.

HO_5: There is no significant difference in Readiness to adopt Mother Togue due to Basic Science and Mathematics Teacher's years of teaching experience. The result on

Table 11.0: ANOVA of Basic Science and Mathematics Teachers' Readiness to Adopt MTL Based Years of Teaching Experience

Groups	Sum of Squares	*Df*	Mean($\bar{x}$) Square	F_{value}	Sig.
Between Groups	1007.022	2	503.511	1.95	0.15
Within Groups	19090.146	74	257.975		
Total	20097.169	76			

Sig: NS (F_{value} (76) = 1.95, > 0.05)

Table 11.0 shows the ANOVA on the Readiness of Basic Science and Mathematics Teachers based on their years of teaching experience. The result on Readiness based on years of teaching experiences F_{value} = 1.95, P > 0.05 was found not to be significant at 0.05 alpha level. This, therefore, meant that there are no significant differences in Basic Science and Mathematics Teachers' Readiness to adopt the Mother Tongue Language Language due to their years of teaching at the Basic Education level in Minna Metropolis. Thus, the hypothesis is not rejected.

Discussion of Findings

The analysis of Basic Science and Mathematics Teachers' Readiness to adopt MTL at Basic Education Grade Levels produced different views of the variables compared. On Basic Science and Mathematics Teachers Readines to adopt MTL between male and female teachers was not rejected (F_{value}(76) = 0.61, P > 0.44) which meant that the P_{value} is greater than 0.05 alpha level. This finding is similar to the study conducted by Alimi et al., (2020) that compared the difference in achievement of primary school pupils' literacy and numeracy with MTL in Osun State Nigeria. Their result showed that there is a 20% variation between male and female pupils' achievement scores. Again, the finding on the comparison of Basic Science and Mathematics Teachers' Readiness to adopt MTL based on the Basic Level of the study showed F_{value} (76) = 0.062, P> 0.05. The hypothesis was not rejected which meant that there was no significant difference based on grade level of study. (Studies related to MTL have shown varying implications concerning willingness on the part of teachers to adopt MTL as a medium of instruction. Mathematics Teacher's Readiness to adopt their Mother Tongue Language at the Basic Education Grade level in Minna Metropolis has also revealed mixed results based on their responses. The result of F_{value}(76) = 0.61, P > 0.44 which meant that the P_{value} is greater than 0.05 alpha level and the hypothesis was not rejected. The findings of this study is a descriptive research design is similar to the findings on MTL being more effective than the use of non-MTL medium in teaching conducted by Morales-OBOD et al. (2020) amongst second-grade Elementary school Pupils in the District of Marilao, Philippines.

The findings of the research study of the Level of Readiness and Instructional Competence of Grade I and II Teachers in the Mother Tongue-Based Multilingual Instruction in Hagonoy National High School, Guihing, Philippines showed that teachers do not significantly differ when analyzed according to gender, ethnic affiliation and the number of training, age and teaching experience. The result is similar to the findings of this research work that found no significant difference in Basic Science and Mathematics Teachers' Readiness to adopt MTL based on gender, Basic level of study, school types (private and public) and teachers' qualifications. In addition, the descriptive analysis also showed that Basic Science and Mathematic Teachers indicated very high readiness to adopt MTL based on Motivation ($\bar{x}$)=4.45 and SD = 097; Maturity ($\bar{x}$) = 4.05, SD=1.09; Technical Strength ($\bar{x}$) = 4.41, SD = 0.84; Attitude to Work ($\bar{x}$) = 4.26 and SD = 0.89 amongst other variables.

Conclusion

From the results of analysis of the variables considered in the paper, the following conclusions are made. Mathematics Teachers' Readiness to adopt MTL is not influenced by their gender differences; the basic Level of the teaching of Mathematics Teachers did not significantly affect their Readiness to adopt MTL while Readiness to adopt MTL amongst Mathematics Teachers is affected by the school type they are teaching. Finally, Mathematics Teachers' Readiness to adopt MTL is not significantly affected by their years of teaching experience.

Recommendation

It is recommended that the Niger State Universal Education Board (SUBEB) and Local Government administrations of Minna Metropolis should consider the use of the Mother Tongue Language (MTL) for the teaching of Mathematics. Mathematics Teachers have indicated readiness to use MTL for Mathematics Instruction.

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ASSESSMENT AVAILABILITY AND UTILIZATION LEVEL OF SCIENCE LABORATORY EQUIPMENT BY SECONDARY SCHOOL SCIENCE TEACHERS AND STUDENTS IN GOMBE METROPOLIS, GOMBE STATE

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Abstract

This study put into consideration the availability and utilization level of science laboratory equipment by science teachers and students of secondary schools in Gombe Metropolis of Gombe State using a research question to guide the study. Descriptive survey design with instrument the Availability and Utilization of Science Laboratory Equipment Questionnaire (AUSLEQ) with determined reliability coefficient of 0.84 was used for the study. Data collected from two hundred and fifty (250) respondents randomly and purposively selected were analyzed using means and standard deviation to answer the postulate research question. From the study, it was shown among others that, there is availability of science laboratory equipment for effective teaching and learning of science subject in many of the secondary schools in Gombe metropolis of Gombe State; most of the secondary schools have only one multipurpose science laboratory used by the science teachers and students and there are no enough enough laboratory technologists to put the laboratory equipment in order in the school for practical. The study recommended that individual science teachers should improvise as much as possible and utilize equipment that can aid effective teaching and learning of science subjects in their schools. Government and other stake holders in education should properly equip the science laboratories at secondary school level of education and should employ more science teacher's science technologists and develop them through capacity training and attendance of workshops, seminars and conferences in their various areas of specializations to improve the performance of secondary school science students for scientific and technological development of the country.

Key words: Availability, Utilization, Equipment, Laboratory, Science, Students and Teachers

Introduction

The great importance of science globally for sustainable and socioeconomic development as well as for technological advancement of nations can never be over emphasized. Therefore, of science and technology is a requirement for individual as well as national development for it provides solution to challenges faced by mankind such as emergences of new drug resistance disease, dangers of nuclear war, explosions and global warming among others (Omosewo, 2011).The knowledge of science had resulted to rapid changes taking place in medicine, industry, communication and agriculture from effective applications. Science as an agent of development plays an important role in bringing about these changes through technological advancement, national wealth enhancement, health improvement and industrialization. This is why scientific and technological breakthrough is usually the goal of any developing nation like Nigeria (Arthur, 2010).

Despite the fact that science is very importance to national development, secondary school science students' learning outcomes has not been encouraging, it has been observed that Secondary School science students have been exhibiting dwindling interest in the study of science over the past few years (Ehindero, 2014). This and other reasons explain the reported low enrolment and consistent poor learning outcome in sciences by Secondary School Students (Omosewo, 2011). The reason for the negative attitude of the students towards the science subjects which is responsible for their low learning outcomes may not be unconnected with the teaching style adopted by science teachers which often times is rote learning and memorization of formulas as opposed to the more effective practical and hands-on approach. This ineffective approach is often blamed on the paucity of relevant and effective science equipment (Nwagbo, 2014).

From series of empirical study results, it has been revealed that, science subjects are generally seen as the most difficult subjects in the school curriculum (Ishola, 2010). Ineffective teaching and learning of sciences as well as consistent students' poor learning outcomes has become a major concern to all stakeholders in the educational sector. There is need to provide urgent solution to the problem and the only remedy to this national embarrassment and the way out of this predicament may be for teachers to embrace an effective instructional strategy. Effective instructional strategies without relevant and effective laboratory equipment cannot in any way address this challenge (Aina, 2012). The most effective approach to science teaching therefore, is to support theoretical explanations with actual practices in the laboratory by using appropriate science laboratory equipment (Ojediran, Oludipe & Ehindero, 2014).

As it was shown by Bello (2012), in his study, on the level of availability and utilization of science laboratory equipment on Students' Academic Achievement in Senior Secondary School Science showed that the use of appropriate teaching equipment and teaching methods are in line with the successful teaching and learning of science. Taale and Antwi (2012), also reported that inadequate exposure of science students to science laboratory work at the secondary school level has been a major cause of first year University students' inability to comprehend, apply scientific knowledge and cope with the contents of the level instruction.

It has been observed and concluded that, no matter how professional, well trained science teacher is, he or she would be unable to put his ideas, opinions and experiences into practice if the school lacks laboratory equipment necessary for him or her to translate his competence into reality in the classroom. Therefore, in order to attract and retain attention of students in science classes, the learning environment must be made more student friendly and this can only be achieved by supplying the relevant and effective laboratory equipment and encouraging teachers to utilize them in order to enhance the students' learning outcomes (Taale & Antwi, 2012). Practical work at senior secondary schools requires availability of functional laboratory experiment, science teachers' ability to demonstrate to the students how to carry out the practical exercises as well as the availability of the equipment for students to conduct the practical exercises on their own either individually or in small groups. This is because laboratory practical teaching can only be said to have taken place when students actively participate in the learning experience rather than sit as passive learners.

The use of equipment or apparatus in teaching such that, teaching and learning activities is based on real life experience is laboratory practical teaching. Availability and utilization of laboratory equipment and apparatus helps learner to transform and retain scientific knowledge or information into their personal knowledge which they can apply in different situations. It also enables the students to acquire manipulative skills of science laboratory equipment.

Effective availability and utilization of laboratory science equipment also help students to construct mental models that prepares them for higher order performance such as applied problem solving and ability to transfer knowledge and scientific skills from one field of study to another. The teacher serves as a facilitator, motivator, guide or a coach but not as a sage on a stage in laboratory practical class (Akuezillo, 2005).

Statement of the Problem

The learning outcomes of students in sciences has been below expectation in spite of the importance of the knowledge of science to humanity in general (Taale & Antwi, 2012). This implies that, science students are performing poorly at their final Senior Secondary Certificate Examinations (SSCE). Therefore, there is the need for a research study to find out whether there is enough laboratory science equipment for science teaching and learning at our secondary school level of education or not. Besides that, to also find out if the available laboratory science equipment is effectively utilized by the science teachers at secondary school level. This is the major reason why this study is aimed at assessing the level of availability and usage of science laboratory equipment on learning outcome of secondary school science students in Gombe metropolis of Gombe State.

Objective of the Study

The specific objective of this study was to determine the level of availability of laboratory science equipment and the extent to which science teachers utilizes them for the teaching and learning of sciences subjects as perceived by science teachers and students in senior secondary schools in Gombe Metropolis of Gombe State.

Research Question

The following research question was postulated to guide the study: -

What is the level of availability and utilization of science laboratory equipment for the teaching and learning of sciences as perceived by science teachers and students in secondary schools in Gombe metropolis of Gombe State?

Methodology

This aspect of the study puts into consideration research design, population and sampling techniques, instrumentation, validity and reliability of the instrument, procedure for data collection and method of data analysis.

Research Design

The descriptive survey design involving the use of questionnaires to collect data from the subjects was employed by the study. Here, data were collected from the representative sample using questionnaire. The main purpose of survey is to describe the characteristic of a population (Awotunde and Ugodunwa, 2004).

Population and Sampling Techniques

The population of this study consists all the science and students in Gombe state. However, the target population consists of fifty (50) and two hundred (200) science teachers and students respectively in Gombe metropolis. The sample size of this study is two hundred and fifty science teachers and students from five (5) secondary schools purposively and randomly selected from Gombe metropolis for the study. From each of the four selected schools, one intact science class was also randomly selected with cumulative population of two hundred and fifty (250) science teachers and SSII students from each of the five purposively and randomly selected secondary schools in Gombe metropolis of Gombe state.

Instrumentation

The research instrument used for data collection was structured questionnaire tagged "Availability and Utilization Level of Science Laboratory Equipment" (AULSLE) by the researchers to obtain the various personal views of the science teachers and SSII students on the availability and utilization level of science laboratory equipment in Gombe metropolis of Gombe State. The ten (10) items questionnaire contains two sections A and B. Section (A) concerns the Bio data of the respondents while section (B) contain items or statement for obtaining the views of the respondents about the level of availability and utilization of science laboratory equipment in their schools.

Validity and Reliability of the Instrument

The instrument was validated by three experts in research measurement and evaluation. Their suggestions, observations and recommendations guided the production of the final copy of the instrument. Pilot study was conducted to test the reliability of the instrument actually measured what what it has been designed to measure. The Crobach's Alpha reliability coefficient gave an estimate of 0.74, which is higher than 0.50 minimum thresholds which indicates that the instrument is reliable and could be used for the study.

Data Collection Procedure

The questionnaire contains A (5) – scale (Likert type) of. Strongly agree (SA), Agreed (A), Undecided (UD), Disagreed (D) and Strongly Disagree (SD), with scoring of 5, 4, 3, 2 and respectively was used. Any score above 3 is accepted (agree) while any score less than 3 is rejected (disagree). This is obtained by finding the average of the points from the five-points Likert scale of the instrument, using $\frac{5+4+3+2+1}{5}$ $= \frac{15}{5} = 3.00$

In each of the schools used for the study, one intact SS2 class was randomly selected and used for the study. This implies that one class of SSII science students was used in each of the five (5) schools. Ten (10) science teachers from each of the selected schools were also used for the study. The questionnaires were distributed to both science teachers and SSII students of the schools by the researchers themselves and to ensure minimum cooperation from the respondents.

Method of Data Analysis

The questionnaires answered were collected back from the respondents after they have been properly filled. One hundred percent (100%) returns rate was recorded for both students and teachers. Data collected were analyzed using mean and standard deviation

Results

The only research question consists of ten (10) which was giving to each of the respondents and their responses were collected and analyzed using frequency counts, mean and standard deviation and any item with mean of 3.00 and above was accepted while any item with less than 3.00 mean was rejected in treating the research question of the study.

Research Question

What is the level of availability and utilization of science laboratory equipment for the teaching and learning of sciences as perceived by science teachers and students in secondary schools in Gombe metropolis of Gombe State?

Table 1: Mean Responses on the Level of Availability and Utilization of Science Laboratory Equipment for the Teaching and Learning of Sciences as Perceived by Science Teachers and Students in Secondary schools in Gombe metropolis of Gombe State

S/N	ITEMS	N	MEAN	SD	DECISION
1	There is availability of Science laboratories equipment for science subjec ts teaching and learning in my school	250	3.40	1.11	Accepted
2	My school has only one multipurpose science laboratory for teaching and learning of science subjects	250	3.66	0.18	Accepted
3	There is adequate and enough science laboratory equip ment for every science subjects' practical class in my school	250	2.67	0.15	Rejected
4	The available science laboratory equipment in my school all are in good standard and appropriate	250	2.82	0.14	Rejected
5	The science teachers in my school handle available science laboratory equipment carelessly.	250	3.66	0.18	Accepted
6	There is effective utilization of science laboratory equipment by science teachers during teaching and learning in my school	250	2.45	0.16	Rejected
7	The teachers in my school could not access the available science laboratory equipment during teaching and learning process.	250	3.47	0.11	Accepted
8	There is availability of enough qualified science laboratory attendants in my school	250	2.35	0.16	Rejected
9	The location of science laboratory is not known by science students in my school.	250	3.87	0.17	Accepted
10	Lack of science laboratory equipment has negative effects on science students.	250	3.58	0.18	Accepted

The mean responses on the level of availability and utilization of science laboratory equipment for the teaching and learning of sciences as perceived by science teachers and students in secondary schools in Gombe metropolis of Gombe State can be seen.

From the above table 1, the mean responses of both teachers and students in the first item with mean 3.40 and meets the mean criterion of 3.00, therefore the item was accepted, hence there is availability of science laboratory with equipment for teaching and learning of science subjects in the school. This indicates that, most Secondary Schools in Gombe Metropolis of Gombe State have science laboratories for science subjects teaching and learning.

From the item 2 responses, on only multipurpose science laboratory that is available for science teaching and learning in my school, the table reveals the mean score of 3.66 which is higher than the criterion mean score of 3.00. Therefore, most of the Secondary Schools in Gombe Metropolis of Gombe State have only multipurpose science laboratories for science subjects teaching and learning and the do not have separate laboratories for Biology, Chemistry and Physics which is supposed to be the case under normal circumstances.

The item 3 that investigated the availability and adequate science laboratory equipment in the school. As can be seen from the table, the mean score of 2.67 which is less than the criterion mean score of 3.00. This shows that, there is neither science laboratories nor multipurpose science laboratories in most Secondary Schools in Gombe Metropolis of Gombe State with lack the prerequisite equipment for science subjects teaching and learning.

To find out the standard and appropriateness of science laboratory equipment in secondary schools, the result from item 4 of the table reveals the mean score of 2.82 which is less than the criterion mean score of 3.00. Hence, it can be concluded that, even the few available equipment in multipurpose science laboratories in most Secondary Schools in Gombe Metropolis of Gombe State are not in good standard and inappropriate.

In order to find out whether the available science laboratory equipment is handled carelessly science teachers in my school, responses from item 5 of the table reveals the mean score of 3.66 which is greater than the criterion mean score of 3.00. It can be seen that, most Secondary Schools science teachers in Gombe Metropolis of Gombe State cannot handle the few available science equipment in their laboratories.

The item 6 that looked into whether Science laboratories are effectively utilized by science teachers during teaching in my school, the responses show the mean score of 2.45 which is less than the criterion mean score of 3.00. It can be seen that, even the multipurpose science laboratories in most Secondary Schools in Gombe Metropolis of Gombe State are not properly utilized.

As it can be observed from item 7 on the table that looked into access of laboratory equipment by secondary school science teachers during teaching and learning process, the response mean score of 3.47 which is higher than the criterion mean score of 3.00 was shown. It can be concluded that, science teachers do not have access to laboratory mainly because there are no equipment in so-called science laboratories.

Looking at the item 8 that find out whether there are qualified science laboratory attendants in my school, the table reveals the mean score of 2.35 which is less than the criterion mean score of 3.00. It has been indicated that, most Secondary Schools in Gombe Metropolis of Gombe State do not even have trained science laboratory Technologist.

Observing the item 9 that put into consideration whether Science students know the location science laboratories in my school, the mean score of 3.87 was shown and is higher than the criterion mean score of 3.00. Hence, science students do not know where their school laboratory is located simply because there are no equipment the laboratory of most Secondary Schools in Gombe metropolis of Gombe State.

From the last item 10 on the table that looks into the effect of non-availability of science laboratory equipment on science students, the table reveals the mean score of 3.58 which is higher than the criterion mean score of 3.00. This attest to the fact that, science students are performing poorly at their final SSCE examinations because lack of laboratory equipment in their schools negatively affect the teaching and learning process of science subjects.

Discussion

Results from the study revealed that, there is availability of science laboratory equipment in secondary schools, most of the secondary schools have only one multipurpose laboratory that are used for all school science subjects teaching and learning and there is enough and adequate laboratory equipment for every secondary science practical classes and the available science laboratory equipment are in good condition and standard. The findings are is in line with those of Omosewo (2011), Bello (2012) and Aina (2014), who reported that most secondary schools have adequate, standard and functional laboratory for effective teaching and learning of science subjects.

In addition, it was shown from the findings that, most of the secondary school science school science teachers handle science laboratory equipment carelessly and do not assess the available science laboratory equipment during teaching and learning of science subjects and the availability and utilization of science laboratory equipment have long effect on the performance of secondary science students. The findings are in line those of Ehindero (2014), Isola (2010) and Nwagbo & Uzoma (2014), all opined that, availability of well-equipped science laboratory equipment have effect on the performance of secondary school students since they will be able to put into practice rather than learning theoretically the science subjects in the school.

Lastly as it can be seen from the findings that there are no enough qualified laboratory science technologists in various secondary schools. This is in line with the findings of of Taale & Antwi (2012), and Nwagbo & Uzoma (2014), that most science laboratories are not effectively utilized for science teaching and learning either because of lack of qualified science teachers or lack of qualified science laboratory technologists to put the science biolaboratory equipment in order and appropriate place for effective utilization.

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MATHEMATICS MASTERY AND PROBLEM-SOLVING ABILITY AS PREDICTORS OF SENIOR SECONDARY SCHOOL PHYSICS STUDENTS IN ABAJI AREA COUNCIL

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Abstract
The study investigated the extent to which Mathematics mastery and problem-solving ability *serves as predictors of Physics students' achievement in Abaji Area Council, Abuja. Two research objectives, two research questions, and two corresponding hypotheses guided the study. The study adopted a correlational research design. The population of this study consisted of senior secondary school students offering physics in Abaji of Federal Capital Territory. The total number of public and private senior secondary schools in Abaji area council is eleven (11) with one thousand and eighty-six (1086) students offering physics. Eight hundred and thirteen (813) are male students while two hundred and seventy-three (273) are female students. Multi-stage sampling technique was adopted during sample and sampling techniques and arrived at 208 male and 71 female representing 75% and 25% of the sample size respectively. Forty (40) items Mathematics Diagnostic Assessment Test (MDAT) and 25 items Physics Achievement Test (PAT) were developed by the researcher and used for data collection. Constructs and a criterion validity of the instruments were carried out by experts from the Department of Science Education Federal University of Technology Minna, Niger State and University of Abuja. The reliability of the instrument was established using split half reliability method and the indices were calculated using Spearman's Brown Formula and the coefficient were found to be 0.87 and 0.84 for MDAT and PAT respectively. The data collected from the sampled students were processed and analyzed using descriptive and inferential statistics. Research questions were analyzed using scattered plot while the formulated hypotheses were tested at 0.05 level of significant using Linear Regression, the data were analyzed using (SPSS) version 21.0 statistical package for social science. The findings from the study revealed that there is significant relationship between mathematics mastery, problem solving ability and Physics students' achievement. Therefore, the study concluded that mastery and problem solving ability is a predictor of academic achievement in physics in senior secondary schools. The study recommends among other that, students offering physics should be taught on how to develop mathematics mastery and problem solving ability as it predicts their achievement in studying physics subject.*

Keywords: Mathematics Mastery, Problem Solving, Physics Students and Achievement

Introduction
Science is crucial to technological advancement and economic improvement of every nation, because science and technology are tools for national growth. In a fast-growing world, a country is considered developed when it has advanced in science and technology. Advancement in science and technology has a strong link with science education. Science is taught at every level of the education system because of the keys it has for scientific and the socio-economic development of a country. Technology and science rebirth supports for economic sustainability and development in health systems, education and infrastructure (Lee-Roy, 2013). Science proffers solution to various forms of human, material and environmental problems through its organized form of knowledge (Ifeobu, 2014). Anyanwu *et al,* (2013) highlighted that Science, Technology and Mathematics (STM) education play a dominant role in the developmental effort of nations. Ajibola (2018) reported that a solid foundation of science is very paramount for industrialization, agricultural development and food security, commerce, transportation, communication and even warfare to be guaranteed. The role of science and particularly physics are evident in

Physics is one of the science subjects taught at the senior secondary level of Nigeria Educational system. Its importance as a discipline cannot be over-emphasized since its applicability inevitably touches every aspect of human life. Physics as a science course of study is perceived generally to be very interesting, vast, mathematical and experimental and all aspects of science, both living and non-living has

something to do with physics, ranging from Engineering to mathematics, biology and chemistry. Thus physics is one of the pre-requisite subjects for the study of Engineering, technology, medical and other applied science courses in the university. Oluwatomisin, *et al.,* (2019) defined physics as a science that involves the study of the physical properties of matter, energy and the interaction between them over time and the study of systematized knowledge produced by careful observation, measurement, and experiment in a view to establishing basic laws as well as give scientifically reliable explanation to natural phenomena. Physics is a foundational science subject whose discoveries have never ceased propelling the engine of technological advancement, Nigerian Education Research and Development Council (NERDC, 2013). The structure of the evolution of the universe and provision of insight into fundamental forces of nature is controlled by the understanding of physics. The knowledge of physics as a science subject contributes to the cognitive reservoir that facilitates the sustenance and advancement of technologically oriented society. Correspondingly, Redish and Kuo (2015) opined that Physics involves a lot of representation like experiments, formulas and calculations, graphs, and concept explanation. It also affirms that there is strong interrelationship between Physics and mathematics in historical views because Physics curriculum had similar aims with mathematics curriculum since both emphasize skills in decision making and problem solving. Considering the interrelatedness between physics and mathematics, it is necessary for physics student to acquire fundamental knowledge of mathematics.

Mathematics is a branch of science that has a very important role in the development of science and technology. The important role of mathematics is recognized by Doran, (2017) which states that at every level of education, one of the most important subjects is mathematics. As such every student with an objective of attaining a height in the knowledge of sciences and physics in particular, must possess average knowledge of mathematics. In this scientific age, we cannot underestimate the usefulness of mathematics because it has its limb in virtually all fields of study either- mathematical or nonmathematical inclined; However, its influence in the mathematically related fields cannot be overemphasized (Awodun & Ojo,2013). In fact, Mathematics is the pivot on which all sciences, engineering, Business and even Social sciences revolve. Because of its importance many institutions of higher learning require a credit pass from senior secondary school students who seek admission to study various courses in the institutions. Awodun and Ojo (2013) opined that mathematics is an intrinsic component of science which serves as a universal language and indispensable source of intellectual tools that is widely regarded as the language of science in general and of physics in particular. The researcher admitted that without Mathematics, there is no science and without science there is no modern technology and without modern technology there is no modern society. In other words, mathematics is the precursor and the Queen of science and technology and the indispensable single element in modern societal development (Herbert, 2013). Mathematics Education is therefore indispensable in nation building and form a strong foundation for the study of physics either simple operations or more advanced all requires some form of mathematics.

Physics and Mathematics solving ability, is defined as student's ability to understand problems, plan problem solving strategies, carry out selected strategies of completion, and re-examine problem to subsequently make solution in other ways when students are dealing with physics mathematical problems (Kuzle, 2013). According to Bahar and Maker (2015) mathematics problem solving ability is referred to by scientist as a high- level thinking process consisting of intellectual ability and major cognitive process. As reported by Michal and Elsbeth (2018) one of the causes of students' difficulty in studying physics is the weakness in the mathematics solving ability. An individual cognitive ability provides the foundation for his / her applicative capabilities such ability includes intelligence, application, creative thinking ability and even pattern recognition. In general, the higher the individual physics mathematics problem solving - ability, the more that person is able to have good physics mathematical mastery.

Mathematics mastery is an approach to science education which is based on mastery learning in which most students are expected to achieve a high level of competence before progressing (Simpson & Wang, 2022). Mastery means students acquiring a deep, long-term secure and adaptable understanding of the subject. Teaching for mastery' describes the elements of classroom practice and school organization that combine to give students the best chances of mastering mathematical concept in physics. Mastery

of mathematics concept is indispensable in the process of learning physics and its application in many fields. Thus it is important that students leaning physics have good mastering of mathematics reasoning in order to apply the skills to other related fields.

Physics achievement in this advanced transformation, information and technology era, is the measurement of physics students overall academic achievement and learning over a period of time and considered important as the basis for scientific knowledge acquisition (Lei & Kathaleen, 2019). In an effort to improve student's overall physics achievement through research in Nigeria, educators need to recognize factors affecting students study result which includes; the knowledge of physics mathematics basic concepts, solving ability, mathematics mastery, and reasoning ability among others as the initial information for teacher to develop successful learning. This research, therefore, sought to investigate the effects of mathematics factors as predictor of physics achievement among senior secondary school students in Abaji of FCT.

Statement of the Research Problem

The benefits derived from studying physics and applying its principles to human life and the society are enormous. In spite of the enormous benefits associated with the study of Physics such as quantitative reasoning, develop problem solving and transferable skills, and its useful applications in the areas of communication, health, energy and power, transportation, entertainment, manufacturing, building and construction, stimulating economy, among other students' academic achievement/progress in the subject has over the years been reportedly low with its attendant negative consequence such as frustration, anxiety, academic vices (Usman & Sule (2017).

This ugly trend in students' low academic achievement in Physics is reflected in both internal and external examination results like West African Senior School Certificate Examination (WASSCE), and National Examination Council (NECO), among others. In particular, reports on WAEC results of Senior Secondary School Certificate Examination in Abaji area council of FCT Abuja over the years often revealed low performance of students in Physics. Maloney, (2014) asserted that this failure in academic achievement by students offering Physics and other science subjects in Nigerian schools could be as result of mathematics-related factors? Which may include (a) mathematics prior knowledge, (b) mathematics solving ability, (c) mathematics mastery, and (d) mathematics reasoning ability in students? There have been several studies on students cognitive or intellectual ability with little or no attention is given to the fact that the students' mathematical ability/ factor can affect their achievement in Physics. It is on this basis that this study intends to find out the relationship between mathematics factors (prior knowledge, solving ability, mastery, and reasoning ability) and achievement in Physics among secondary school students in Abaji Area council FCT, using gender as moderating variable.

Objectives of the Study

The aim of the study is to investigate the relationship between students' prior knowledge, problem solving ability, mastery and mathematics reasoning ability as predictors of Physics achievement among secondary school students' in Abaji, Federal Capital Territory. The specific objective is to;

4. Determine the influence of students' mathematics problem solving ability on students' Physics achievement in secondary schools Abaji, FCT.
5. Find out the influence of students' mathematics mastery ability on students' Physics academic achievement in senior secondary schools Abaji, FCT.

Research Questions

The following research questions were raised to guide the study:

1. What is the relationship between students' mathematics problem solving ability and Physics academic achievement in secondary schools Abaji, FCT?
2. What is the relationship between students' mathematics mastery ability and physics academic achievement in secondary schools Abaji, FCT?

Null Hypotheses

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

HO_2: There is no significant relationship between students' mathematics problem solving ability and Physics achievement in secondary schools Abaji, FCT.

HO_3: There is no significant relationship between students' mathematics mastery ability and Physics achievement in secondary schools Abaji, FCT.

Research Methodology

This study adopted a correlational research design. The correlational design is one that helps to describe or explain the relationship between the predictor or independent variables and the criterion or dependent variable and it seeks to clarify phenomena through careful data collection and analysis (Creswell, 2015). The population of this study consisted of senior secondary school students offering physics in Abaji of Federal Capital Territory. The total number of public and private senior secondary schools in Abaji area council is eleven (11) with one thousand and eighty-six (1086) students offering physics. Eight hundred and thirteen (813) are male students while two hundred and seventy-three (273) are female students. The target population for this study comprised of senior secondary (SS 2) students in the public and private schools in Abaji Area Council, FCT Abuja, 2022 / 2023 academic sessions. The total target population was two hundred and seventy-nine (279) with two hundred and eight (208) male students' and seventy-one (71) female students. Multi-stage sampling technique was adopted during sample and sampling techniques. David (2014) affirms that multi-stage sampling involves first selection of clusters and then randomly choosing a specified number of respondents from each cluster to participate in the study. Cluster sampling technique was used to categorize the population (schools) into three 3 zones, namely North zone, Central zone, and South zones. Secondly simple random sampling techniques was used to select 46 students from North Zone, 89 students from Central Zone and 73 students from South zone. This gives a total of 279 students offering physics as the sample size for the study. Using Krejcie and Morgan (1971) table for determining sample size. This sample size is made of 208 male and 71 female representing 75% and 25% of the sample size respectively.

Mathematics Diagnostic Assessment Test (MDAT): the instrument was developed by the researcher. MDAT consist of forty essay items. Graph Computation, Simple arithmetic, algebraic, and geometry were the topics used in the construction of the instrument. The instrument MDAT contains construct A and B. Construct A consist of 10 items that were used to collect data on students Mathematics Problem Solving ability to Physics achievement, Construct B consist of 10 items that were used to collect data on students Mathematics Mastery ability to Physics achievement. And each item was given two (2.5) marks making a total of hundred (50).

Physics Achievement Test (PAT) was also developed by the researcher and was administered to students offering physics subject. Physics Achievement Test (PAT) consists of two sections. Section A requested for relevant information on the personal data of the respondents such as school name, class, year, gender. Section B consists of 25 items including six numbers of essay items and 20 numbers of multiple choices questions. The items of the instrument were developing from these topics; graph computation, accelerated motion, work and energy, force and linear momentum from SS1 and SS2 syllabus. Each question has a maximum of 4 score making a total mark of 100 and marking scheme will be prepared to guide the scoring of the instrument.

To determine the validity of the instruments, constructs and a criterion validity of the instruments was carried out by experts from the Department of Science Education Federal University of Technology Minna, Niger State and University of Abuja. They examine how the research instruments will have sought for data or information needed and its appropriateness on mathematics and physics expressions, formulae, signs and symbols. The experts' corrections, observations, and recommendations was noted and corrected. Two schools beside those selected for main study were used for pilot testing of the instruments. Twenty students were used for the pilot study, ten (10) students from Government secondary school Nuku Abaji area council and ten (10) students from government day secondary school Abaji. The researcher established splint half reliability method from the result obtained during pilot testing and the coefficients were determined using Spearman Brown Formula for Physics Achievement Test (PAT) and Mathematics Diagnostic Assessment Test (MDAT) and found to be 0.87 and 0.84 respectively.

The researcher obtained a letter of introduction from the Department of Science Education, Federal University of Technology, Minna and visited the sampled schools in each Zones in the first week to seek for permission from the school's management to use their schools to conduct research. After the permission is granted, the researcher was introduced to the students offering physics subject in the schools and trained research assistant for the purpose of the study in the second week.

The students were briefed using the third and fourth weeks on the objectives of the study, and how to answer the tests questions to ensure collection of valid data and assured them the data collected were used strictly for the purpose of this research. Thereafter, the instruments were administered by the researcher and trained research assistants on all the respondents, the completed instruments were retrieved by the researcher and research assistants. The data collected from the sampled students were processed and analyzed using descriptive and inferential statistics. Research questions were analyzed using scattered plot while the formulated hypotheses were tested at 0.05 level of significant using Linear Regression, The data were analyzed using (SPSS) version 21.0 statistical package for social science.

Analysis of Result

Research Question One: What is the relationship between students' mathematics problem solving ability and Physics academic achievement in secondary schools Abaji, FCT?

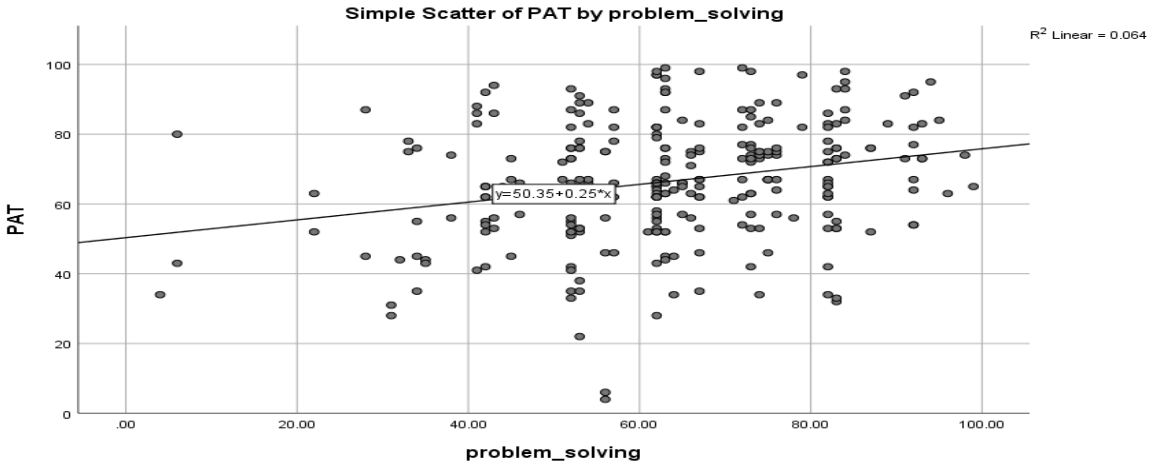

Figure 1: scattered plot of Mathematics Problem Solving Ability and Academic Achievement

Research Question Two: What is the relationship between students' mathematics mastery ability and physics academic achievement in secondary schools Abaji, FCT?

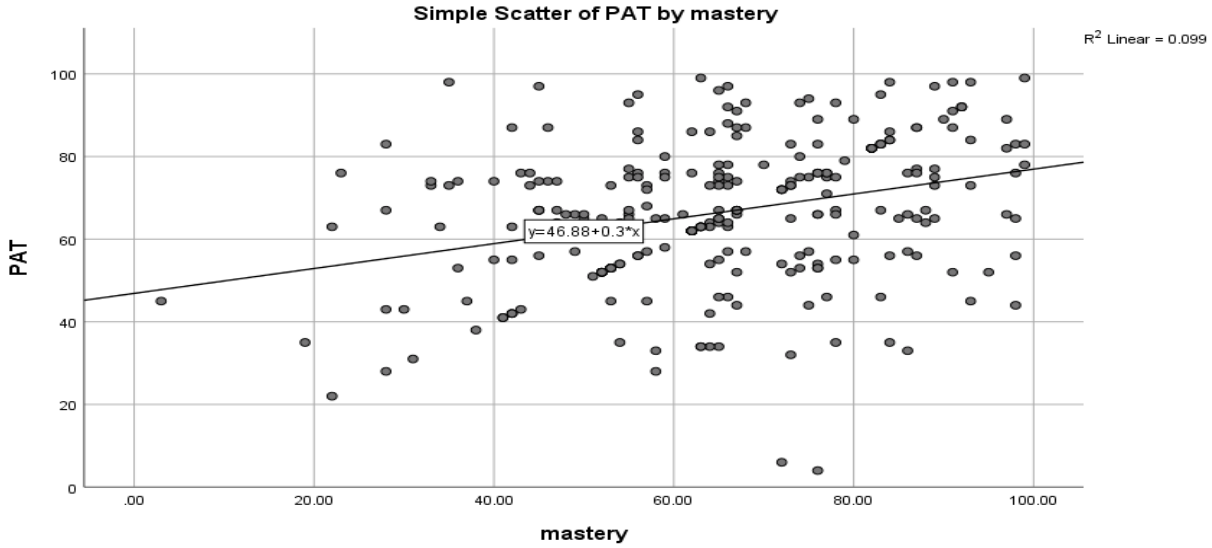

Figure 2: scattered plot of Mathematics Mastery Ability and Academic Achievement

Null Hypothesis Testing

Table 1: Linear Regression Analysis of Students' Mathematics Mastery Ability, Mathematics Problem Solving Ability and their Academic Achievement in Physics

Model	R	R Square	df	P-value
problem solving ability	0.314	0.099	277	0.000
Mathematics Mastery	0.290	0.084	277	0.000

Dependent Variable: Academic Achievement
Predictors: (Constant), Mathematics Mastery Ability, Mathematics Problem Solving Ability

Null Hypothesis One: There is no significant relationship between students' mathematics problem solving ability and Physics achievement in secondary schools Abaji, FCT.

Table 1 shows Linear Regression Analysis of students' mathematics problem solving ability and their academic achievement in physics. The result revealed that there is significant a weak positive relationship between physics student academic achievement and their mathematics problem solving ability (N=279, R = 0.314, R^2 = 0.099, p<0.05). Thus, null hypothesis 1 is hereby rejected at $p < 0.05$ and concluded that there is significant relationship between physics student's mathematics problem solving ability and their academic achievement. Hence, mathematics problem solving ability is a predictor of science students' academic achievement.

Null Hypothesis Two: There is no significant relationship between students' mathematics mastery ability and Physics achievement in secondary schools Abaji, FCT.

Table 1 shows Linear Regression Analysis of students' mathematics mastery ability and their academic achievement in physics. The result revealed that there is significant a weak positive relationship between physics student academic achievement and their mathematics mastery ability (N=279, R = 0.290, R^2 = 0.084, p<0.05). Thus, null hypothesis 1 is hereby rejected at $p < 0.05$ and concluded that there is significant relationship between physics student's mathematics mastery ability and their academic achievement. Hence, mathematics mastery ability is a predictor of science students' academic achievement.

Discussion of the Result

The results of the study were discussed based on the two research question stated:
The finding of this study revealed that the joint effect of the independent variables (that is, (mathematics mastery and problem solving ability) on Physics students' achievement in Senior Secondary shows that the independent variables account for a high proportion of about 86% of Physics student achievement. This implies that the skills are relevant towards the determination of the dependent measure (student academic achievement in Physics). This is in line with the research outcome of Liu, *et al* (2014), Rohmah, *et al* (2018). Omeodu, (2019) that there is strong interrelationship between Physics and mathematics mastery, solving ability in historical views and the result also agrees with the findings of Yeo (2013) that Physics curriculum had similar aims with mathematics curriculum since as both emphasize skills in decision making and problem solving and that positive students' master and problem solving ability will result to positive academic achievement in physics.

Conclusion

The findings of the study revealed that the mathematics mastery and problem solving ability of the students had significant and positive relationships with their academic achievement in physics. Hence, the researchers therefore concluded that mathematics mastery and problem solving ability are major predictors of students' academic achievement in physics. In other words, high mathematics mastery and problem solving ability might lead to high students' academic achievement in physics. Thus, mathematics mastery and problem solving ability of students should not be disregarded in their ability to achieve higher students' achievement in physics.

Recommendations

Based on the findings of this study, the researchers made the following recommendations

- The relationship of mathematics to physics subjects is worthy of note by classroom practitioners as well as curriculum planners to influence the learners' achievements in physics.
- Adequate mathematics Education should be given to the prospective physics student.
- There should be collaboration between mathematics and physics curricula.
- The government should invest more into mathematics and science education since science is the bedrock of technology and without technology a country can not be said to have advanced or developed.

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EFFECTS OF VIRTUAL LABORATORY PACKAGE ON ACHIEVEMENT AND RETENTION IN CHEMISTRY AMONG SENIOR SECONDARY SCHOOL STUDENTS IN MINNA METROPOLIS

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Abstract

The study determined the effects of a virtual laboratory package on achievement and retention in Chemistry among senior secondary school students in Minna metropolis. This study used a quasi-experimental design of pretest-posttest, experimental and control groups. The study population comprised 3395 chemistry students (2020/2021) in the senior secondary schools within the Minna metropolis. In this study, the researcher adopted multi-stage sampling techniques to draw the sample size of 132 SS2 chemistry students, based on the area of interest and availability of facilities for the research study. Balancing of Chemical Equation Achievement Test (BOCEAT) was used as the instrument for data collection. The instrument was subjected to both content and criterion validation to estimate the instrument's psychometric properties. The instrument was given to three experts, one science educator in the Department of Science Education of the Federal University of Technology, Minna and two from the Department of Chemistry, Niger State College of Education, Minna. The reliability coefficient of the BOCEAT was determined using Pearson Product Moment Correlating Coefficient (PPMC). The reliability coefficient of 0.82 was obtained, showing that BOCEAT was reliable. The data collected from the pre-test, post-test and retention tests were analyzed using mean and standard deviation to answer the research questions, while the hypotheses were tested using independent t-test at 0.05 levels of significance using computer software statistical package for social science (SPSS) version 23.0. The findings revealed that the experimental group taught using the virtual laboratory package had higher means scores(13.39) than those taught using the physical method(11.61). Furthermore, the achievement mean scores of the female group taught using virtual laboratory package (13.13) was also higher than the male group (11.65). The finding also revealed that the experimental group taught using the virtual laboratory package had higher retention mean scores (11.60) than those taught using the physical method. Based on the study's findings, it was recommended that; Chemistry teachers be encouraged to use virtual laboratory packages in teaching chemistry concepts, especially balancing chemical equations, among others.

Key words: Chemistry, Achievement, 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 programs. 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 application available to students (SAVVIS, 2010; Jeschke et al., 2016). Virtual laboratories provide students with meaningful virtual 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 for better academic achievement (Reese, 2020). Achievement is an important academic factor that is influenced by teaching strategies. Achievement is the process of getting something done effectively and successfully using effort and skills to accomplish academic goals. Falode *et al.* (2016), viewed achievement as measurable changes in students' academic behavior as a result of exposure to a given concept over period of time.

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. Abou and 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. Determine the effect of virtual laboratory packages and physical method on students' mean achievement scores in balancing of chemical equations.
2. Determine the effect virtual laboratory package on male and female students' mean achievement score in balancing of chemical equations.
3. Examine the effect of virtual laboratory packages and physical methods on students' mean retention scores in balancing chemical equations.
4. The effect of virtual laboratory package on male and female students' mean retention scores in balancing of chemical equations.

Research Questions

1. Is there any difference between the mean achievement scores of students taught balancing of chemical equations using virtual laboratory package and those taught using physical laboratory method?
2. What is the effect of virtual laboratory package on male and female students' mean achievement scores in balancing of chemical equations?
3. Is there any difference in the mean retention scores of students taught using a virtual laboratory package and those taught using the physical laboratory methods?
4. What is the effect of virtual laboratory package on male and female mean retention score in balancing of chemical equations?

Hypotheses

The following null hypothesis ware tested at 0.05 level of significance:

$H_{O1:}$ There is no significant difference between the mean achievement score of students taught balancing of chemical equations using virtual laboratory package and those taught with physical laboratory method.

H_{O2}: There is no significant difference between male and female students' mean achievements scores taught balancing of chemical equations using virtual laboratory package.

Ho_{3}: There is no significant difference between the mean retention score of students taught balancing of chemical equations using virtual laboratory package and those taught with physical laboratory method.

H_{O4}: There is no significant difference between mean retention scores of male and female students taught balancing of chemical equations using a virtual laboratory package.

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 between the mean achievement scores of students taught balancing of chemical equations using virtual laboratory package and those taught using physical laboratory method?

Table 1: Summary of Mean and Standard Deviation of the Experimental and Control Groups on Achievement Test

	Pretest			Posttest		
Treatments	**N**	**Mean**	**Std. Deviation**	**Mean**	**Std. Deviation**	**Mean Gain**
Experimental group	88	6.34	3.02	13.39	2.47	7.05
Control group	44	5.97	2.74	11.61	2.27	5.64

The Table 1 shows that the students in the experimental group had (M = 6.34, SD = 3.02) in the pretest and (M = 13.39, SD = 2.47) in posttest with mean gain of 7.05. While the students in the control group had (M = 5.97, SD = 2.74) in the pretest and (M = 11.61, SD = 2.27) in posttest with mean differences of 5.64. Therefore, the researcher concluded that students' benefits from the treatment. Hence, the students in the experimental group achieved better (M = 13.39) than those in the control group (M = 11.61), with mean differences of 1.41.

Research Question Two: What is the effect of virtual laboratory package on male and female students' mean achievement scores in balancing of chemical equations?

Table 2: Mean Scores of Male and Female Students Exposed to the Treatments

Treatment	Gender	N	Mean	Std. Deviation	Mean Differences
Virtual Laboratory package	Male	44	11.65	2.26	1.48
	Female	44	13.13	2.48	

The Table 2 shows that the male group in the experimental group achieved lower than the female group with (***M*** = 11.65 ***SD*** = 2.26). This result indicated that the female group achieved better than the male group in the experimental group, with a mean difference of 1.48. Therefore, the result showed that there is a difference between the mean scores of male and female students when exposed to treatments in favour of the female students.

Research Question Three: Is there any difference in the mean retention scores of students taught using a virtual laboratory package and those taught using the physical laboratory methods?

Table 3: Summary of Mean and Standard Deviation of the Retention Test for the Students Exposed to the Virtual Laboratory Package and those exposed to the physical laboratory method

Treatments	N	Posttest Mean	Posttest Std. Deviation	Retention Mean	Retention Std. Deviation	Mean Differences
Virtual Laboratory package.	88	13.39	2.47	11.60	2.62	1.04
Physical Method	44	11.61	2.27	10.56	2.30	

Results in Table 3 show that the students taught using Virtual Laboratory package (experimental group) had (***M*** = 11.60 ***SD*** = 2.62) while those taught using Traditional method (control group) had (***M*** = 10.56 ***SD*** = 2.30). The mean differences that exist between the students exposed to both treatments are 1.04. From this result, the mean posttest score of the students in the experimental group dropped by (1.79) and (1.05) for the control group. However, the experimental group taught with a virtual laboratory package retained a greater proportion of the concept. The result indicated that the virtual laboratory package enhanced the retention of the balancing of chemical equations.

Research Question Four: What is the effect of virtual laboratory package on male and female mean retention score in balancing of chemical equations?

Table 4: Mean and Standard Deviation of Retention test score for Male and Female students taught using Virtual Laboratory package

Treatment	Gender	N	Mean	Std. Deviation	Mean Differences
Virtual Laboratory package	Male	44	10.68	2.31	1.84
	Female	44	12.52	2.62	

The data presented in Table 4 shows that the male group had (***M*** = 10.68 ***SD*** = 2.31) while that of female group had (***M*** = 12.52 ***SD*** = 2.62). The result indicated that the female group has the highest retention mean score compared to the male group after using a virtual laboratory package to balance chemical equations. Therefore, this implies that the female students retained the highest proportion of the concept than their male counterparts, with mean differences of 1.84 when exposed to the treatment.

Hypothesis One: There is no significant difference between male and female students' mean achievement scores taught balancing of chemical equations using physical laboratory method.

Table 5: t-test Comparisons of the Mean Achievement Score of Students Taught Balancing of Chemical Equations Using Virtual Laboratory Package and Those Taught with Physical Laboratory Method

Treatments	*N*	Mean	Std. Deviation	*t*-value	*df*	*p*-value	Decision
Virtual Laboratory Package	88	13.39	2.47	2.76	130	0.00	Rejected
Physical Laboratory Method	44	11.61	2.27				

*Significant at 0.05

Table 5 shows the t-test comparisons of the achievement mean score of students exposed to the virtual laboratory package and those exposed to physical laboratory method. The result revealed that the mean score of the experimental group = 13.39 and that of control group = 11.61 at p (0.00) < 0.05 level of significance (t-value =2.76 p = 0.00). Therefore, the null hypothesis is rejected, and the hypothesis is retained. Hence, there is a statistically significant difference in the achievement of students taught

balancing chemical equations using virtual laboratory package and those taught with the physical method.

Hypothesis Two: There is no significant difference between male and female students' mean achievements scores taught balancing of chemical equations using virtual laboratory package.

Table 6: t-test Comparisons of the Mean Achievement Score of Male and Female Students exposed to Virtual Laboratory package

Gender	*N*	Mean	Std. Deviation	*t*-value	*df*	*p*-value	Decision
Male	44	11.65	2.26	2.92	86	0.00	Rejected
Female	44	13.13	2.48				

*Significant at 0.05

Tables 6 shows the t-test comparisons of male and female achievement mean scores of students exposed to virtual laboratory packages. The table revealed that the mean score of the male group =11.65 and female group =13.13 at a 0.05 level of significance (t-value = 2.92 p = 0.00). Therefore, the null hypothesis is rejected and the hypothesis is retained. Hence, there is a statistically significant difference in male and female achievement taught balancing chemical equations using a virtual laboratory package favoring the female group.

Hypothesis Three: There is no significant difference between the mean retention score of students taught balancing of chemical equations using virtual laboratory package and those taught with physical laboratory method.

Table 7: **t-test Comparisons of the Mean Retention Score of Students Taught Chemical Equations Using Virtual Laboratory Strategy and Those Taught with Traditional Method**

Treatments	*N*	Mean	Std. Deviation	*t*-value	*Df*	*p*-value	Decision
Virtual Laboratory Package	44	11.60	2.62	2.21	130	0.02	Rejected
Physical Laboratory Method	44	10.56	2.30				

*Significant at 0.05

Table 7 shows the t-test result of the mean retention score of the students taught balancing the chemical equation with virtual laboratory package and those taught with the physical laboratory method. The result revealed that the mean score of the experimental group = 11.60 and that of control group = 10.56 at $p < 0.05$ level of significance (t-value =2.21 p = 0.02). the mean posttest score of the experimental group dropped by (0.79) and (1.04) for the control group. On this basis, the null hypothesis is rejected, and the hypothesis is retained. Hence, there is a statistically significant difference in the retention level of students taught balancing of chemical equations using virtual laboratory package and those taught with the physical method.

Hypothesis Four: There is no significant difference between mean retention scores of male and female students taught balancing of chemical equations using a virtual laboratory package.

Table 8: **t-test Comparisons of the Mean Retention Score of Male and Female Students exposed to Virtual laboratory package**

Gender	*N*	Mean	Std. Deviation	*t*-value	*df*	*p*-value	Decision
Male	44	10.68	2.31	3.49	86	0.00	Rejected
Female	44	12.52	2.62				

*Significant at 0.05

Tables 8 showed the t-test comparison of male and female retention mean score of students exposed to virtual laboratory packages. The table revealed that the mean score of male group =10.68 and female group =12.52 with t-value = 3.49 and *p(0.00)* <0.05 level of significance. This indicated that there is a statistically significant difference in the mean score of the male group (10.68) and female group (12.52) exposed to experimental treatment at 0.05 level of significance. Therefore, the null hypothesis is rejected and the hypothesis is retained. Hence, there is a statistically significant difference between the retention score of males and females taught with virtual laboratory package regarding the female group.

Discussion

The study's findings revealed that virtual laboratory packages affect students' achievement compared to students taught balancing chemical equations using the physical laboratory method. This concurs with AbouFaour and Ayoubi. (2017), 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, interactively completing experiment process (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 (Al Hassan, 2016).

The study also revealed a significant difference in the achievement of students taught balancing of chemical equations using the virtual laboratory package and those taught balancing of chemical equations using the physical laboratory method. In addition, using a virtual laboratory package enriched the students' learning experiences and improved their experiment-related skills, such as balancing chemical equations. This study is supported by the results of Azare (2017), who observed that science education is strongly influenced by technology in most but not all cultures.

The study also revealed that female subjects performed better than males, which is in consonance with Kawu (2017), who observed that female students are significantly better than their male counterparts and that there was a significant difference between the male and female students in their ability to solve quantitative problems. Gambari *et al*. (2016) found out that female students perform better than their male counterparts in science. Similarly, Azare (2017) researched cognitive style and students' problem-solving behaviour in Chemistry. It was found out that there was a gender difference in performance using the Chemistry process skill test. In this study, girls performed better than boys.

The result of the study also revealed that there was a significant difference in the retention scores of students taught using a virtual laboratory package and those taught using the physical laboratory method. This concurs with Usman and Geraldine (2020), who assert that computer-based instructional applications are considered an effective alternative to physical teaching methods. Today, in numerous educational and training settings, interactive computer programs are used to teach young students and adults computer literacy skills. Virtual laboratory instructional strategies provide great promise for handling functions like testing, diagnosing student deficiencies, student progress and providing individual schedules and study assignments. Equally, Tran (2014) reported that achievement and knowledge retention in genetics among secondary school students using virtual instructional strategy was significantly more effective in teaching genetic concepts and enhancing knowledge retention among students. This can reduce rote learning, thereby improving writing retention and balancing a chemical equation.

In addition, the study's findings revealed a significant difference in gender retention scores of students taught using virtual laboratory packages in favour of females. This is in line with Achor, and Ukwuru (2017), who reported that using a computer-assisted instructional package improved the achievement and retention of students in science education. The findings equally concur with Gambari *et al.* (2017) who reported that gender effect was significant among girls and insignificant among boys while using computer-assisted learning with different presentation formats (animation, still graphics, and text).

The difference between the performance of males and females exposed to teaching using virtual laboratory package in favour of females, which the research revealed, might be due to the upbringing

and nature of the learning environment which involved schools with the same gender (male separate and female separate) without any interaction with each other.

Conclusion

From the findings of this study, it could be concluded that virtual laboratories simulate a real laboratory environment, and processes provide students with meaningful virtual experiences and present important concepts, principles, and processes. Students can repeat any incorrect experiment or deepen the intended experiences using virtual laboratories. Moreover, it is gender-friendly and improves students' retention in Chemistry. Therefore, this strategy is a better approach for teaching balancing a chemical equation and other concepts in Nigeria's chemistry education classroom.

Recommendations

1. Based Chemistry teachers should be encouraged to use virtual laboratory package to augment physical laboratories while teaching chemistry concepts, especially balancing of a chemical equation.
2. Educational agencies and other stakeholders should organize workshops and seminars for teachers on the use of virtual laboratory package
3. Nigeria Educational Research and Development Council (NERDC) or individuals involved in producing Chemistry resource materials should develop and produce virtual laboratory materials in chemistry and other sciences to help the teachers.
4. 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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CONNECTED LEARNING FOR STEM (CL4STEM) LESSON PLAN APPROACH AND QUALITY STEM EDUCATION

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Abstract
The quality of life in any society depends significantly on the quality of its education and the quality of education revolves round the quality teachers. Therefore, the success of any education system depends on the quality of teachers, which, in turn, depends on the effective teaching / learning process. STEM education is considered as a precious way to make the education system keep up with the developments and to meet the expectations of 21st century skills. For effective teaching, students' learning and classroom management, every teacher needs to follow a well design lesson plan. Thus, the study explores the stages involved in writing a model lesson plan based on Connected Learning for STEM (CL4STEM) lesson plan approach. CL4STEM approach is both student – based and Activity – based, identifying and addressing misconceptions, Universal Design Learning (UDL) and use of technology. The topic for the lesson plan is linear inequalities in one variable. The objectives, pre-requisite knowledge, instructional materials, learning activities and how to cater for diverse learners and address misconceptions were well specified. It was then recommended that teachers should be encouraged to imbibe the principles of CL4STEM lesson plan approach in the teaching/learning of Mathematics at all educational levels. It also recommended capacity building workshops for in-service STEM teachers and integration of the lesson plan approach in the in-service teachers' methodology courses and micro-teaching.

Key words: CL4STEM, Lesson Plan, STEM and Universal Design Learning (UDL)

Introduction
The quality of life in any society depends significantly on the quality of its education and the quality of education revolves round the quality teachers. Education provides individuals with skills to live a healthy, meaningful and productive life. So also, education empowers people with the civic values and critical thinking needed to contribute actively to their communities. Quality education is the education that best fits the present and future needs of the learners. It is the education that provides students with the tools to deal with and find solutions to challenges confronting mankind.

Quality education according to (UNICEF, 2000) includes among others, learners who are healthy, well-nourished and ready to participate and learn, and processes through which trained teachers use child-centered teaching approaches in well-managed classrooms and schools and skillful assessment to facilitate learning and reduce disparities. Education, and particularly Science, Technology, Engineering and Mathematics (STEM) education, plays a crucial role in achieving the Sustainable Development Goals (SDGs). Goal number (4) of (SDGs) is on Quality Education it says "Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all." STEM education seeks to elaborate and provide innovative solutions to solve global issues (IBE-UNESCO, 2019).

STEM education is considered as a precious way to make the education system keep up with the developments and to meet the expectations of 21st century skills (Kazu & Cemre, 2021; Ghazali, & Yusof, 2022). 21st century skills include among others creative thinking, critical thinking, problem-solving, and collaborative work and information and communication technologies literacy. Equipping individuals with such skills contributes to human development and promotes innovation, helping nations grow and compete in the global knowledge economy (Şahin et al 2014).

Teachers play most crucial role in the development of the education system as a whole and also in imparting and maintaining of education at all levels. Teacher formulates, designs, controls, supervises, selects, explores, facilitates, manipulates, assesses the teaching-learning materials, and evaluates all other factors in teaching-learning process (Abell, 2007). Teaching is a very demanding job. It involves the use of the teacher's intellect and experiences, planning of the lesson, sourcing for and gathering of teaching materials, rehearsing on the lesson plan, developing techniques and skills and choosing the methodology or combining different methodologies in lesson delivery.

Lesson plan is a clearly, orderly and systematically planned procedure of teaching method, teaching facts and teaching materials which a teacher has prepared for use in the teaching of a lesson in order to achieve mapped out objective. A lesson plan should not limit the teacher in his/her approach and it should contain sufficient flexibility to carter for circumstance as they arise in the session. According to Volkan and Tok, (2022) an effective teacher has (i) positive expectations for student success; and lesson plan reflects such expectations, (ii) he or she knows how to design lessons for student mastery; which is reflected in lesson plan, and (iii) is an extremely good classroom manager; which is possible via good time management during class time and that is possible only by effective implementation of a good lesson plan.

The Connected Learning for STEM (CL4STEM) seeks to strengthen the capacities of middle and secondary school science and mathematics teachers in Bhutan, Nigeria and Tanzania to foster inclusive higher-order learning in their classrooms. The CL4STEM essentially focuses on developing the capabilities of science and mathematics teachers and emphasizes the pedagogical content knowledge requirements of teachers in the different country contexts in Nigeria, Bhutan and Tanzania. Some innovative features of CL4STEM lesson plan include: integration of technology, identification and addressing of students' misconceptions and use of Universal Design Learning (UDL) principles for inclusion and equity. UDL aims to break down learning barriers and provide all students with an equal chance to achieve. It consisted of three principles: multiple means of representation, multiple means of action and expression, and multiple means of engagement. Therefore, this study explores the stages involved in writing a model lesson plan based on Connected Learning for STEM (CL4STEM) lesson plan approach.

Cl4stem Lesson Module

Topic: Linear inequalities in one variable

Learning Objectives (LO) *(Indicate essential concepts to be taught, skills to be developed and broad objectives)*

Objective: By the end of the lesson the students should be able to:

i. Solve linear inequalities in one variable
ii. Solve word problems involving inequalities

Pre-requisite knowledge

i. Interpret simple inequality sentence;
ii. Write linear inequalities in one variable for given scenarios;
iii. Solve word problems involving inequalities; iv. Students have solve problems involving simple linear equations; v. Students have solve word problems involving simple linear equations

Teaching and learning resources:

Flash cards with numbers and the inequality symbols; posters of inequalities on the number line and graphs

https://youtu.be/j1WUosaZSAE

https://www.youtube.com › watch

https://www.twinkl.com.ng/search?q=linear+inequalities

https://www.pbslearningmedia.org/resource/mgbh.math.ee.inequality/solving-linear-inequalities-with-negative-numbers/

https://www.goteachmaths.co.uk/solving-single-linear-inequalities/

i. Poster of some words and their arithmetic signs

+	−	×	÷
- More - Sum - Add together - Add up to - Plus	- Minus - Differences - Subtract - Less	- Multiply by - Times - Product -	- Divide by - Quotient - Shared

ii. Posters of some words and their inequality representations

<	≤	>	≥
- Is smaller than - Is less than - Below	- Maximum - At most - Not more than - Is not greater than	- Is more than - Is greater than - Is larger than - Above	- Minimum - At least - Is not less than - Is not smaller than

Testing prior knowledge

Solve the following equations and check your solutions:

i. I think of a number then multiply it by 4. I add 16. The result is 84. What is the number?

ii. Aliyu subtracted 3 from a certain number, multiply the result by 6and then add 8. If the result is 50, what is the original number?

iii. Veronica has ₦90 less than Peter. They have ₦320 between them. How much does each have?

iv. A pencil cost ₦75 each and a pen cost ₦105 each. If 24 mixed of both pencils and pens cost ₦2010, how many pens were there?

Session Narrative

Equations and inequalities are both mathematical sentences that relate two expressions to each other.

i. In an inequality, the two expressions are related by the symbols: >, <, ≤ or ≥

ii. An equation or an inequality that contains at least one variable is called an open sentence.

iii. When a number substituted for the variable in an open sentence, the resulting statement is either true or false. If the statement is true, the number is a solution to the equation or inequality.

Often in real life we find ourselves in situations that can be represented mathematically by inequalities. For example, in our light bill we find that there is a fixed charge of ₦30 standard charge plus ₦15 per unit. If we only have ₦1000 to recharge, then we can describe the situation with the following inequality:

Let the number of the unit be u

Now, $15u + 30 \leq 1000$

By solving the inequality we say the maximum units we afford to buy

$15u + 30 \leq 1000$

Subtract 30 from both sides

$15u + 30 - 30 \leq 1000 - 30$

$15u \leq 970$

Divide both sides by 15

$\frac{15u}{15} \leq \frac{970}{15}$

$u \leq 64.67$

What are the maximum units that we can buy with ₦1000?

a. 63 units b. 64 units c, 65 units

Justify your answer

From $15u + 30 \leq 1000$

$let\ u = 63, we\ have\ 15 \times 63 + 30 = 946 + 30 = 976$

$let\ u = 64; 15 \times 64 + 30 = 950 + 30 = 980$

$let\ u = 65; 15 \times 65 + 30 = 975 + 30 = 1005$
$\therefore$ ₦1000 $can\ buy$ 64 units only
i if$x < 3; x\ has\ values$ … … . . $-2, -1, 0, 1\ and\ 2$
ii.$if\ x > 3; x\ takes\ values$ 4,5,6 … … …
iii. if $x \leq 5; x\ takes\ values$ $0, 1, 2, 3, 4, 5$
iv. if $x \geq 9; x\ takes\ values$ $9, 10,$ … … … …
v. $if\ 7 > 3; then\ 3 < 7;\quad vi. if\ 2 < 5; then\ 5 > 2$ Similarly, $if\ 2 < x; then\ x > 2$

Examples

Solve the inequality

1. $6 < 2x - 1$

Add 1 to both sides

$7 < 2x$

Divide both sides by 2

$\frac{7}{2} < x$

Now if $\frac{7}{2} < x$; what will be the value x ?

$then\ x > \frac{7}{2}$

Misconception: a student may write, $< \frac{7}{2}$; this may be due to his misapplication of previously learned concept on equality, when solving if $2 = x; then\ x = 2.$

To address this, the teacher should bring example such as:

$if\ 7 > 3; then\ 3 < 7\ ;\quad if\ 2 < 5; then\ 5 > 2$

Similarly, $if\ 2 < x; then\ x > 2$

2. $5 - x > 3$

Subtract 5 from both sides

$-x > -2$; what will be the value x ?

$then\ x < 2$

Misconception: a student may writes $x > 2$; this may be due to his misapplication of previously learned concept on equality, when solving if , $-x = -2; then\ x = 2.$

To address this, the teacher should let the students consider some true statements such as; $-2 > -5\ this\ statement\ is\ true\ and\ can\ be\ verified\ on\ the\ number\ line.$ Now if you multiply both sides of the inequality by-1, this will give $2 > 5\ which\ is\ not\ true.$ The statement can only true if $we\ say\ 2 < 5,$ that is by changing the direction of the inequality. Similar examples can be demonstrated before the teacher should generalize that when you" Multiply the same negative number on both sides of inequality then reverse the sign of the inequality". The students see why it is so.

Activity

Teacher: Let's add, subtract, multiply, and divide an inequality and look for a pattern.

	$8 > 4$	True/False	Direction
Add 2 to both sides	$8 + 2 > 4 + 2$ $10 > 6$	True	$>$
Subtract 10 from both sides	$8 - 10 > 4 - 10$ $-2 > -6$	True	$>$
Multiply both sides by 2	$8 \times 2 > 4 \times 2$ $16 > 8$	True	$>$
Divide both sides by 2	$8 \div 2 > 4 \div 2$ $4 > 2$	True	$>$
Multiply both sides by -2	$8 \times -2 > 4 \times -2$ $-16 > -8$	False	$<$
Divide both sides by -2	$8 \div (-2) > 4 \div (-2)$ $-4 > -2$	False	$<$

Classroom management/ Organization of class.
The teacher will group the class into four and give the following activities to each group and let each group reports her observation to the class.

Activity I
i. $-6 < -2$ ii. $3 > -9$ iii. $-4 < 2$ iv. $10 > 5$

Activity II
Linear Inequality Card Sort
The teacher will create cards with linear inequality statements, both true and false, and then shuffling them. Distribute the cards to each student, and have them sort the cards based on whether they are true or false.

Description of the activity/task/ *based on UDL principles*
The teacher will cater for different abilities by providing students with different activities and assignments graded according to levels of difficulty so that students can work on exercises that match their progress in learning. Less able students will be engage with the activities in a relatively straightforward way while the more able students will be engage in more open-ended and challenging activities. The teacher will also utilise pair and group work to encourage peer interaction and to facilitate discussion. These will help to ensure that the needs of all students are met and that students are encouraged to articulate their mathematics openly and to share their learning

Activity III
The teacher divides the class in to two groups for this activity. He writes 12 scenarios on 12 cards and 12 corresponding inequalities for those scenarios on another 12 cards. The first group will show the second a card, students have to match the written scenarios with the correct inequality.
Examples:

1. The cost of a gallon of orange juice is ₦350. What is the maximum number of containers you can buy for ₦1500?
2. Peter charges ₦450 per car at his car wash stand. Write and solve an inequality to find how many cars he has to wash to earn at least ₦3000.
3. An elevator can safely lift at most 4400 kg. A concrete block has an average weight of 41kg . What is the maximum number of concrete blocks that the elevator can lift?

Activity IV
Collaborative Problem-Solving
The teacher will divide the class into groups and provide them with a linear inequality problem to solve. Have them work together to come up with a solution to the problem. This activity promotes teamwork, and students get to learn from one another while having fun.

Activity V
Real-World Applications
The teacher will ask students to research real-world problems that can be solved using linear inequalities, such as budgets, wages, pay bills or speed limits. Have them present their findings to the class, explaining how linear inequalities were used to solve the problems.

Conclusion
Teaching linear inequalities can be a challenging task, but with the right activities, and using UDL principles that cater to diverse learners it can become engaging and fun for students. These activities ensure that students are mentally engaged in the subject and allow them to learn through hands-on practice. Quality lessons will ensure a quality teaching and learning environment thus, ensuring quality education.

Recommendations
Based on the quality of the CL4STEM lesson plan approach, it was recommended that teachers should be encouraged to imbibe the principles of the CL4STEM lesson plan approach in the teaching/learning of Mathematics at all educational levels. It also recommended that capacity-building workshops for in-

service STEM teachers be organized during students' long vacations. CL4STEM lesson plan approach is an integrative part of the lesson plan approach in the in-service teachers' methodology courses and micro-teaching.

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EFFECT OF SELF-DIRECTED LEARNING STRATEGY ON STUDENTS' ACHIEVEMENT AND INTEREST IN BASIC TECHNOLOGY FOR SUSTAINABLE DEVELOPMENT

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Abstract

The study adopted a quasi-experimental design. The study was carried out in technical colleges in Niger State. The population of the study consists of seven technical colleges in Niger State. The sample of the study was two hundred and forty-seven (247) NTC II, Basic Technology students in technical colleges in Niger State. The Basic Technology Achievement Test (BTAT) and Basic Technology Interest Scale (BTIS) were used as the instrument. The two instruments were validated by three experts from the Department of Industrial and Technology Education, Federal University of Technology, Minna. Pearson Product Moment Correlation Coefficient was used to compute results of the trial testing after test re-test instrument administration and the results indicated positive correlation coefficients of 0.85 and 0.88 for BTAT and BTIS respectively. The researcher administered the instrument with the help of two research assistants. Data for the study were collected through pre-test and post-test using the Basic Technology Achievement Test (BTAT) and the Basic Technology Interest Scale (BTIS). Data collected were analysed using Mean and Standard Deviation to answer the two research questions while Analysis of Co-variance (ANCOVA) was used to test the two null hypotheses at 0.05 level of significance. From the findings, the study revealed that self-directed learning enhances students' achievement in Basic Technology in technical schools more than the lecture method. The finding also revealed that self-directed learning promotes students' interest in Basic Technology in technical schools more than the lecture method among others. The study therefore concluded that students' poor achievement and interest in Basic Technology informed the need for the study on the effect of self-directed learning on students' achievement and interest in Basic Technology in Technical Colleges in Niger state.

Keywords: Self-directed learning, students, Basic Technology, achievement, interest

Introduction

Technical colleges are specialized institutions of learning where learners acquire knowledge, skills and attitudes necessary for the world of work. Technical college's according to Umar *et al.* (2020) are integral part of the total educational system in Nigeria that contributes towards the development of good citizenship by developing the physical, social, civic, cultural and economic competencies of the individual. The goals of technical colleges, as stated by Federal Republic of Nigeria, FRN, (2013) 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 requisite skills to individuals who shall be self-reliant economically.

Basic technology is aimed at exposing students to career awareness by exploring usable options in the world of work and enabling youth to have an intelligent understanding of the increasing complexity of technology. (Adodo, 2013) it is meant to provide the technical knowledge and vocational skills necessary for self- reliance. Basic technology is a three year programmes of preparatory instruction in manipulative skills, mathematics, sciences, communicative abilities and leadership skills which prepares individual for self- employment. Some of the instructional programmes of basic technology are; wood work, metal work, electrical/electronic, building architecture/technical drawing. (Federal Republic of Nigeria, 2013).

Basic technology, stresses the preparatory aspect of pre-vocational training offered to student at Junior Secondary School level to introduce them into the world of technology and have an appreciation of technology towards interest arousal and choice of a vocation at the end of Junior Secondary School and professionalism later in life.

As a result of this focus, Adodo (2013) states that, these are components of the general education curriculum which introduces pupils to the elements of technology in order to acquaint them with the role of technology in a contemporary life and permits them to develop basic practical skills in the manipulation of simple tools and materials. This element is also designed for information and guidance purposes for eventual educational and occupational choice. Federal Republic of Nigeria, (2013) refers to those aspects of the educational processes involving the study of technologies and related sciences, and the acquisition of practical skills, attitude, and knowledge relating to occupation in various sectors of economic and social life. Okorie, (2009) perceives vocational education as any form of education whose primary purpose is to prepare persons for employment in a recognize occupation.

Rocser, (2011) is of the view that, education consists of two components input and output. Input consists of human and material resources while outputs are the goal and philosophy of the educational process. Both the input and output form a dynamic organic whole and if one want to investigate and assess the educational system in order to improve its performance, effects of one component on the other. Instructional materials are those materials that teachers need to incorporate in the teaching learning processes, to help the pupils benefit maximally from the learning experiences (Keshav, 2020).

Self-Directed Learning is a learning process for which students take their role and initiatives to learn independently without the help of other persons. The activities that are performed by students in this SDL include diagnosis of the necessity needed in the learning activity, formulating learning objectives, identifying learning source, choosing and performing learning strategy and evaluating learning achievement. Harsono (2008) states that SDL is one of the educational learning strategies of equality which is done either individually or group outside of lecturing or tutorial. It needs to be well managed by the manager of instruction through well planning.

SDL is considered to be one of the learning methods that is performed by a person for self-interest. SDL can be conducted in classrooms and in classroom environments that are individual or group who need limited assistance to orderly conduct in activities (Nur, 2017). Knowles' theory of SDL as cited by Malison & Thammakoranonta (2018) state that SDL is as a study process in which students need help or without the help of others, assessing their learning, formulating goals with appropriate strategies and evaluate learning outcome. SDL can be viewed as learners' effort of performing learning activity independently or with the help of others concerning their motivation to master learning material or to achieve a particular competency. Students in SDL are usually more actively participating in learning assignments as they read online learning material, completing class assignments, planning and evaluating learning outcomes (Geng *et al*., 2019). With the implementation of self-directed learning might improve student academic achievement.

Student Academic achievement has to do with the successful accomplishment of goals, measured by the extent to which instructional objectives are achieved. According to Eze and Osuyi, (2018), academic achievement is a measure of the degree of success in performing specific tasks in a subject area or area of study by students after a learning experience. Whereas Ahmad and Ombuguhim, (2020) defined achievement as the scholastic standing of a student at a given moment in learning both theoretical and practical skills in Basic technology therefore, is essential to students' progress in the changing world of technology. In this regard, effective instructional approach must be developed to improve skills achievement and to maintain acquired skills at a functional level over a period of time. With adoption of design-thinking learning strategies, students' interest might increase. When students' interests are piqued, their performance improves.

Student interest according to Duru *et al.* (2021) is defined as a content-specific, person-object relationship that emerges from an individual's interaction with the environment. According to the authors, interest is an important variable in the school context, as it can influence students' level of

participation in learning, Self-efficacy of their learning experience as well as their level of performance. The study therefore poised to find out the effect of self-directed learning on students' achievement and interest in basic technology for sustainable development.

Statement of the Problem

Basic technology is one of the trade programme offered at the Technical Colleges which is meant to prepare students with the requisite skills that can make them to be self-reliant after graduation. Such skills include but not limited to demonstration of basic knowledge in theory and practical skill content (NBTE, 2017). The National Examinations Council (NECO) reports show the persistent records of the students' low performance in Basic technology and this has been attributed to teachers' inappropriate pedagogical approaches. Study Mbonyiryivuze, *et al.* (2019) had shown that students' poor academic achievement is as a result of teaching methods employed by teachers. Similarly, Researchers such as Duhu and Ibanga, (2020) and Lawal *et al.*, (2020) also identified several factors responsible for students' poor performance in subjects such as Basic technology to be specific, and they classified these factors as students-related factors, teacher related factors, society-related factors and government–related factors. Among other things that form the teacher-related factors is the teaching methods adopted by teacher like conventional teaching method. These learning methods adopted by teacher`s' in the technical colleges according Ayonmike, (2020) results to students' abseentism during lesson thereby paving way for students poor learning outcome.

Various methods of improving the poor performance of students have been neglected, hence there is the need to look for more proactive methods that will incorporate individual differences of learners and make them learn in a more profitable way. To search for more efficient methods that will improve students' academic performance call for the trial of another individualized approach such as design-thinking teaching methods. Therefore, the study, seeks to investigate effect of self-directed learning on students' achievement and interest in basic technology for sustainable development in Niger State.

Research Questions

The following research questions guided the study:

3. What are the mean achievement scores of students taught Basic technology using self-directed learning and those taught using lecture method for sustainable development?

4. What are the mean interest scores of students taught Basic technology using self-directed learning and those taught using lecture method for sustainable development?

Hypotheses

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

Ho_1: There is no significant difference in the mean achievement scores of students taught Basic technology using self-directed learning and those taught using lecture method for sustainable development.

Ho_2: There is no significant difference in the mean interest scores of students taught Basic technology using self-directed learning and those taught using lecture method for sustainable development.

Methodology

The study adopted quasi-experimental design. The study was carried out in technical colleges in Niger State. The population of the study consists of seven technical colleges in Niger State. The sample of study was two hundred and forty seven (247) NTC II, Basic technology students in technical colleges in Niger State. Basic technology Achievement Test (BTAT) and Basic technology Interest Scale (BTIS) were used as the instrument. The two instruments were validated by three experts from the Department of Industrial and Technology Education, Federal University of Technology, Minna. Pearson Product Moment Correlation Coefficient was used to compute results of the trial testing after test re-test instrument administration and the results indicated positive correlation coefficients of 0.85 and 0.88 for BTAT and BTIS respectively. The researcher administered the instrument with the help of two research assistants. Data for the study were collected through pre-test and posttest using the Basic technology Achievement Test (BTAT) and the Basic technology Interest Scale (BTIS). After the pre-test, items of the BTAT were reshuffled before re-administration for posttest. The essence of reshuffling the items was to ensure that students do not memorise all the contents of the BTAT. Data collected from the two

tests (pre-test and post-test) were used for data analysis. Data collected were analyzed using Mean and Standard Deviation to answer the two research questions while Analysis of Co-variance (ANCOVA) was used to test the two null hypotheses at 0.05 level of significance. The ANCOVA was preferred because of its power to take care of the initial lack of equivalence (differences) in the experimental and control groups since intact classes were used for the study. The pretest served as covariate to the post-test and this justifies more the use of ANCOVA for testing the null hypotheses.

Results

Research Question 1: What are the mean achievement scores of students taught Basic technology using self-directed learning and those taught using lecture method?

Table 1: Mean Achievement Scores of Students taught Basic technology using Self-directed learning and those taught using Lecture Method

Teaching Methods	N	Pre-test		Post-test		Mean Gain Score
		Mean	SD	Mean	SD	
Self-directed learning	126	33.28	10.32	79.08	8.80	42.80
Lecture Method	121	33.62	6.20	37.77	7.25	4.15
Total	**247**	**33.45**	**8.26**	**58.43**	**8.03**	**23.48**

Table 1 showed that students taught Basic technology in technical schools using Self-directed learning had a mean and standard deviation achievement score of 33.28 (10.32) in pre-test while students taught with lecture method had pretest mean and standard deviation achievement score of 33.62 (6.20) respectively. This suggests that at pretest level students in both design thinking based and lecture methods almost had the same achievement. The post-test mean and standard deviation achievement of students taught Basic technology in technical schools using the design thinking based and lecture methods are 79.08 (8.80) and 37.77 (7.25) respectively. This implies that students taught Basic technology in technical schools with design thinking based had better achievement than their counterparts taught using the lecture method. Thus, the Self-directed learning enhances students' achievement in Basic technology in technical schools more than the lecture method.

Research Question 2: What are the mean interest scores of students taught Basic technology using self-directed learning and those taught using lecture method?

Table 2: Mean Interest Scores of students taught Basic technology using Self-directed learning and those taught using lecture method

Teaching Methods	N	Pre-test		Post-test		Mean Gain Score
		Mean	SD	Mean	SD	
Self-directed learning	126	1.69	0.80	3.39	0.68	1.70
Lecture Method	121	1.55	0.62	1.76	0.75	0.21
Total	**247**	**1.62**	**0.71**	**2.58**	**0.72**	**0.95**

Table 2 revealed that students taught Basic technology in technical schools using Self-directed learning had a mean and standard deviation interest score of 1.69 (0.80) in pre-test while students taught with lecture method had pretest mean and standard deviation interest score of 1.55 (0.62) respectively. This suggests that at pretest level students in both Self-directed learning and lecture method almost had the same interest level. The post-test mean and standard deviation interest of students taught Basic technology in technical schools using the design thinking based and lecture methods are 3.39 (0.68) and 1.76 (0.75) respectively. This implies that students taught Basic technology in technical schools with design thinking based had higher interest in Basic technology than their counterparts taught using the lecture method. Thus, the Self-directed learning promotes students' interest in Basic technology in technical schools more than the lecture method.

Ho_1: There is no significant difference in the mean achievement scores of students taught Basic technology using self-directed learning and those taught using lecture method.

Table 3: ANCOVA Summary Table of the difference in the mean (x) achievement scores of students taught Basic technology using Self-directed learning and those taught using lecture method

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	109046.255[a]	2	54523.128	1081.545	.000
Intercept	28358.581	1	28358.581	562.534	.000
Pretest	3708.140	1	3708.140	73.556	.000
Method	**106104.674**	**1**	**106104.674**	**2104.740**	**.000**
Error	12300.587	244	50.412		
Total	976558.000	247			
Corrected Total	121346.842	246			

Table 3 shows the F value as 2104.74 and the probability value as .000. The probability value of .000 of this finding is less than the alpha value of 0.05. Therefore, the null hypothesis is rejected and thus, there is significant difference in the mean achievement scores of students taught Basic technology using Self-directed learning and those taught using lecture method in favour of the Self-directed learning. This implies that students taught Basic technology with Self-directed learning had better achievement compared with their counterparts taught with the lecture strategy.

Ho_2: There is no significant difference in the mean interest scores of students taught Basic technology using self-directed learning and those taught using lecture method.

Table 4: ANCOVA Summary Table of the difference in the mean (x) interest scores of students taught Basic technology using Self-directed learning and those taught using lecture method

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	165.925[a]	2	82.963	163.546	.000
Intercept	313.734	1	313.734	618.469	.000
Pre-Interest	2.219	1	2.219	4.374	.038
Method	**165.854**	**1**	**165.854**	**326.950**	**.000**
Error	123.775	244	.507		
Total	1948.000	247			
Corrected Total	289.700	246			

Table 4 showed the F value as 326.95 and the probability value as .000. Since the probability value of .000 of this finding is less than the alpha value of 0.05. Therefore, the null hypothesis is rejected and thus, there is a significant difference in the mean interest scores of students taught Basic technology using Self-directed learning and those taught using lecture method in favour of the Self-directed learning. This suggests that students taught Basic technology with the Self-directed learning had higher interest in the subject compared to their counterparts taught with the lecture method.

Discussion of Results

The data presented in Table 1 and Table 3 revealed that students taught Basic technology in technical schools with design thinking based learning had better achievement than their counterparts taught using the lecture method. There is significant difference in the mean achievement scores of students taught Basic technology using Self-directed learning and those taught using lecture method. This implies that students taught Basic technology with Self-directed learning had better achievement compared with their counterparts taught with the lecture method. This finding is expected as students' direct involvement in the teaching and learning processes enhances students' achievement more than teacher-dominated instruction. The finding of this study is coherent with that of Fabiano *et al.* (2021) who

found that Self-directed learning was very effective in promoting students' academic performance and retention in children.

The data presented in Table 2 answered research question 2 while the data presented in Table 4 answered hypothesis 2. The result of the analysis revealed that students taught Basic technology in technical schools with Self-directed learning had higher interest in Basic technology than their counterparts taught using the lecture method. There is a significant difference in the mean interest scores of students taught Basic technology using Self-directed learning and those taught using lecture method in favour of the Self-directed learning. This suggests that students taught Basic technology with the Self-directed learning had higher interest in the subject compared to their counterparts taught with the lecture method. This finding is expected as students' active participation in teaching and learning process rekindles their interests and deactivates boredom and day dreaming. In line with the findings of this study Cereja *et al.* (2018) found out that students taught using design thinking exhibited higher interest in the subject Technical Drawing, than those taught by their teachers using the lecture method.

Conclusions

Students' poor achievement and interest in Basic technology informed the need for the study on the effect of self-directed learning on students' achievement and interest in Basic technology in Technical Colleges in Niger state. The study indicated that self-directed learning enhances students' achievement and interest in Basic technology more than the lecture method. Basically, there was significant difference in the mean achievement and interest scores of students taught Basic technology using Self-directed learning and those taught using lecture method in favour of the Self-directed learning. It was concluded that appropriate use of self-directed learning in teaching Basic technology would facilitate students' achievement and interest in Basic technology.

Recommendations

Based on the findings of the study, the following recommendations were made.

3. Basic technology teachers should be encouraged by the government through its relevant ministries to adopt self-directed learning in teaching and learning Basic technology for better academic achievement of the students in the subject.
4. The Government through its relevant ministries of education should organize seminars, workshops and symposia for the in-service teachers on the use of self-directed learning for effective teaching and learning of Basic technology in technical schools.

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SCIENCE, TECHNOLOGY AND SUSTAINABLE DEVELOPMENT GOALS

THE ROLE OF CURRENT AWARENESS SERVICES IN ENHANCING QUALITY LIBRARY SERVICE DELIVERY USING CAS-UP GRAPHICS IN FUT MINNA, NIGER STATE.

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Abstract

This study is focused on the role of current awareness services in enhancing quality library service delivery in the Ibrahim Badamasi Babangida Library FEDERAL University of Technology Minna. Libraries have long been recognised as an important storehouse of information, knowledge and services. With the increase in the number of resources available in academic libraries, keeping library users informed of new acquisitions has become a necessity to improve leaning, teaching and research. Current Awareness Services (CAS) are designed to help users stay informed about recent developments, issues, and activities relating to their field of study. The Federal University of Technology Minna Library has implemented CAS, but it is not clear how effective it is in meeting the needs and expectations of library users. This study aimed to investigate the availability and use of CAS in the Federal University of Technology Minna Library, as well as the perceived expectations of library users from CAS. The study further developed Current Awareness Service-Upgrade (CAS-UP) using a graphical design template to revitalize the existing CAS in the library. A survey research design was adopted using copies of questionnaire designed with Google Forms to randomly collect data from 234 undergraduate and postgraduate students of FUT Minna. The findings from this research showed that the level of awareness of CAS was low while the expectations from students as regards CAS was high. CAS-UP was developed as a way of upgrading the existing current awareness services using a graphical design template. The study recommended that regular training should be encouraged for library staff to ensure effective current awareness service delivery and CAS-UP should be promoted through various channels such as social media, newsletters, emails and posters.

Keywords: academic library, CAS-UP, current awareness service, FUT Minna, quality education and learning.

Introduction

Libraries have been in existence for a very long time and are generally presumed as information and service collections. Libraries originally were specifically created to keep books and records, but over time the library has evolved and is now the backbone and the center of every university, polytechnic, institution, or organization.

The library as a living organism keeps growing and increasing in the collection, and there is a need to keep library users informed of any recent acquisitions. Most libraries today have responded to this reality through what is known as Current Awareness Services (CAS). CAS is designed to help users with limited time and busy schedules stay informed of the recent developments, issues, and activities relating to their field of study.

Graphic design can be seen as the art of creating visual content (text, images, shapes, symbols, etc.) to communicate ideas and messages to a particular audience. The mastery of graphic design can strongly influence CAS by creating compelling and attractive graphical content which could be in the form of posters, banners, and magazines, that would keep users abreast of the recent acquisitions of information resources relevant to their field of study.

S.R. Ranganathan, the father of library science in India, described Current Awareness Services (CAS) as "the process of keeping the readers informed about the latest additions to the library's collection in their fields of interest" (Ranganathan, 1931). The work emphasized the importance of providing timely and relevant information to library patrons, in order to ensure that they have access to the latest research and information in their area of study. This concept of CAS has been widely adopted by libraries worldwide and is considered a cornerstone of modern library services.

Also, another scholarly definition of CAS was given by Stempler and Polger (2014) to be "a service which provides the recipient with information on the latest developments within the subject areas in which he or she has a specific interest or need to know."

Basically, current awareness services can be even referred to as an announcement mechanism. It is the system in the library institution or any information center keen to always informing its clientele about newly acquired publication in their field or related field of study.

In the early days of library science, CAS was typically provided in the form of printed lists, such as new book lists, that were manually produced by library staff (Cano-Kollmann, 2019). However, with the advent of digital technologies, libraries have been able to create more sophisticated and automated CAS offerings, such as electronic databases and email notifications (Wong, 2020).

Despite these advancements, the fundamental purpose of CAS remains the same: to keep library patrons informed about the latest additions to the library's collection and other resources that may be of interest to them (Hamilton, 2018). This is especially important in academic libraries, where the collection is constantly growing and changing and where patrons are in need of staying informed of the latest research and information in their field of study (Cano-Kollmann, 2019).

In recent years, the use of CAS in libraries has become increasingly relevant as patrons have come to expect more personalized and relevant services from their libraries. To meet this demand, libraries have been experimenting with new and innovative ways to deliver CAS, such as social media, mobile technologies, and digital kiosks (Wong, 2020).

The graphic design presents a way out by offering librarians a visually appealing way of rendering current awareness services to library patrons. After carefully observing the library of the Federal University of Technology, Minna, it was discovered that there is a need to revitalize, re-strategize, and fully maximize the use of CAS via the aid of graphic design. Observations have also revealed that there seems to be poor knowledge of the availability of CAS amongst students in the Federal University of Technology, Minna library. This study hopes to upgrade the current awareness services in the Federal University of Technology library using graphic design. The developed system will be referred to as CAS-UP, an acronym for Current Awareness Services-Upgrade (CAS-UP).

Aim and Objectives of the Study

The aim of the study is to design and implement a Current Awareness Service Upgrade (CAS-UP) at the Federal University of Technology Minna. In order to achieve the aim, the following objectives were set:

4. Determine the availability and use of Current Awareness Services (CAS) in the Federal University of Technology Minna, Library.
5. Determine perceived expectations from CAS in the Federal University of Technology Minna Library.
6. Develop a CAS-UP to revitalize the existing current awareness service in the Federal University of Technology Minna Library.

Literature Review

Current awareness services have been offered in different ways and formats. Naqvi (2013) typified that current awareness services exist in many ways in university libraries as follows:

i. Library bulletin and newsletters
ii. List of latest resources acquired (New arrivals)
iii. Topical bibliographical on demand
iv. Contents page service
v. Routing of periodicals
vi. News clipping service
vii. Abstract bulleting
viii. List of microform documents
ix. Commercial current content service
x. Telephone service
xi. E-mail and bulletin board services
xii. Display among others

These are generalized kind of awareness services where the users have to scan through their own relevant information.

Types of Current Awareness Services (CAS)

i. **Table of Contents:** provides an overview of the structure and organization of a publication, including the headings, subheadings, and page numbers. It allows users to quickly locate specific information within the publication, making it easier to navigate and find what they are looking for (Cano-Kollmann, 2019). The use of table of contents is particularly relevant in academic libraries, where users are often looking for specific information related to their field of study. In addition to making it easier for users to find the information they need, table of contents can also provide a quick overview of the content of a publication, allowing users to make informed decisions about whether or not they want to read the publication in its entirety.
ii. **New Arrivals Display:** is a type of current awareness service that showcases new items or acquisitions to library patrons. This service is usually implemented through physical displays, such as shelves, posters, or banners, which are placed in prominent locations within the library. The purpose of New Arrivals Display is to make patrons aware of the most recent additions to the library's collection and to encourage them to explore and check out the new materials. The service is particularly useful for academic libraries, where the collection is constantly growing and changing and where patrons are in need of staying informed of the latest research and information in their field of study (Cano-Kollmann, 2019).
iii. **Email Alerts and Newsletter Services:** This type of service enables patrons to subscribe to emails that contain information about new resources, updates, and changes in library policies (Cano-Kollmann, 2019). Library patrons can choose to subscribe to either daily, weekly, or monthly newsletters.
iv. **Social Media Services:** Libraries use social media platforms such as Twitter, Facebook, and Instagram to provide updated information on new resources, changes in services, and events to patrons (Wong, 2020). This type of service enables patrons to interact with the library and receive up-to-date information in real-time.
v. **Mobile Application Services:** Some libraries have developed mobile applications that enable patrons to access library services and receive updated information on new resources, changes in policies, and events (Paull & Toze, 2015). This type of service provides a convenient and user-friendly platform for patrons to receive updated information.
vi. **Electronic Display Services:** Some libraries have installed electronic displays within their premises to provide patrons with real-time updates on new resources, changes in services, and events (Brown, 2018). This type of service is an effective way to reach a large number of patrons at once.
vii. **Web-based Services:** Libraries have developed web-based platforms that provide patrons with updated information on new resources, changes in services, and events. This type of service is an effective way to reach a large number of patrons who have access to the internet (Cassella & Bojar, 2017).

viii. **Research-in-Progress Bulletins:** it notifies users of recent research projects alongside the progress of the research document. It even contains information about where the project is being carried out, names of researcher/associate researcher, length of the project, and the necessary equipment employed.

Why CAS?

The aim of current awareness services is based on satisfying user needs either in a library or an information center. There are some key factors that influence the need for current awareness services;

- Current information: the fuel of every research is information, not just any information but relevant and current information. Most library user visit the library in quest for information because the library as we know it is also an information repository. The library is charged with the duty of providing up-to-date information resources to its clientele.
- Continuous information needs: in a society where we have increasing rates of publication, intellectual contents, and users ever changing needs it is expedient that the library is also equal to the task of continually updating its collection and thereby satisfying its users.
- Response to Changes: It enables users respond effectively to changes in the working environment or field of study.

Graphic Design

Graphic design may be traced back to ancient cave drawings from circa 38,000 BCE, according to historians. The majority of these paintings, which can be seen all throughout the world, represent hunting-related subjects such as animals and weaponry. Although no one truly knows what these cave drawings were used for, it's apparent that they were used to communicate visually.

The term "graphic design" was not in existence until 1922, when William Dwiggins coined the phrase to define the art of graphic design. Professionals in the early days of graphic design sketched by hand. Graphic design, on the other hand, has advanced fast in the previous 60 years, especially since the introduction of today's digital art tools.

Despite the fact that the concept of graphic design was not created, some of the first designs still incorporated typography in newspapers and books. Paintings on cave walls might potentially be considered a sort of early graphics.

Graphic Design and Library Service Delivery

Images, pictures, and text surround people and we encounter them in daily activities. The library houses a space where people encounter different forms of images, text, and pictures and these components communicate messages and viable information to library users and staff.

These avenues could be good or bad design which influences the experience and satisfaction of the user. Graphic design in libraries is a significant and underexplored area of library practice to improve communication for promotion and outreach (Polger & Okamoto, 2013). It also has a connection to visual literacy which can be seen as the ability to find, use, analyze, and create visual materials, Visual Literacy Standards Task Force, (2012).

Libraries should harness the possibilities of effective promotion and communication activities through graphic design as well as librarians should also acquire hands-on skills and training since many libraries are responsible for creating and designing signage, posters, brochures, and instructional handouts for their libraries. All these varieties of designs fall under the umbrella of "graphic design".

Graphic Signage as a Communication Tool in Libraries

Library users in need of information must interact with the physical library environment before accessing information. The environment of the library serves as the user's means of movement and communication. Graphic signage in the library can greatly improve the user experience and enhance navigation and accessibility because these graphical displays serve as guides to users. For instance, where to find the library catalog or the restroom. Signage includes all visible text and pictures that people consult at a place for guidance and explanation. According to Stempler and Polger (2014),

Regular library users require assistance to inform and direct them through the ongoing changes that a library experiences, Signage is frequently used to provide this support; it needs to be checked and updated frequently.

According to Serfass (2012) the two major objectives for library signage is: "informing library users and seeking to influence their behavioural patterns. "Graphical Signage can help users navigate through the overwhelming information world of any library by welcoming, guiding, instructing, and delighting them. Graphical signage system makes information content system tangible by embodying and communicating the informational content of the library's program or events.

CAS-UP

The acronym CAS-UP means Current Awareness Service-Upgrade. It is a library management system designed in an attempt to upgrade the current CAS in the Federal University of Technology, Minna, library. In recent years, academic libraries have faced increasing pressure to provide efficient and effective current awareness services to their users. To address this need, a new design template called CAS-UP (Current Awareness Service-Upgrade) has been developed. This template is designed to improve current awareness services in academic libraries by providing a more efficient and effective way to deliver current information to library users.

CAS-UP is essentially an initiative to create a more visual and informative design system, which is solely for improving current awareness services (CAS) in the library. The bankruptcy of visual communicative elements in the current library can be bridged upon the implementation of CAS-UP. This will significantly improve the user experience and essentially serve as a communicative tool, keeping them informed and engaged.

Research Methodology

The survey method is the research design adopted in this study. This approach is deemed the best method for generating relevant data. This survey method was chosen since it allowed the researcher to contact study participants in their various locations and gather data for the study. The findings of the study will then be applied to the whole population. As data would be collected from respondents via copies of the questionnaire, the survey approach was necessary for this investigation. Students (undergraduate and postgraduate) are the study's target population. The total number of undergraduate students is 21,617 : (Academic Office, Federal University of Technology, Minna, 2021). The questionnaire was divided into two sections: Section A (respondent demographic data) and Section B (question items).

Presentation of Results

A Google form was designed and the link was shared with the class representative of students in 100-500 level, MSc, and PhD. The collection process took about three weeks. The total number of 234 copies of questionnaire responses were retrieved and analyzed.

Demographic Data

Table 1: Distribution by School

School	Frequency	Percentage (%)
SEET	18	7.7
SEMT	30	12.8
SET	17	7.3
SICT	42	17.9
SIPET	19	8.1
SLS	23	9.8
SPS	37	15.8

SSTE	30	12.8
Total	**234**	**100%**

Table 1 above shows that the largest school is SICT (School of Information and Communication Technology) with 42 students, which makes up 17.9% of the total student population.

Table 2: Distribution by Gender

Sex	Frequency	Percentage
Male	140	59.8%
Female	94	40.2%
Total	**234**	**100%**

Table 3: Level of the Respondents

Level	Frequency	Percentage (%)
100	21	9.0
200	36	15.4
300	54	23.1
400	33	14.1
500	61	26.1
MSc	25	10.7
PhD	4	1.7
Total	**234**	**100**

Research Question One

Are you Aware of Current Awareness Services (CAS) in the Federal University of Technology Minna?

Table 4: Awareness of CAS in FUT Minna Library

Statements	SA	A	D	SD	Mean	Decision Mean
I am aware of when new books are delivered to the library	17 (7.3%)	102 (43.6%)	36 (15.4%)	79 (33.8%)	2.24	Disagreed
I get notifications of new materials in the library	10 (4.3%)	24 (10.3%)	131 (56%)	69 (29.5%)	1.89	Disagreed
The library has a list of materials, print and non-print that are of interest to me	40 (17.1%)	88 (37.6%)	70 (29.9%)	36 (15.4%)	2.56	Agreed
The library recommends books to me via emails	7 (3%)	26 (11.1%)	120 (51.3%)	81 (34.6%)	1.82	Disagreed

Table 4 indicated the awareness of Current Awareness Services (CAS) in the Federal University of Technology Minna. It is evident from the table that the awareness of current awareness services in the library is low.

Research Question Two

What is the Perceived Expectation from CAS in FUT Minna Library?

Table 5: Perceived Expectations from CAS in FUT Minna Library

Statement	SA	A	D	SD	Mean	Decision Mean
I want to be aware of new library materials	129 55.1%	92 39.3%	6 2.6%	7 3%	3.47	Agreed
I want to see library updates on bulletin boards	108 46.2%	115 49.1%	6 2.6%	5 2.1%	3.39	Agreed
I want to receive library recommendations on recent materials in my field of study	141 60.3%	85 36.3%	3 1.3%	5 2.1%	3.55	Agreed
I want to receive notifications on the recent happenings in and outside the library	122 52.1%	92 39.3%	17 7.3%	3 1.3%	3.42	Agreed
I want to subscribe to the library newsletter	103 44%	103 44%	18 7.7%	10 4.3%	3.28	Agreed

Table 5 indicated the Perceived expectation from CAS FUT Minna library. The result shows that that the expectations of current awareness services in the library is very high.

Research Question 3
Can CAS-UP revitalize the existing current awareness service in the Federal University of Technology, Minna?

CAS-UP is a design template that uses a variety of graphical tools, principles, and software, such as Adobe Photoshop, to create a visually appealing and informative template for delivering current information to library users. CAS-UP template was designed to be easy to use and customizable, with pre-made designs for various types of CAS documents, including books, pamphlets, reports, theses, and standards. This means that libraries can quickly and easily create eye-catching displays that highlight new arrivals in the library. By providing a more efficient and effective way to deliver current information to library users, CAS-UP can help libraries to build stronger relationships with their users, increase user satisfaction, and ultimately support academic success. Figure 1 shows the CAS-UP graphical template:

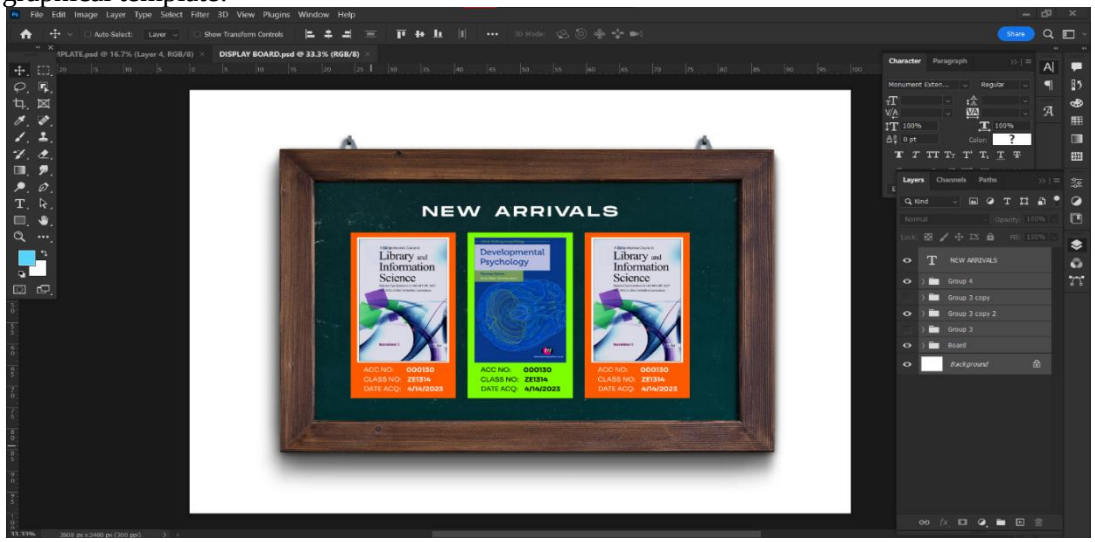
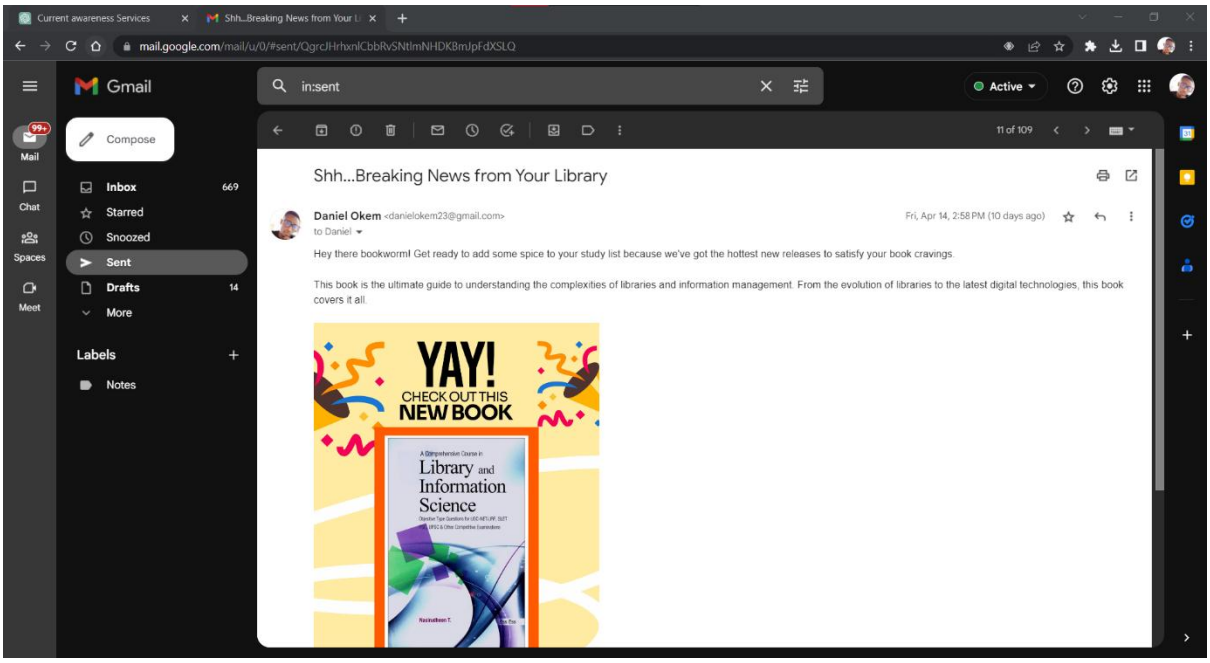


Figure 1: CAS-UP Template

A clear and concise email, with an eye-catching subject line that will grab the reader's attention. containing information on relevant and useful information, such as the latest library acquisitions, upcoming workshops, or events can be easily shared using the CAS-UP template.

Figure 2: Snapshot of CAS-UP email to library users



Discussion of Findings

It was observed that undergraduate students of the Federal University of Technology are not aware of when new books are delivered to the library and do not receive notifications of new materials in the library. However, the majority of the students agree that the library has a list of materials, print and non-print, that are of interest to them. Also, most students disagreed that the library recommends books to them via email. This shows a lack of awareness of Current Awareness Services in the FUT Minna Library. A study by Olatokun and Idowu (2018) found that many undergraduate students in Nigerian universities were not aware of the availability of online databases, e-journals, and other electronic resources in their university libraries. This lack of awareness can result in the underutilization of library resources and services, which can impact the academic performance of students.

Also, the survey conducted on the perceived expectations of students from CAS showed that many students want to be aware of new library materials, receive library recommendations on recent materials in their field of study, and receive notifications on the recent happenings in and outside the library. Also, most students want to see library updates on bulletin boards and subscribe to the library newsletter. Research has shown that personalized information services can enhance the user experience and increase the use of library resources (Spiteri & Burkell, 2009).

Finally, determining how the newly designed CAS-UP can influence the use of the library by students, findings showed that most of the students agree that the newly designed CAS-UP can increase their awareness of newly published material in their field of study, improve their intensive and extensive research works, and provide easy access and retrieval of information. The importance of user-centered design in library services focuses on understanding users' needs and preferences and designing services and resources that meet those needs.

Also, the survey conducted on the perceived expectations of students from CAS showed that many students want to be aware of new library materials, receive library recommendations on recent materials in their field of study, and receive notifications on the recent happenings in and outside the library. Also, most students want to see library updates on bulletin boards and subscribe to the library newsletter. Research has shown that personalized information services can enhance the user experience and increase the use of library resources (Spiteri & Burkell, 2009). Personalized information services

aim to provide users with customized and relevant information based on their individual needs and interests.

Recommendations

The study recommends the following:

1. Increase the visibility of the CAS to library users by promoting it through various channels, such as social media, email newsletters, and posters.
2. Continued use of visually appealing and engaging materials, such as infographics and videos to communicate the latest information to library users.
3. Provide training and development opportunities for librarians to acquire new skills and update their knowledge on current awareness services and related areas such as graphical design.
4. Implement the newly designed Current Awareness Service Upgrade (CAS-UP) to enhance the existing CAS and meet the needs and expectations of library users.

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INFORMATION USE FOR GOOD HEALTH AND WELL-BEING IN CURBING EMERGING DISEASES AMONG SENIOR SECONDARY SCHOOL STUDENTS, A STUDY OF FEDERAL CAPITAL TERRITORY, ABUJA, NIGERIA

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Abstract

The study examined the Information Use for Good Health and Well-being in Curbing Emerging Diseases Among Senior Secondary School Students, A Study of Federal Capital Territory, Abuja, Nigeria. The study adopted the descriptive survey research design. The purposive Sampling procedure was used to select a representative sample size of 329 out of 2,777 students from four senior secondary schools in Abuja, two public schools, and two private schools. A self-developed questionnaire was used for students and a seventh nine percent (79.3%) response rate was obtained. Two research questions and one hypothesis were answered and data were analyzed using descriptive statistics. The result shows that the Internet, computers, textbooks, television, newspapers, magazines, and dictionaries were readily available to senior secondary school students. While social media and encyclopedias were less available and had the lowest scores in terms of availability. The study revealed that the use of information helped in addressing emerging diseases among Senior Secondary School students in FCT, Abuja. Also, the analysis established a significant relationship between the use of information and the containment of emerging diseases among senior secondary school students in FCT, Abuja.

Keywords: Information use, Good health, Wellbeing, Emerging diseases, Senior Secondary School Students

Introduction

The attainment of a secure and confident global environment, particularly in Nigeria, hinges on the effective containment or rigorous control of life-threatening diseases, whether they are novel or emerging. The escalation of hazardous illnesses, posing imminent threats to life and well-being, is not merely a growing concern; it is a phenomenon that continues to surface at an alarming rate. This unsettling trend impacts all sectors of society, sparing no demographic from its reach. Even the secondary school students of Nigeria, particularly within Federal Capital Territory (FCT) Abuja, are vulnerable to this rapidly growing challenge. As emerging diseases claim the lives of adults, secondary school students too are not immune, finding themselves vulnerable to these health risks. Contributing to their susceptibility is the fact that some students lack access to vital information resources, while others may possess such resources but fail to harness them effectively.

Olumade, *et al*. (2020) define emerging infectious diseases as those that have not previously afflicted humans or have only affected a limited number of individuals within specific regions or have a historical presence but have only recently been identified due to infectious agents.

Emerging infections are characterized by their recent emergence within a particular population, often marked by swift geographical expansion or the potential for further dissemination in the near future. The global spread of COVID-19, which prompted widespread disruptions including prolonged closures of schools, including senior secondary institutions, in over 160 countries, underscores the pressing need for comprehensive public awareness and readiness. This preparedness hinges on the effective utilization of information as a critical tool in combatting emerging infectious diseases. The term "information"

encompasses any element capable of alleviating uncertainty or providing solutions to inquiries. However, information is inherently intricate, conveying meanings through communicable signs (Berestova, 2019).

The crux of information's utility lies in its potential to contribute to the welfare and optimal health of its users. Information loses its practicality when its accessibility and usability are compromised. Conversely, information acquires significance and utility when it is readily accessible to students who are in a state of good health. The notion of information utilization entails evaluating the extent to which information obtained through information and communication technology (ICT) is effectively employed to address the rapid propagation of critical diseases.

Hence, the term "good health" signifies a state of physical and mental well-being wherein an individual's body and mind function optimally. This encompasses not only the absence of ailments, injuries, and diseases but also the capacity to cope with daily stressors and challenges. Good health transcends mere absence of illness; it encompasses the pursuit of a balanced lifestyle, regular physical activity, a nourishing diet, sufficient sleep, adept stress management, and timely medical intervention (Schramme 2023).

"Wellbeing" denotes a state of contentment, sound health, and happiness across various facets of life. It encompasses dimensions spanning physical, mental, emotional, and social spheres. This entails positive emotions, involvement in meaningful pursuits, fostering healthy relationships, a sense of purpose, and a feeling of accomplishment. When it comes to students, wellbeing can be seen as a term that applies to the general population, focusing on having positive self-regard and having the internal capability to handle the pressures and demands of student life and education (Barkham, *et al.* 2019). Therefore, to understand information's role in student wellbeing, empirical evidence is crucial

Research Questions

The study tried to answer the following research questions.

1. What are the information resources that are available to the senior secondary school students in FCT, Abuja?
2. How could information use help to curb/or prevent emerging diseases among senior secondary school students in FCT, Abuja?

Hypothesis

The following hypothesis was tested at 0.05 level of significance:

There is no significant relationship between Information Use for Good Health, well-being and curbing of emerging diseases among senior secondary school students in Abuja.

Literature Review

Information use for good health and well-being are essential ingredients for curbing emerging diseases. Thus, any entity that can be used to resolve uncertainty or provide answers to some kind of questions is referred to as information (Berestova, 2019).

A disease is a disruption in the normal functioning of a human, animal, or plant, leading to specific symptoms and not solely caused by physical injury or personal traits. It hampers the body or mind's proper operation. Diseases are divided into two categories: communicable (infectious) and non-communicable. Communicable diseases are persistent infections that cannot be well controlled and include modern outbreaks like HIV, COVID-19, Ebola Monkeypox etc. These diseases arise from the spread of harmful agents and can lead to severe outcomes, even without symptoms.

Husnayain, *et al.* (2020) studied COVID-19 as a case to explore using information for disease management. They gathered Google trend data from Taiwan, focusing on coronavirus, hand washing, and face masks. Their research revealed that as local COVID-19 cases increased, searches related to the virus peaked in Taiwan. However, as online health media provided more information, public understanding improved, and online searches gradually decreased. This underscores the potential of utilizing information to effectively manage and mitigate the risks of emerging diseases.

Ale (2020) conducted a study using an online survey to develop a library-based model for delivering COVID-19 information to patrons via mobile technology devices. The study highlighted that various devices like cell phones, smartphones, laptops, etc., can effectively convey COVID-19 information to library patrons in Nigeria. Key facilitating factors include access to the internet, ownership of devices, operational skills, and alternative internet options.

Adeniyi (2019) examined students' acceptance and knowledge of using tablets for learning, and how this impacted teaching effectiveness and academic performance. The study surveyed 250 teachers in Osun State's Senior Secondary Schools, using random sampling. Results indicated teachers' belief in students' positive response to e-learning tablets, influencing teaching quality. However, concerns arose about students potentially diverting tablets for non-educational activities.

Otto, *et al.* (2021) examined the 11-year follow-up of the German BELLA study, which focuses on mental health in children, adolescents, and young adults. The research analyzed the trends in general health and well-being based on age and gender, using standardized measures across five assessment points. Results showed younger and male participants reported better overall health and well-being. Childhood and adolescent mental health issues predicted poorer health outcomes at 6 and 11 years later. The study is part of the larger German Health Interview and Examination Survey for Children and Adolescents, using a subset of participants. Strengths include extensive, reliable data from a diverse age group (7 to 31 years), but limitations include language diversity exclusion and follow-up loss. The BELLA study contributes essential insights into mental health and quality of life for youth in Germany, aiding health promotion and prevention efforts.

Pascoe, *et al.* (2020) did a review on the widespread academic-related stress among students of diverse backgrounds, impacting mental and physical well-being, leading to academic challenges and long-term health issues. They highlighted the need to develop stress-management skills during adolescence. They explored how academic stress affects academic performance, mental health, and overall well-being, driven by factors like daily academic pressures and grade concerns. Depression between ages 16 to 21 was linked to long-term problems such as welfare dependency and unemployment. Stress also contributes to conditions like metabolic syndrome and obesity due to unhealthy lifestyles and disrupted stress regulation. Successful education requires emotional well-being. They further analyzed global studies on stress's effects on mental health, substance use, sleep, dropout rates, physical activity, and academics. academics. The literature stressed the role of information use for good health and well-being in combating emerging diseases. Yet, limited research examines these factors among Nigerian senior secondary school students. This study aims to address this gap and provide a reference for future research.

Methodology

The descriptive survey research design was adopted. The Purposive Sampling procedure was used to select out 329 of 2,777 students. The study is opened to senior students in SSS 1 and 2 of senior secondary schools for the 2022/2023 session. The respondents for the study are chosen from two public and two private senior secondary schools, totalling four schools, specifically from Gwagwalada and Kuje Area Councils. The public schools are GSS Gwagwalada and GSS Kuje, while the private schools are Sheik Hamdan Model Senior Secondary School Gwgwalada and New Hope International Schools Kuje. However, senior secondary 3 students were not included in the study because they are in terminal classes. A self-developed questionnaire was used to collect data for the study. The research questions were analysed using descriptive statistics, such as mean and standard deviations, while the hypothesis was tested with Pearson Correlation Coefficient and Independent t- Test at 0.05 level of significance.

Results and Discussion of Findings

The results/findings of the study are reported below based on the research questions.

What are the Available Information Resources among Senior Secondary School Students in FCT, Abuja?

In order to answer the first research question, the information resources that were available to students in senior secondary schools were defined by 9 components. At Government Secondary School, Gwagwalada, it is evident that resources such as the Internet, computers, textbooks, newspapers, magazines, and dictionaries are available, while social media, television and encyclopedias are unavailable. Likewise, at Government Secondary School, Kuje, available resources include the Internet, computers, television, textbooks, newspapers, magazines, and dictionaries, However, social media and encyclopedias are unavailable. Additionally, at Sheikh Hamdan Model Secondary School (SHMS) Gwagwalada, the school provides the Internet, computers, textbooks, newspapers, magazines, encyclopedias, and dictionaries. However, social media and television are unavailable. Finally, at New Hope International School Kuje, the available resources comprise the Internet, computer, television, textbooks, newspapers, magazines, encyclopedias, and dictionaries. However, social media is unavailable. Therefore, in the surveyed schools, no provision was made for social media likely due to its inherent abuse by the students.

These findings emphasize the disparities in the accessibility of information resources among the surveyed schools. It has been confirmed that specific resources, such as the Internet, computers, textbooks, newspapers, and magazines, are generally present in the majority of schools. Nevertheless, the presence of resources such as social media, television, and encyclopedias varies among the schools. Undoubtedly, the absence of these resources would influence students' ability to access and make use of various types of information sources.

Table 1: The available items in the Senior Secondary Schools

S/No	Items	GSS Gwagwalada		GSS Kuje		SHMS Gwagwaglada		NHIS Kuje	
		A	NA	A	NA	A	NA	A	NA
1	Internet	✓		✓		✓		✓	
2	Social media		✓		✓		✓		✓
3	Computer	✓		✓		✓		✓	
4	Television		✓	✓			✓	✓	
5	Textbooks	✓		✓		✓		✓	
6	Newspaper	✓		✓		✓		✓	
7	Magazine	✓		✓		✓		✓	
8	Encyclopaedias		✓		✓	✓		✓	
9	Dictionaries	✓		✓		✓		✓	
	Total	6	3	7	2	7	2	8	1

Key: GSS = Government Secondary School, SHMS = Sheikh Hamdan Model Secondary School, NHIS = New Hope International School, A = Available and NA = Not Available.

How could information use help to curb/or prevent emerging diseases among senior secondary school students in FCT, Abuja?

In order to answer the second research question, the information used in curbing emerging diseases among senior secondary school students in Abuja was defined by nine (9) components and they were measured on a four-point Likert scale, where mean scores above the benchmark of 2.50 indicate a higher level of usage. Descriptive statistics was used to analyze the data collected and the results are presented below.

Among the nine items assessed, five items obtained high mean scores above the benchmark. These items include item 2: I use social media such as WhatsApp and Twitter to share news relating to emerging diseases (`X=3.01, Std=1.02) item 3: I use a computer to access information on how to manage emerging diseases. (`X=3 15, Std=1.12). item 4: I use television to watch updates on emerging diseases. (`X=2 .69, Std=1.14) item 5: I use the textbook to access information on the types of emerging diseases (`X=3.23, Std=0.98) and item 6: I use newspapers to access information on the preventive measures of emerging diseases (`X=3.02, Std=1.09)

On the other hand, four items obtained mean scores below the benchmark of 2.50. These particular items encompass the following: item 1: I use the Internet to access information on the spread of emerging diseases (`X=1.65, Std=0.98), item 7: I use magazines to access information on the latest developments and trends in emerging diseases (`X=2.06, Std=1.18), item 8: I use an encyclopedia to learn about the history of emerging diseases (`X=2.49, Std=1.23) and item 9: I use dictionaries to look up the meanings of words related to emerging diseases (`X=2.38, Std=0.93)

The table below highlights that the majority of respondents indicated greater usage of social media, computers, television, textbooks, and newspapers as their preferred means to access information regarding emerging diseases. In contrast, there appears to be relatively limited or minimal usage of the Internet, magazines, encyclopedias, and dictionaries for the purpose of accessing such information.

These findings offer insights into the preferred sources of information used by the respondents when seeking information on emerging diseases. They suggest that social media, computers, television, textbooks, and newspapers play significant roles in accessing relevant information, while the Internet, magazines, encyclopedias, and dictionaries are less utilized.

Table 2: Information used in curbing emerging diseases among Senior Secondary School Students in FCT, Abuja

S/N	Statements	VL 1	L 2	H 3	VH 4	N	FX	`X	StD
1	I use the Internet to access information on the spread of emerging diseases.	162	55	18	26	261	430	1.65	0.98
2	I use social media such as WhatsApp and Twitter to share news relating to emerging diseases.	51	33	39	138	261	786	3.01	1.20
3	I use the computer to access information on how to manage emerging diseases.	42	21	55	143	261	821	3.15	1.12
4	I use television to watch updates on emerging diseases.	52	68	50	91	261	702	2.69	1.14
5	I use textbook to access information on the types of emerging diseases.	29	16	81	135	261	844	3.23	0.98
6	I use newspaper to access information on the preventive measures of emerging diseases.	44	21	81	115	261	789	3.02	1.09
7	I use magazines to access information on the latest developments and trends in emerging diseases.	123	52	34	52	261	537	2.06	1.18
8	I use encyclopaedia to learn about the history of emerging diseases.	84	46	50	81	261	650	2.49	1.23
9	I use dictionaries to look up the meanings of words related to emerging diseases.	65	50	128	18	261	621	2.38	0.93

The hypothesis was carried out to determine the relationship and efficiency of utilising information in curbing emerging diseases. Those with a Likert Scale mean score for Information Utilisation greater than or equal to 2.5 were classified into the "I do not use information for Curbing Emergent Diseases"

group, while those with a score below 2.5 were grouped as "Use Information for Curbing Emergent Diseases."

Table 3: Relationship between students utilising information and the students who do not use information in curbing of emerging diseases.

Information grouping * observation emerging diseases mean score (Binned) Cross tabulation							
		SA	**D**	**S**	**Total**	**□X**	**StD**
Use of information grouping	I do not use information for Curbing	2	75	0	77	1.54329	0.215283
	I use Information for Curbing	0	0	184	184	3.498188	0.193228
Total		2	75	184	261		

The analysis below revealed an exceptionally strong positive linear relationship between utilizing information to curb emerging diseases with a correlation coefficient of 0.996 (Pearson's R). This indicates a nearly perfect positive correlation between the two variables. Furthermore, the associated p-value of 0.000 demonstrates that this strong correlation is highly statistically significant and not due to chance.

Likewise, the Spearman correlation yielded an impressive coefficient of 0.998, suggesting an almost perfect positive monotonic relationship between utilizing information to curb emerging diseases. Higher ranks in one variable were consistently associated with higher ranks in the other variable. The associated p-value of 0.000 reinforces the significance of this relationship.

Table 4: Correlation between utilization of information and curbing emerging diseases using Pearson's R and Spearman correlation.

Symmetric Measures					
		Value	**Asymp. Std. Error[a]**	**Approx. T[b]**	**Approx. Sig.**
Interval by Interval	Pearson's R	0.996	0.003	172.115	.000[c]
Ordinal by Ordinal	Spearman Correlation	0.998	0.001	287.961	.000[c]
N of Valid Cases		261			
a. Not assuming the null hypothesis.					
b. Using the asymptotic standard error assuming the null hypothesis.					
c. Based on normal approximation.					

The assumption of equal variances was examined below through Levene's test, yielding a p-value of 0.203, greater than the typical significance level of 0.05, leading to the assumption of equal variances. The t-tests were conducted under both equal and unequal variance assumptions, producing t-values of -72.033 and -68.908, respectively, both with p-values of 0.000 (two-tailed). Consequently, the null hypothesis, stating no significant difference in mean scores between the "I do not use information for Curbing" and "I use Information for Curbing" groups concerning curbing emergent diseases, was confidently rejected.

Table 5 Independent sample test for the two groups.

Independent Samples Test							
		Levene's Test for Equality of Variances		**t-test for Equality of Means**			
		F	**Sig.**	**t**	**df**	**Sig. (2-tailed)**	**Mean Difference**
Observation ED mean score	Equal variances assumed	1.631	0.203	-72.033	259	-	-1.955
	Equal variances not assumed			-68.908	129.757	-	-1.955

In essence, the statistical evidence strongly supports that the use of information significantly aids in curbing emergent diseases.

Discussion of Findings

The analysis of the available information resources among senior secondary school students in FCT, Abuja, indicated that there were indeed resources accessible to the students. Notably, New Hope International Secondary School stood out with the highest number of information resources. This could be attributed to various factors, including the school's location in a favorable environment within the Kuje Area Council, which is in close proximity to the Abuja Municipal Area Council. This area is known for having a high concentration of schools. Additionally, being a privately owned school with parents paying significant school fees suggests that there may be ample funds allocated to furnish the library with a rich collection of resources, thereby attracting more students.

These findings align with the research conducted by Mahwasane and Mudzielwana (2016), which emphasized the essential conditions necessary for effectively utilizing information and communication technology to enhance information access in Nigeria. They highlighted the need for students and teachers to have adequate access to digital technologies and the Internet within their learning spaces. Moreover, the availability of high-quality and culturally relevant digital content is crucial for supporting teaching and learning. Lastly, teachers need to possess the necessary knowledge and skills to utilize these digital tools and resources effectively, ensuring that all students can meet high academic standards.

The findings of the study also indicated that the use of information plays a crucial role in curbing emerging diseases among senior secondary school students. Students have been utilizing various information sources to access relevant information related to emerging diseases. They have been using the Internet to gather information about the spread of emerging diseases, computers to learn about the management of such diseases, television to stay updated with the latest developments, textbooks to understand different types of emerging diseases, newspapers to access preventive measures, and magazines to acquire in-depth knowledge about emerging diseases.

These findings align with a study conducted by Husnayain, *et al.* (2020), which focused on the use of information for disease management using COVID-19 as a case study. They investigated the search trends in Taiwan and found that as locally acquired COVID-19 cases increased, the public's online searches related to the virus, hand washing, and face masks also increased. As more information became available through online health media and news reporting, the number of online searches gradually decreased. This indicates that access to and utilisation of information helped the public in understanding the necessary preventive measures and reducing the risk of the disease.

However, the findings of the current study contradict those of Tarimo and Kavishe (2017) who explored the access and usage of the Internet by secondary school students in Morogoro municipality, Tanzania. Their study did not consider the individuals' and institutions' strengths and weaknesses in terms of

computer application knowledge and skills, revealing that students primarily use the Internet for entertainment purposes rather than for educational purposes.

Conclusion and Recommendations

The research has shown that information resources were available for use to senior secondary school students. The number of available information resources was considered adequate with the exception of social media and encyclopedias. The use of available information resources has been observed to effectively assist in managing the spread of emerging diseases. Therefore, the study reveals that the use of information is beneficial and improves the efforts to curb emerging diseases. The inference that can be drawn from the outcome of this study is that information utilization plays a crucial role in enhancing good health and well-being in curbing emerging diseases among senior secondary school students. Based on the findings of this study, it could be recommended that efforts should be made to provide adequate and updated information resources, enhance ICT education for all students, allocate sufficient funding for information-related initiatives, and promote the importance of using information resources seriously which will contribute to a healthier school environment.

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EXPLORING THE IMPACTS OF SCIENCE AND TECHNOLOGY ADVANCEMENT ON THE ECOSYSTEM: AN AWARENESS ON THE HEALTH IMPLICATIONS

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Abstract
Science and Technology (S&T) is the use of scientific and technological knowledge, engineering principles, and practical skills to create innovative solutions that address complex problems and improve efficiency and quality of life. It has evolved leading to advancements and innovations that cuts across all aspects of human life. This widespread resulted in air pollution, deforestation and extreme mining activities among several others. This study therefore looks at the concept of ecosystem, current scientific and technological trends in ecosystem, consequences of the S&T advancement on human health, measures taken to reduce the impact of S&T activities on ecosystem, general health implications and conclusion.

Keywords*:* Exploring, impacts, science and technology, advancement, ecosystem, awareness, Implications

Introduction

Science is the foundation on which modern day technological progress is hinged. Igwe (2003) defined science as a systematic study of the nature of the behavior of the material and physical universe through observation, experimentation, measurement and recording. Science is often an exciting and satisfying enterprise that requires creativity, skill and insight. Based on this, Fape (2007) defined science as a rationally structured knowledge about nature, which embraces systematic methods of positive attitudes for its acquisition, teaching, learning and application. Technology is the application of scientific knowledge, skills, and tools to create products, systems, and processes that fulfil human needs and improve our daily lives. Technology is the application of scientific knowledge to the practical aims of human life or, as it is sometimes phrased, to the change and manipulation of the human environment. John Kenneth Galbraith. A very similar definition to Mesthene's was employed by Galbraith in his 1967 book The New Industrial State: "Technology means the systematic application of scientific or other organized knowledge to practical tasks (https://techliberation.com). Carrol (2017) define technology as everything humans create from thoughts, ideas, and knowledge to achieve a certain goal. Technology is the purposeful application of knowledge and skills to improve or create a product that benefits society (Wahab et al., 2012).

Science and technology (S&T) have affected human society and his surroundings in a number of ways. In some societies, S&T have helped develop more advance economies and have allowed the rise of a leisure class. S&T have many positive effects in the life of man and his environment, yet they have created some serious problems that have many negative or undesirable effects on the life of man and his environment.

The beginning of the third millennium, witnessed a lot of global environmental problems, like reduction in biodiversity, climate change, ozone depletion, overpopulation, and hazardous wastes, resulting in great concerns among the citizens of the planet. The general problems in developed nations are air and water pollution and toxic waste disposal are common in all industrialized countries. In developing countries, a lot lack access to sanitation services and safe drinking water, while dust and soot in air are causing the death of many people every year. Moreover, serious damage from pollution and overuse of renewable sources challenges world fisheries, agriculture, and forests, with significant present and possible adverse effects on the physical environment (Boyle, & Boyle, 1994).

Science and Technology involves the use of scientific knowledge, engineering principles, and practical skills to create innovative solutions that address complex problems and improve efficiency and quality

of life (Küpers & Batel, 2023). Science and Technology is constantly evolving and driving progress in various fields, leading to advancements and innovations that shape the world we live in. This trend in S&T has undoubtedly brought numerous benefits to our society; However, some of these benefits had significant harmful effects on the ecosystem. These effects have threatened peaceful co-existence in the ecosystem causing all kinds of hazards and resulting to health implications.

Studies on the environmental impact of S&T are being approached in interdisciplinary ways. The natural sciences are involved in anthropogenic planetary processes and transformations—those induced by human activities. Therefore, the analysis and discussions are concern with physical, chemical, and biological systems through diverse disciplines such as geology, atmospheric chemistry, hydrology, soil science, and plant biology (Gruber, 1996). However, many social science professionals are also involved in these studies, since analysis of environmental changes also involves social causes. The scope of human intervention in the environment and how it is managed bear particular importance in that humans are now the main causes of environmental changes (Gilpin, 2000).

The Concept of Ecosystem

An ecosystem refers to a complex community of living organisms (including plants, animals, and microorganisms) in conjunction with their physical environment. It is a community of organisms interacting with each other and their physical environment within a specific geographic area (Luo, *et al*. 2022). It involves the interactions between these organisms and their surroundings, including the exchange of energy and matter. The ecosystem consists of basically biotic and abiotic components, understanding and managing these aspects of ecosystems is crucial for their preservation, conservation, and sustainable use. Knowing the complex interactions and interdependencies within ecosystems, helps to make informed decisions to ensure the long-term health and functioning of these critical natural systems. Preservation of ecosystems is essential for maintaining biodiversity, sustaining ecosystem services, addressing climate change, supporting sustainable resource use, preserving cultural values, and securing a better future for both nature and humanity (Maiti, *et al*. 2023). However, one factor threatening the peaceful existence of the ecosystem is current trends in S&T.

One of the major causes of environmental problems is S&T and how humans use them can be both source and remedy of environmental problems. It also plays a critical role as an instrument for observing and monitoring the environment on global and local scales (Gruber, 1998). Although S&T has a crucial role in finding solutions to environmental problems, by itself it cannot fix anything.

Current Scientific and Technological Trends in Ecosystem

Many scientific and technological processes produce unwanted by products known as pollution and deplete natural resources, to the detriment of the earth and its environment. Besides, various implementations of S&T influence values of a society and new S&T often raises new ethical questions. Recent trends in S&T cuts across every facet of life including Agriculture, Transportation, Education, Health, Commerce, and Communication among others. The world which has long become a global village is still welcoming new innovations almost every day, as innovators are on a quest to make life easier and more comfortable for people. Digitalization is the order of the day, robotics is replacing human labour, artificial intelligence is substituting human reasoning, genetic modification is taking over natural reproduction and wireless technology connection the world and beyond.

It is well known that 21st century human beings are causing major environmental changes, notably in the biosphere, hydrosphere, and atmosphere through applications of S&T. These changes are the results of local actions of many individuals accumulated in time and space, leading to global environmental problems (Harrison, 1996), For instance, in the United States, emissions of primary pollutants into the atmosphere are due to transportation (46%), fuel consumption in stationary sources (29%), industrial processes (16%), solid waste disposal (2%), and miscellaneous (7%). The breakdown of pollutants by weight is 48% carbon monoxide, 16% nitrogen oxides, 16% Sulphur oxides, 15% volatile organic compounds, and 5% particulate matter. Other developed nations show

the same statistics; however, these percentages vary considerably since their activities are quite different (NRC, 1994).

In the primitive society, weapons used in hunting and wars were limited to clubs, spears and machetes. These progressed to Dane guns, double barrel guns, machine guns, grenades, bombs, and now nuclear, chemical and biological weapons. All these are product of S&T. Through the advancement of S&T, the build-up of nuclear weapons of mass destruction has been alarmingly on the increase.

Every nation wants to acquire and store nuclear weapon in readiness for an eventual attack form hostile or enemy country. The development of S&T has enabled man to develop and equip himself with dangerous arsenals of various degrees and capacities for his own destruction. Nuclear weapons pose grave danger and threat to humanity because of their unmitigated destructive capacities. One atomic or hydrogen bomb is capable of wiping a whole nation in few minutes.

Yet, nations spend so much of their wealth in acquiring these dangerous weapons without considering the adverse or retroactive effects on the society. As it were, with every nation shamelessly and unrestrictedly amassing nuclear weapons, the whole world is presently sitting on a time bomb that already begun its timing

Metals and hydrocarbons appear to be abundant in the earth's crust. Accessibility and concentration (both being functions of technology and price) determine if a particular deposit is minable. Enormous expansion of metal production worldwide has led to emission of copper, lead, zinc, arsenic, and so on into the environment (NRC, 1999). However, with regard to impacts on the environment, such quantitative data have to be supplemented with qualitative characteristics of different wastes, most prominently toxicity. For instance, total US dioxin and furan emissions amount only to one metric ton per year, but they cause serious environmental concern (NRC, 1999).

Consequences of Technology Advancement on Human Health

There is a fight against the emission of greenhouse gases and the use of environmental friendly energy sources is highly encouraged and sorted after as one of the several measures to save the ecosystem. Nevertheless, current trends in S&T have resulted to high level of electromagnetic emissions, air pollution, deforestation and extreme mining activities. These activities are gradually ravaging our dear ecosystem with adverse health implications that are not recognized by many users. Here are some key areas where S&T has negatively impacted the ecosystem and its associated health implications:

1. Climate Change: Scientific and technological advancements have contributed to increased greenhouse gas emissions, primarily through the burning of fossil fuels for energy production, transportation, and industrial processes. The resulting climate change has far-reaching consequences, including rising temperatures, melting ice caps, sea-level rise, extreme weather events, and shifts in ecosystems. These changes can negatively affect human health by causing heat-related illnesses, exacerbating respiratory conditions, spreading vector-borne diseases, and impacting food and water availability (Zhao, *et al*. 2022).
2. Environmental degradation: Environmental degradation has become both national and international concern. The achievements of S&T have led to serious pollution and degradation of the human environment. Industries, factories and locomotive wastes and smokes pollute the air leading to acid rains, global warming and depletion of the ozone layer. This ozone layer is a very important layer because it shades off or protects man from direct contacts with the heat of the sun. When this ozone layer is depleted or worn out as a result of environmental pollution or degradation, humans is then exposed to direct sunshine which is harmful as it is capable of causing cancer of the skin and frost bites. Also, solid wastes such as broken bottles and glasses, sachet water bags, polythene bags, metal scraps, broken plates etc., which cannot be recycled, are capable of endangering the environment.
3. Environmental pollution is the release of substances or energy such as carbon (iv) oxide, carbon (iii) oxide from internal combustion engines, radioactive rays, oxides of nitrogen and sulphur, smoke, soot, dust, aerosols, insecticides, sewage, crude oil etc, into the environment in great quantities. They are capable of polluting soil and water thereby endangering the lives of animals

and plants. It is one of the most harmful effects of industrial technology. Pollutants are capable of causing ill health and in severe cases, death of man, animals and plants, mutation, corrosion, death of aquatic organisms and contamination of water for domestic and industrial use.

Pollution can be in form of sound just like siren from locomotives, loud speakers, airplanes and supersonic jets. All these are harmful to both humans and animals, and they are as a result of advancement in S&T. Science and Technological progress has led to various forms of pollution, such as air, water, and soil pollution. Industrial activities, transportation, and the widespread use of chemicals and electronic waste contribute to the release of pollutants into the environment. Air pollution, for example, can cause respiratory problems, cardiovascular diseases, and other health issues. Air pollution may be defined as unwanted change in the quality of the earth's atmosphere caused by the emission of gases and solid or liquid particulates. It is considered to be one of the major causes of climatic change (greenhouse effect) and ozone depletion, which may have series consequences for all living things in the world. Polluted air is carried everywhere by winds and air currents and is not confined by national boundaries. Therefore, air pollution is a concern for everybody irrespective of what and where the sources are. Due to the seriousness of air pollution, this article concentrates more on that topic than on others. Water pollution can lead to waterborne diseases and ecological damage, while soil pollution can affect agricultural productivity and contaminate food sources.

4. Chemical usage in Agriculture. The use of herbicides and insecticides in agriculture has significantly contributed to increased crop yields and pest control. However, there are several health hazards associated with the unguided use of these chemicals. This can have a drastic and chronic effect on human health that most times lead to loss of lives. Prominent side effects that have gained special attention include premature birth, congenital malformations, learning disabilities, behavioral disorders, asthma, allergies, early puberty, diabetes, reduced fertility, and cancer (Lopes-Ferreira *et al*, 2022). Micro-organisms that play major roles in soil nutrition have also been destroyed by the use of some of these herbicides. Highlighted are some key health concerns common in most parts of the world:

Pesticide Poisoning: Pesticide exposure can lead to acute poisoning, resulting in symptoms such as nausea, vomiting, headaches, dizziness, and in severe cases, seizures or even death. A study published in Environmental Health Perspectives reported that pesticide poisoning accounted for approximately 385,000 deaths globally in 2017 (GBD 2017 Pesticide Collaborators, 2020).

Developmental Effects: Prenatal exposure to pesticides has been associated with adverse developmental effects in children. A systematic review published in Environmental Health Perspectives found evidence linking pesticide exposure during pregnancy to an increased risk of neurodevelopmental disorders, such as autism spectrum disorder (ASD) and attention-deficit/hyperactivity disorder (ADHD) (Centers for Disease Control and Prevention (CDCP), 2021).

Cancer: Several studies have suggested a potential association between pesticide exposure and the risk of certain types of cancer. The International Agency for Research on Cancer (IARC), a specialized agency of the World Health Organization (WHO), has classified certain pesticides, such as glyphosate, as "probably carcinogenic to humans" based on animal studies and limited evidence in humans.

Respiratory Disorders: Pesticide exposure has been associated with respiratory problems, including asthma and chronic obstructive pulmonary disease (COPD). A systematic review and meta-analysis published in Environmental Health Perspectives reported an increased risk of asthma among individuals exposed to pesticides.

Endocrine Disruption: Certain pesticides have been found to disrupt the endocrine system, leading to hormonal imbalances. These disruptions can have various health effects, including

reproductive disorders, developmental abnormalities, and metabolic disorders (Nicolella & Assis, 2022).

It is important to note that regulations, safety measures, and proper training can help minimize the risks associated with pesticide use. Integrated Pest Management (IPM) practices, which focus on minimizing chemical inputs and utilizing alternative pest control methods, can also contribute to reducing the reliance on pesticides and mitigating associated health hazards.

5. Electronic Waste: Rapid Scientific and technological advancement results in a constant stream of obsolete electronic devices being discarded as electronic waste (e-waste). Improper handling and disposal of e-waste can release hazardous materials like lead, mercury, cadmium, and brominated flame retardants into the environment. These toxic substances can contaminate soil, water, and air, posing health risks to both humans and wildlife.

6. Loss of Biodiversity: Scientific and technological activities, such as deforestation for infrastructure development, mining, and agriculture, have led to habitat destruction and fragmentation, contributing to the loss of biodiversity. Ecosystems rely on diverse species interactions for stability and resilience. The loss of biodiversity can disrupt these interactions, leading to imbalances in ecosystems and potential negative health impacts, including the spread of zoonotic diseases.

7. Energy Consumption: The increasing demand for energy to power technological devices and infrastructure has placed significant pressure on natural resources. Traditional energy sources like fossil fuels have detrimental environmental impacts. Transitioning to renewable energy is crucial to mitigate these effects and reduce the associated health risks from pollution and climate change.

8. Electromagnetic Radiation: The proliferation of wireless technologies, such as cell phones, Wi-Fi, and smart devices, has raised concerns about the potential health effects of long-term exposure to electromagnetic radiation. While some studies have reported a possible association between long-term cell phone use and certain types of brain tumors and damage of vital cells in the human body (McCredden, *et al*. 2022). Other researches on this topic are still on-going. Some studies suggest a possible link between electromagnetic radiation and adverse health effects in humans and wildlife.

9. Genetic Modification and Bioengineering: Advancements in genetic engineering and biotechnology have enabled the manipulation of organisms' genetic makeup. While these technologies have the potential for positive applications, such as improving crop yields and developing medical treatments, their unintended consequences on ecosystems and human health are not yet fully understood by many. Design and development of biological weapons and altering the genetic makeup of viral diseases is possible as a result of this technology.

10. Electronic dependence: Scientific and technological advancements have led to increased electronic device usage, resulting in sedentary behaviors and reduced physical activity. This shift has contributed to a rise in health problems associated with a sedentary lifestyle, including obesity, diabetes, and cardiovascular diseases.

Measures taken to mitigate the impact of S&T on Ecosystem

To address these challenges and mitigate the health implications of scientific and technological advancement on the ecosystem, it is essential to create awareness, prioritize sustainable practices, promote energy efficiency, develop clean technologies, and adopt responsible waste management strategies. Additionally, raising awareness, implementing regulations, and supporting research and innovation can help foster a healthier relationship between technology and the ecosystem. Furthermore, adopting the sustainable practices listed below is crucial in mitigating the negative effects of technology advancements on the ecosystem and human health:

A. Transitioning to clean energy sources like solar and wind power to reduce greenhouse gas emissions and combat climate change.
b. Implementing proper waste management systems for e-waste, including recycling and safe disposal methods to prevent the release of hazardous substances into the environment.
c. Promoting sustainable manufacturing practices that minimize resource consumption, encourage recycling, and reduce the environmental impact of technology production.
c. Raising awareness and educating the public about the environmental and health implications of technology use, encouraging responsible consumption and disposal of electronic devices.
d. Supporting research and development of eco-friendly technologies that are energy-efficient, use fewer resources, and have minimal environmental impact throughout their lifecycle.

By addressing these issues and incorporating sustainable practices into technological advancements, we can mitigate their negative effects on the ecosystem and promote a healthier environment for both nature and humans. It is important for individuals, organizations, and policymakers to consider the long-term consequences of technology advancements on the ecosystem and prioritize sustainable practices that minimize negative impacts while harnessing the benefits technology has to offer. Additionally, promoting awareness and responsible use of technology can help mitigate potential health risks associated with excessive use or exposure.

General Health Implications

Nonetheless, throughout the modern public health era, health has been pursued as though our lives and lifestyles are disconnected from ecosystems and their component organisms. The inadequacy of the societal and public health response to obesity, health inequities, and especially global environmental and climate change now calls for an ecological approach which addresses human activity in all its social, economic and cultural complexity. The new approach must be integral to, and interactive, with the natural environment.

We see the continuing failure to truly integrate human health and environmental impact analysis as deeply damaging, and we propose a new conceptual model, the ecosystems-enriched Drivers, Pressures, State, Exposure, Effects, Actions or 'eDPSEEA' model, to address this shortcoming. The model recognizes convergence between the concept of ecosystems services which provides a human health and well-being slant to the value of ecosystems while equally emphasizing the health of the environment, and the growing calls for 'ecological public health' as a response to global environmental concerns now suffusing the discourse in public health.

More revolution than evolution, ecological public health will demand new perspectives regarding the interconnections among society, the economy, the environment and our health and well-being. Success must be built on collaborations between the disparate scientific communities of the environmental sciences and public health as well as interactions with social scientists, economists and the legal profession. It will require outreach to political and other stakeholders including a currently largely disengaged general public.

The need for an effective and robust science-policy interface has never been more pressing. Conceptual models can facilitate this by providing theoretical frameworks and supporting stakeholder engagement process simplifications for inherently complex situations involving environment and human health and well-being. They can be tools to think with, to engage, to communicate and to help navigate in a sea of complexity. We believe models such as eDPSEEA can help frame many of the issues which have become the challenges of the new public health era and can provide the essential platforms necessary for progress.

Conclusion

There is no doubt that technology advancement has and will continue to have enormous benefits to man and his environment. Innovations will continue to surface in all aspects of human life with the aim to create a better living. The advantages of these innovations clearly outweigh the disadvantages or consequences, also that most of these consequences are as a result of ignorance and carefree attitude of users. Notwithstanding, one cannot turn a blind eye to the fact that technological advancement has

negative effects on human health and the ecosystem at large. Adequate awareness is a fundamental tool alongside efficiency of regulatory bodies to help mitigate these effects. The ecosystem is ours to either protect or destroy.

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SOCIAL ENGINEERING ATTACK DETECTION BASED ON SYNTHETIC MINORITY OVER-SAMPLING TECHNIQUE (SMOTE) ALGORITHM AND STACKED ENSEMBLE MACHINE LEARNING APPROACH

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Abstract
Social engineering stands out as a well-recognized and straightforward attack technique, capitalizing on human vulnerability within the cybersecurity landscape. Research highlights that a significant portion of computer breaches originates from skillful employment of social engineering tactics, leveraging their manipulative nature. Detecting such attacks poses challenges, especially in a diverse online chat contexts like business domains or social networks. These environments provide avenues for potential hackers to manipulate individuals and gather information for malicious purposes. Academic research on social engineering primarily comprises analyses of industrial reports and accounts from self-proclaimed social engineers. To address this gap, our study utilizes the SEADerV2 dataset to discern potential attacks within chats. Our approach focuses on refining precision through an ensemble learning strategy. This stacked model merges a gradient boosting machine with a random forest classifier as base learners, resulting in a remarkable accuracy of 96.5%, surpassing the previous achievement of 92.6%. Additionally, the evaluation incorporates key metrics like Area Under the Curve (AUC), precision, and F-measure to comprehensively gauge the models' performance.

Keywords: Ensemble Machine Learning, Social Engineering Detection, Stacked, SMOTE.

Introduction

A social engineer employs the use of psychology to persuade unsuspecting people to do something the attacker wants them to do, which they would not do under normal circumstances, this could include persuading someone to provide information or duping someone into acting on the social engineer's behalf as a result, human behaviour norms give social engineers the ability to exploit legitimate users' trust to get around standard security measures; in other words, the most dangerous threat to an organization's security comes from its employees (Long, 2013), as their goals are similar to those of a typical hacker: " to gain illegal access to the systems or information with the intent of committing fraud, identity theft, network intrusion, industrial espionage, or just disrupting the system or network. Many of the research done to detect this attack have feasibility study models that use a diversity of methodology; however, documentation is absent that the theory has been carried out and proven to work, although understanding how people mingle and act with others is vital, there is little evidence of effectiveness (Lansley et al., 2019). Dr Robert Cialdini, a well-known psychologist, proposed the six persuasion principles: authority, scarcity, similarity, reciprocation, social proof, and commitment/consistency and additional work via psychologists have come to the same conclusion that these are the significant aspects in defining an eloquent individual, and utilizing the fundamental properties as a foundation, research scientists speculated and sought to design systems that detected those traits and projects in this area can be divided into the following categories; Data Collection, Segmentation and Aggregation of Results (Lansley et al., 2019).

The research article is founded on the idea that a conversation is going on in an online chat setting, the majority of findings include some admissible data that has been pre-processed. Although the systems differ, they are working toward the same aim: to prepare data for classification and to eliminate any unfitting attribute, such as Hyper Text Markup Language (HTML) tags or taint texts, from the text dialogues (Manning et al., 2014).

Related Literature

The research of (Peng et al., 2018) employ Netcraft, a well-known cyber security service, to assess a URL's safety and instead of manually creating a blacklist, they use a Naive Bayes classifier to create a black list of the topic from a large collection of phishing emails. The study of (Mouton et al., 2018) proposed an attack detection model by extending the model to cater for the attack that uses bidirectional communication, unidirectional communication or indirect communication. The paper (Fathollahi-Fard et al., 2018) proposes a new single-solution meta-heuristic algorithm called Social Engineering Optimizer (SEO) inspired by Social Engineering (SE) phenomenon and its techniques. The algorithm has four main steps and only three simple parameters to tune and is applied to solve twelve famous benchmark functions, common engineering, and multi-objective problems. The result shows its superiority in comparison with other well-known and recent meta-heuristics. The research (Wang et al., 2022) acknowledges that the performance of certain classifiers is not stable enough, with some classifiers showing a large variation in performance indicators and the presence of outliers in the recall performance boxplot. This indicates that the stability of the classifiers could be improved and while the datasets used in the experiments are relatively small, which may limit the performance improvement of complex models like Random Forest, AdaBoost, and MLP, it demonstrates the feasibility and effectiveness of ML techniques in detecting general social engineering threats by training nine types of ML models based on three different feature combination datasets and comparing their performance.

The authors (Sandouka et al., 2009) indicate that machine learning, specifically neural networks, can add an extra layer of security to protect individuals and organizations from social engineering attacks, the authors have used benchmark data and developed a new technique for extracting features that can be used for testing and training the neural network on the benchmark data that was proposed in. This data set is the first publicly available benchmark data for social engineering and was artificially generated by Dr. Marcus Rogers, the director of the Cyber Forensics Program at Purdue University and consists of 20 conversation scenarios with nine social engineering attacks. The authors filtered the keywords that are considered to be an indication of social engineering attack in the benchmark data and data set is used for testing and training the neural network in order to evaluate the effectiveness of the proposed technique for social engineering detection. (Lansley, Mouton, et al., 2020) proposes a method for detecting social engineering attacks in online environments using natural language processing and artificial neural networks by involving parsing conversation text, checking for grammatical errors, and using an artificial neural network to classify possible attacks on both real and semi-synthetic datasets, with high accuracy results. The paper highlights the importance of accuracy in social engineering attack detection, especially in online chat environments, and suggests that the proposed method can be a valuable tool in identifying and mitigating such attacks. The study done by (Derakhshan et al., 2021) presents the results of evaluating the Anti-Social Engineering Tool (ASsET) in detecting social engineering attacks in telephone conversations by gathering a dataset of telephone scams, consisting of 75 scam call samples generated by their study and 140 non-scam call transcripts from the Call Home dataset so as to distinguish scam and non-scam calls, with the peak accuracy achieved when approximately 53.3% of the scam conversations were used for training, while also demonstrating that social engineering attacks can be characterized by a set of speech acts, which they refer to as scam signatures, and their approach successfully detects these scam signatures in conversations.

Methodology

In order to detect social engineering attack, the procedures depicted in figure 1 are followed from data collection from an external source, pre-processing to correct any error or missing value, k fold validation of the data, ensemble machine learning approach and model evaluation criteria.

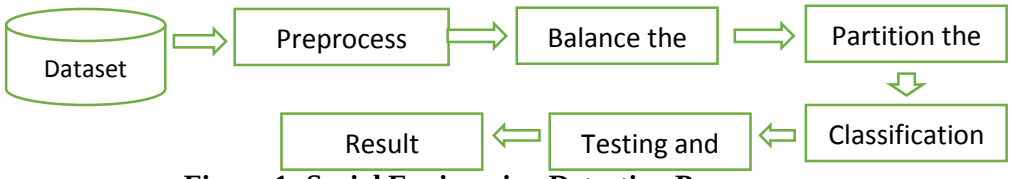

Figure 1: Social Engineering Detection Process

DATASET COLLECTION AND PREPROCESSING

The SEADerv2 dataset (Lansley et al., 2020) which contain 1050 data sample and 7 attributes is used for this work. The dataset features and their data type are presented in Table 1. Pre-processing is one of the procedures in these approaches, and it necessitates data analysis, after being processed, the dataset must be accessible and executable for the next step. This study considers 70% of them for training and 30% for testing. In addition, we have used a 10-fold cross-validation method.

Table 1: Seaderv2 Dataset Features and Type

No	Feature Name	Data Type
1	Intent	Real
2	Spelling	Real
3	Link	Real
4	Is attack	Integer
5	topic modeling (0)	Real
6	Topic Modeling (1)	Real
7	Topic Modeling (2)	Real

DATA BALANCING

It was observed that the dataset is imbalanced with most entries not being an attack and to address the issues, the SMOTE algorithm generates imitation data to establish a balance between minority and majority category sizes thus the justification for balancing the dataset so as to establish a balance between minority and majority category sizes in the seaderv2 dataset.

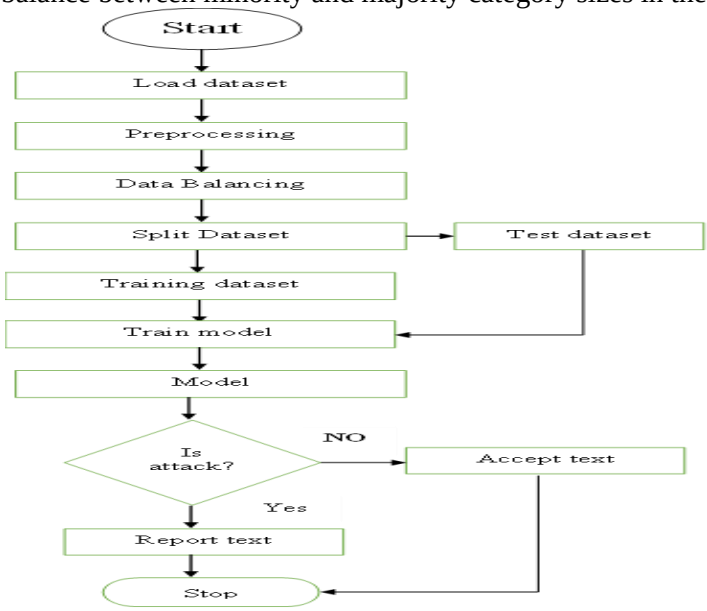

Figure 2: **Flowchart Illustration of The Model.**

Feature Transformation

To enhance classification accuracy, the class attribute, initially comprising of "Attack" and "Not attack," was transformed into binary 1 and 0, focusing on attack detection. Extraneous common words with minimal relevance were removed. The SMOTE algorithm processed the dataset, balancing it through synthetic data points, by rectifying the minority-majority imbalances. Figure 2 depicts the flowchart from dataset to model predictions. A 70:30% split yielded training-test sets. Training set balancing employed SMOTE for ensemble learning. Likewise, the test set was preprocessed and balanced for testing. The model classifies conversations as attacks or non-attacks bidirectionally.

Algorithm Used

In order to achieved the research objectives, a variety of algorithms were harnessed to manipulate the data, balance the data, and execute the model. The subsequent list provides a comprehensive account of these algorithms, accompanied by explanations of their functions.

Synthetic Minority Over-sampling Technique (SMOTE) Algorithm

The SMOTE algorithm was employed to address class imbalance within the dataset. It generated synthetic instances of the minority class, effectively equalizing the representation of both the minority and majority classes. This technique aimed to prevent biases and improve the model's predictive capabilities.

i. When we have a dataset D consisting of two classes: the majority class (M) and the minority class (m).
ii. For each sample x in the minority class m, the algorithm finds its k nearest neighbors from the minority class as well as some from the majority class.
iii. For each sample x in the minority class m, synthetic samples are generated by interpolating between x and its k nearest neighbors. The interpolation is controlled by a random value between 0 and 1, denoted as λ.

The equation for generating a synthetic sample S is:

$$S = x + \lambda * (x_neighbor - x) \quad (1)$$

Here, x_neighbor is one of the k nearest neighbors of x.

iv. The above step is repeated to generate the desired number of synthetic samples to balance the class distribution.

Gradient Boosting Machine

Gradient boosting is a machine learning technique for improving power either in regression, classification and other tasks in the form of an ensemble of weak prediction models by identifying the shortcomings to boost the power of the estimator.

i. To predict y given a collection of x, for example. The residual is the difference between the predicted and actual value, and it is used to create subsequent trees. Let's suppose the output model y is as follows when only one decision tree is used:

$$y = A_1 + (B_1 * X) + e1 \quad (2)$$

where e1 is the residual of the decision tree. And the subsequent decision trees will be represented mathematically as:

$$e1 = A_2 + (B_2 * X) + e2 \quad (3)$$ and

$$e2 = A_3 + (B_3 * X) + e3 \quad (4)$$

ii. The final model of the decision tree will be given by combining all three equations:

$$y = A_1 + A_2 + A_3 + (B_1 * x) + (B_2 * x) + e_3 \quad (5)$$

Random Forest

This algorithm produces an ensemble of the classifier based on different decision trees using random feature selection during the training phase by generating two categories of nodes namely class and features and is frequently employed as.

$$Gini = 1 - \sum_{i=1}^{n} (P_i)^2 \quad (6)$$

The Gini of each branch on a node is calculated using class and probability, showing which branch is more likely to occur. Pi represents the class's relative frequency in the dataset, and n is the number of classes.

Entropy may also be used to determine how decision tree nodes branch as it is more theoretically demanding to use a logarithmic function than the Gini index.

$$Entropy = \sum_{i=1}^{n} - P_i * Log_2 (P_i) \quad (7)$$

Stacked Ensemble Model

This model improves performance of classifiers by training and combining predictions from sub-models to determine if an online dialogue is a social engineering attack or not. In this work, both the random forest and gradient boosting machine are used as the base learners (level-one classifiers) and logistic regression as the aggregate learner that is, the meta classifier. The aggregation is based on the probability or based on all outcomes of the predictive models to determine if a dialogue is a social engineering attack. The algorithm for the stacked model is given in figure 3 while the flowchart is shown in figure 2. and the internal implementation of the ensemble model is depicted in figure 2. In this work, both the random forest and gradient boosting machine are used as the base learners (level-one classifiers) and logistic regression as the aggregate learner that is, the meta classifier.

a. False Positives (FP): Social engineering attack belong to its class when it does not.
b. False Negatives (FN): Social engineering attack is said not to belong to its class when it does.
c. True Positives (TP): Social engineering attack is correctly predicted to its class.
d. True Negatives (TN): Correctly predicting that a social engineering attack does not belong to its class.
e. Accuracy is the number of correct classifications made out of all instances in the test data. The formula to calculate accuracy is below:

```
Algorithm: Stacked Model
Start
Input: Trained social engineering dataset T
Output: An ensembled is attack or not classification
LOAD data
        positives → 1
        negatives → 0
        is attack ← 1
         not attack ← 0
learn first base model classifier
for p ← 1 to T do
end for
   construct a training set for the second base model
    for recall do get a prediction of the new dataset
end for
learn second base model classifier
for p ← 1 to T do
learn Random Forest classifier based on E
end for
learn the base model using the meta learner
return final prediction
End
```

Figure 3: Stacked Ensemble Learning Model Pseudocode

Evaluation Criteria

The following performance metrics are used to evaluate the work: accuracy, f-measure. precision and recall are used to measure the success of the model using a confusion matrix, which offers a visual representation of the model systems' performance indicators.

Table 2: Confusion Matrix for Detection of Social Engineering Attack

Real Class	**Negative Class Not Attack**	**Positive Class Is Attack**
Positive	TP = 496	FP = 9
Negative	FN = 23	TN = 438

$$Accuracy = (TP + TN)/ ((TP + TN + FP + FN+ FP)) \quad (8)$$

f. Precision is a measure of the classifier's precision which measures the number of instances that have been accurately categorized as shown below:

$$P = TP/ (TP + FN) \quad (9)$$

g. Recall is the number of positive examples accurately identified by the classifier from a set of all positive instance.

$$R = TP/ ((TP +FP) \quad (10)$$

h. The F1 score is calculated by taking the weighted average of the precision and recall values.

$$F1-Measure = 2 \times ((P \times R))/ ((P + R)) \quad (11)$$

Results and Discussion

The research successfully detected social engineering attacks in the SEADerv2 dataset. The proposed method was compared with other researchers who also used machine learning on the same dataset. The comparison follows: (Lansley et al., 2019a) achieved 79.1% detection accuracy, with an AUC of 79.0, no reported F1 measure, using random forest classifier. In (Lansley, Kapetanakis, et al., 2020), their ensemble model attained 92.6% accuracy, AUC of 0.722, and F1 of 0.769. Our study yielded 96.5% accuracy and an F1 of 0.965 for social engineering attack detection using our ensemble learning method. Notably, our proposed approach outperforms others in the evaluation criteria for this context.

Table 3: Result Comparisons with Previous Work

S/N	Author	Model	Precision	Recall	ACC%	F1	AUC
1	Lansley et al., 2019)	Random Forest Classifier	-	-	79.1	-	0.790
2	Lansley et al., 2020)	Ensemble Model	-	-	92.6	0.769	0.722
3	Proposed Model	SMOTE + Stacked (RF + GB + LR)	96%	96%	96.5	0.965	0.995

Conclusion

Social engineering attacks, exploiting human psychology for unauthorized access, remain highly unpredictable. Effective detection demands timely intervention due to its subtle influence. This study employs stacked ensemble approach which attains a strong 96.5% accuracy. Moreover, key metrics including AUC, recall, train time, precision, and F-1 were scrutinized. Future endeavors involve fortifying the dataset for improved machine learning, reducing detection latency, and elevating attack identification efficiency.

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SYSTEMATIC LITERATURE REVIEW ON MOBILE DEVICES FORENSIC

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Abstract

Mobile Device Forensics (MF) is an interdisciplinary field consisting of methods used with a variety of computer devices, including cell phones and satellite navigation systems. This work provides a system literature review (SLR) on mobile (android) forensics, by presenting a detailed assessment of the actions and methodologies taken throughout the last eleven years. The SLR presented in this research will serve as a resource to support efficient and effective reference and adaptation to future researchers. This review was able to identify that there is no general or standard framework that supports all the versions of mobile device Operating Systems (OS) without building on the existing framework to accommodate the newer version of mobile device OS and the update in the devices which may be challenges for forensic experts in terms of tools compatibility with that latest mobile device and developing a forensic tool.

Keywords: Android Mobile Device, Digital Forensic, Forensic Investigation, Mobile Forensic, Mobile Forensic Process.

Introduction

essentially, forensic science is the study of evidence left behind after an incident or crime. The development of technology has greatly influenced forensic science. The evidence that is gathered by the authorities and used in forensic investigations is frequently in the form of digital data. Digital forensics is the term for this technique of analyzing digital material for an inquiry (Lohiya *et al.* 2015). According to the National Security Database (NSD), Digital Forensics (DF) is a branch of forensic science that deals with the recovery and examination of data from digital devices. Computer forensics, mobile forensics, and network forensics are all subfields of the discipline known as digital forensics. This paper's concentration is on "Mobile Forensics," which is it's the focus of the study. Mobile forensics is a subset of digital forensics that deals with recovering data from mobile devices while maintaining forensically sound practices. The development of smartphones, which come with a full operating system, software programs, and a user interface that makes interacting with the user simple and comfortable, is entirely to thank for the revolution in mobile forensics (Lohiya *et al.* 2015).

As our society becomes more digital and ideas like smart cities, smart buildings, and Industry 4.0 (Industry 4.0 refers to a new phase in the Industrial Revolution that emphasizes profound interconnectivity, automation, machine learning, and real-time data) become the standard, digital investigation is playing an increasingly significant part in both cybercrime and regular crime investigations (Zhang *et al.* 2021). For instance, in a drug or sex trafficking investigation, it's likely that potential sources of evidence will include mobile devices that have been used for communications (like Android and iOS devices and instant messaging services like WhatsApp), IP-based CCTV cameras installed in the city, wearable devices (like a smartwatch), in-vehicle infotainment systems (with built-in GPS, WiFi, and Bluetooth capabilities to provide connectivity), and Internet of Things (IoT) devices. "Unless hardware itself is contraband, evidence, an instrument of crime, or a fruit of crime, it is only a container for evidence," despite the fact that a digital device may contribute to a crime in several ways Casey (2011). The investigation process primarily consists of three phases: data acquisition, which involves obtaining the device's data if it is in good shape; otherwise, a mirror image of the device is created and utilized for data retrieval. The collected data is analyzed for the purpose of obtaining evidence in the following phase, which is analysis. The next step is preservation, which is storing the

data and evidence gathered in a secure state so that it can be utilized to present evidence in a court of law (Lohiya *et al.* 2015).

Restoring deleted data from a phone is comparable to recovering data from a hard drive, since information may be stored on mobile devices just like it can on computers. The 2008 terrorist attack in Mumbai is the best illustration of a cell phone being used as a terror weapon to carry out a crime. The terrorist made the most of his generation's use of mobile phones. Throughout every stage of their activity, they maintained an electronic connection with both their controllers and one another. Although the use of a mobile phone in an attack is not new, the manner in which it was carried out is noteworthy and instructive. These devices can be used to extract a lot of data that can be utilized as forensic evidence in these situations (Lohiya *et al.*2015). Currently, both businesses and individuals use three different types of mobile phones: basic phones, which are primarily simple voice and messaging communication devices; advanced phones, which offer additional multimedia capabilities and services; and smartphones, or high-end phones, which combine the capabilities of an advanced phone with those of a personal digital assistant (Taylor *et al.* 2012).

Mobile forensics includes ways for extracting evidence from mobile phones and analyzing that evidence for information retrieval. It entails a SIM and phone memory examination. There are four (4) stages of the mobile forensics process, which are (i) Seizure (ii) Acquisition (iii) Analysis (iv) Examination. Due to a lack of knowledge management in mobile forensics, there are difficulties conducting mobile forensic investigations, which has caused a few problems in the field.; these are as follows: (i) difficulty of the investigation process for newcomers into the MF domain, (ii) confusion in MF concepts and terminologies, and (iii) difficulty in understanding various processes involved in this domain (Lohiya *et al.* 2015).

Android has emerged as the most widely used operating system in the mobile phone industry, with the largest user base in various regions of the world. This most widely used mobile OS supports a huge number of financial applications, including mobile banking and online banking. Android phones also retain other private data, like health records, passwords, and usernames. There are four significant methods in conducting forensics on Android devices Ranjan (2016): which are (i) *Acquiring Physical Image:* The physical Image is a bit-by-bit copy of the Android device. Through this procedure, data stored on a device, as well as data stored on the unallocated space and deleted data files, are all transferred. (ii) *Acquiring Logical Image*: Even if there are many tools for this strategy, logical images cannot restore the data from deleted or unallocated data space. A logical image is a device backup. (iii) *Imaging Memory Card:* Safely removing the memory card allows for data duplication and analysis. (iv) *Manual Method:* Screenshots of each action made on an Android smartphone are taken when it is brought in for a forensics investigation. This is both time-consuming and inaccurate.

According to Zhang *et al*. (2021), the process of acquiring digital evidence relevant to criminal activity is made more difficult by the growing variety and volume of computer devices and remote data storage (in cloud servers) (unauthorized access and espionage). In order to enable digital investigators to locate, obtain, analyze, and present the wide variety of potential artifacts of forensic interest - a process sometimes known as digital forensics - a systematic strategy is required.

In order to make the findings of this study generalizable to a broad range of contexts, this study summarizes the various approaches and methodologies involved in carrying out a mobile/android forensic investigation in the MF field. In the literature, there are surprisingly few systematic reviews of mobile. However, the main problem with those earlier reviews is that there is not a generalization and adaptation framework in place for all mobile platforms due to variations in operating system structure and device updates, which could present difficulties for forensic experts when it comes to creating forensic tools that are compatible with the most recent mobile devices. Organizations and researchers are finding it difficult yet challenging to develop a common framework or standardization model due to the rapid changes in technology, variances, and gaps between various types of mobile devices and OSs.
The purpose of this review work is to have a clear view of mobile forensics, to understand the mobile forensic processes, framework/methodology, approach, and tools used in the field of MF, and to also

perceive the previous researchers' activities so as to ease the forensic investigation process when a crime is committed using android mobile devices.

The remaining parts of the paper are organized as follows: part two presents a detailed analysis of previous related literature; part three presents the detailed methodology used in this research and Part four discusses the results and findings. Part five contains the conclusion of the work while part six discusses the future work for the upcoming researchers in the field of MF.

Related Work

The field of Android device forensics is still reasonably developed despite the occasion difficulties. This is due to the rapid pace at which mobile device technology progresses and the wide variety of Android devices that have arisen recently, such as in recent literature evaluations on mobile device forensics, Casey *et al.* (2011) provided a methodology for acquiring and examining forensic duplicates of user and system partitions from a device running webOS. On these devices, the main sources of digital evidence are discussed with examples for clarity. On webOS devices, the topic of recovering deleted items from various locations was also covered. Digital investigators can glean a substantial amount of usable information from the system partition of webOS devices using the methods and tools described in their article. Grispos *et al.* (2011) investigated what information held on a Windows Mobile smartphone can be recovered using several different approaches to acquisition and decoding. The paper showed that no single technique can fully recover all information from a Windows Mobile device that would be of forensic significance and that sometimes the information recovered is contradictory.

The legal implications of the forensic examination of mobile phone applications were studied by Taylor *et al.* (2012). Instances where mobile telephone applications have been implicated in the propagation of malware for harmful or illegal objectives include cases of fraud, theft, money laundering, the broadcast of copyrighted information or indecent photographs, and the exploitation of computers in general. Barmpatsalou *et al.* (2013) provided a comprehensive overview of the field of Mobile Forensics (MF), by presenting a detailed assessment of the actions and methodologies taken throughout the last seven years. The most important studies were grouped into multiple levels of chronological categories in order to offer a rapid yet thorough manner of observing the field's tendencies.

Lohiya *et al.* (2015) conducted a survey on mobile forensics which discusses about the mobile device characteristics, the steps for mobile forensic investigation, and different tools for mobile forensics. A CPU, read-only memory (ROM), random access memory (RAM), a microphone, a speaker, a digital signal processor, a variety of hardware keys and interfaces, and a Liquid Crystal Display (LCD) are all included in the set of characteristics for mobile devices. Tajuddin and Azizah (2015) investigated a wealth of personal and sensitive data by types of digital information as evidence and conducted forensic analysis on a popular smartphone Samsung Galaxy Note III. The typical method used to physically acquire and analyze data from a smartphone is Cellebrite UFED.

Walnycky *et al.* (2015) forensically acquired and analyzed the device-stored data and network traffic of 20 popular instant messaging applications for Android. The authors' ability to recreate part or all of the message content from 16 of the 20 evaluated applications speaks badly of the security and privacy safeguards implemented by these programs, but it may be seen favorably for gathering evidence by digital forensic specialists. Daware and Thakare (2016) gave an overview of digital forensic processes and tools and also the comparison between computer and mobile forensics. Each well-known digital forensic tool provides an insider's perspective to help investigators decide whether to use paid or free resources. The authors also concentrated on the field and uses of digital forensics.

In order for mobile phone forensics to keep up with mobile phone release cycles, a more thorough and detailed methodology for evaluating mobile forensic toolkits should be created. Additionally, data on the best tools and procedures for each type of phone should be made promptly available. Wei and Zhao (2016) proposed two kinds of algorithms which are biometric feature and face recognition algorithms into two separate kinds of multiple granularity feature-based person recognition algorithms for forensics applications. Also suggested was a facial recognition method based on bionic pattern recognition. The suggested approach has a satisfying recognition precision and a low time complexity in numerous

forensics scenarios, according to experimental results. Algorithm optimization was also their future work.

Kim *et al.* (2017) proposed the mobile forensic reference set (MFReS), a process and tool for conducting mobile forensic investigations were created. The MFReS is made up of repositories, databases, and services that make it simple to obtain information from a database and classify it meaningfully among the various data kinds found in mobile devices, including information on crime.

Umar *et al.* (2017) conducted an investigation involving smartphone devices, the investigators need to use forensic tools. However, WhatsApp and mobile technology are developing more quickly than the currently available forensic tool technologies. WhatsApp and smartphones are constantly running the most recent version. To handle a case involving an Android smartphone and WhatsApp in particular, study on the effectiveness of the current forensic tools must be done. The parameters from NIST and WhatsApp artifacts were used in this study to evaluate the forensic tools that are currently available for doing forensic analysis on WhatsApp. Zheng *et al.* (2017) presented an anti-forensics approach for Android devices that protects AES keys from being acquired by forensics tools. Attackers cannot steal private information since the keys are kept in a particular memory area where the data will be covered when Android reboots. An anti-forensics strategy was put forth in their article to prevent the acquisition of AES keys by forensics tools through cold boot attacks. Chen *et al.* (2018) discussed the digital forensic procedure and techniques for analyzing the local artifacts from four popular Instant Messaging applications in Android. The user chat message details and contacts for each program were looked into as part of their results.

Lin *et al.* (2018) proposed a fully automated tool, Fordroid for the forensic analysis of mobile applications on Android. Fordroid built control flow and data dependency graphs and performed inter-component static analysis on Android APKs. Fordroid also used taint analysis to determine what and where information had been written in local storage. Ali *et al.* (2018) proposed a common concept for the mobile forensics domain based on the concept extraction process. The proposed concepts simplified the investigative process and allowed teams to record and use specialized forensic information, which helped clear up terminological and conceptual ambiguity in the mobile forensics field.

Gill *et al.* (2018) conducted a bibliometric analysis of the topic of mobile forensics, allowing for examination of the degree to which this novel development can become potentially useful evidence, the progress researchers have made over time on the topic, potential future technologies that could influence more changes in the field of mobile forensics and its impact, as well as the distinction between mobile forensics and computer forensics. Al-sabaawi and Foo (2019) gave a comprehensive overview of the forensic analysis of Android phones and discussed the fundamentals of acquiring and analyzing an Android disk image. The complexity of the Android operating system, the wide range of techniques and tools available for data collection, and issues with hardware setup are all hurdles in Android forensics.

Camacho *et al.* (2019) presented a systematic mapping of the Forensics Analysis on Mobile Devices; this research has been conducted following the guidelines of Kitchenham's methodology. Their goal was to give background information on pertinent behaviors that investigators believed involved handling potentially valuable digital evidence from mobile devices. Kim and Lee (2019) proposed an efficient forensics investigation method for mobile devices with Android OS, which holds the highest share in the world among mobile devices. They looked at data analysis, evidence management, data pre-processing (classification and identification of data), and Android Data Taxonomy.

Sharma *et al.* (2020) presented a mobile cloud forensic process that incorporates time synchronization and inter and intra-application analysis along with the traditional forensic procedure. A necessary step for the investigator to execute application forensics in the mobile cloud efficiently is time synchronization. By effectively leveraging the metadata of prospective application forensics in the mobile cloud, an inter and intra-application analysis procedure ensures the extraction of the forensic-rich evidence and enriches the performance of the cloud event traceability.

Akinbi and Ojie (2021) presented a forensic analysis of the artifacts generated on Android smartphones by Conversations and Xabber apps. Their research located external Secure Digital card directories that hold local copies of user metadata as well as databases that are maintained by each app. The authors examined each app's forensic artifact storage options and forensic investigation potential. Humphries *et al.* (2021) focused on existing curricula and courses in the domain of mobile forensics. The researchers use open-source information collection, together with a questionnaire and interviews, to acquire more information and the opinions and experiences of educators and/or trainers in order to identify courses in areas of computing where mobile forensics may be given. According to their research, the majority of the existing education and training programs include issues related to buying mobile devices and analyzing the data you buy.

Fukami *et al.* (2021) proposed a new model for forensic acquisition. The model is supported by a legal framework concentrated on the usability of digital evidence obtained through vulnerability exploitation. Additionally, it examined current mobile forensic methods and contrasted them with earlier methods. Zhang *et al.* (2021) used the Design Science (DS) approach to guide the development of an integrated digital forensic framework. The framework is then used to demonstrate how a forensic examiner might use it to look at Android applications, with the help of a number of case studies (also known as "instantiations" of the method artifact in the design science field). Despite the fact that there have been many studies concentrating on mobile device and app forensics, the researchers found a lack of comprehensive but adaptable protocols that take into consideration the various conditions that may arise during the data recovery and investigation process. These forensic artifacts can help with the reconstruction of the incident, including "what happened," "how," "when," and "where," as well as "who was involved" and "why" (the motivation construct in the Routine Activity Theory).

Chauhan *et al.* (2022) focused at extracting significant adaptable mobile criminological proprietary tools for comparative and statistical analysis of physical data collecting. The suggested study also describes recently created utility tools and their distinguishing traits that aid in successful mobile device data extraction. Lee (2022) examined user status and a framework for smartphone user analysis was put into place with the intention of extracting important digital evidence in a digital forensic manner from a blockchain perspective. This study looked into a system that, through these frameworks, can offer crucial information to digital forensic experts. The suggested system is anticipated to grow to include much more structured data as well as online unstructured data, such SNS reports.

Moreb *et al.* (2023) developed a brand-new approach for the mobile forensics process model lifecycle called the Mobile Forensics Investigation Process Framework (MFIPF), which includes all the crucial steps and information sources utilized to build the crime case. By creating a mobile forensics model that streamlines the examination process and allows forensics teams to collect and reuse specialized forensic knowledge, the developed framework helps to identify common principles of mobile forensics.

Methodology

This section presents the research steps followed to review the existing works in the area of mobile/android forensics, applications and tools used for investigation. The selection of the existing studies which was done through a set of inclusion and exclusion criteria was also explained

Protocol and Phases of the Study

The Preferred Reporting Items for Systematic Reviews and Analyses (PRISMA), Moher *et al*. (2009) and the established guidelines in the work of Kitchenham *et al*. (2009) were adopted in this review.

Source of Data

In order to acquire data from reliable data source, reputable academic research databases encompassing computational disciplines with high publication reputation. Such databases included but not limited to Science Direct, Springer, IEEE Xplorer, Scopus and Research-Gate as shown in Table 1. Conference papers and journals from those sources formed the primary source of data for the study. Papers from untrusted sources such as Wikipedia were not considered since they are rated unreliable.

Table 1: Database Search Sources

S/N	Database Sources	No. of Articles
1.	Research gate	30
2.	Scopus	15
3.	Science Direct	17
4.	IEEE Xplorer	10
5.	Springer	15
	Total	87

Search Keywords

The literature search approach of Kitchenham *et al*. (2009) was used in this study. In order to determine the most appropriate search phrases; the core search terms were carefully chosen. The following terms were used to search the relevant material in some renowned academic archives using the review specified goals: mobile/android, forensic, forensic + investigation.

Inclusion and Exclusion Criteria for Papers Selection

In selecting papers for this study, some standards were set. Only papers that matched and met these criteria were selected. The criteria and matching justification are presented in the table 2.

Table 2: Inclusion/Exclusion Criteria of Research Publications

S/N	Criteria	Explanation/Justification
1.	The original research publication, not a survey or review paper.	The research papers are expected to focus on the mobile/android forensic techniques.
2.	The proposed solutions must be on the methodologies/techniques/processes of mobile forensics.	The aim of this research is to aid newer and expert researcher in the development of better techniques and approaches.
3.	The publication must be full-length paper.	Short papers are insufficient in providing relevant information on the proposed solution.
4.	The language chosen for writing research paper must be written in English language.	The publication must be written in English language.
5.	The paper must be published between 2011-2023	The coverage of the Systematic Literature Review is 11 years, from 2011-2023.

Study Selection Process

There was a total of 100 studies identified by the initial keyword searches on the chosen database platforms. After eliminating the duplicate research, the number was reduced to 89. The research papers that match the inclusion/exclusion criteria were thoroughly examined, and 59 publications were left over for reading. Only papers written in English and published between 2011-2023 were chosen. After reading all 59 papers in detail and using the inclusion/exclusion criteria again, 26 papers were left for the systematic literature review. The identification, screening, eligibility, and included phases are presented in Figure 1.

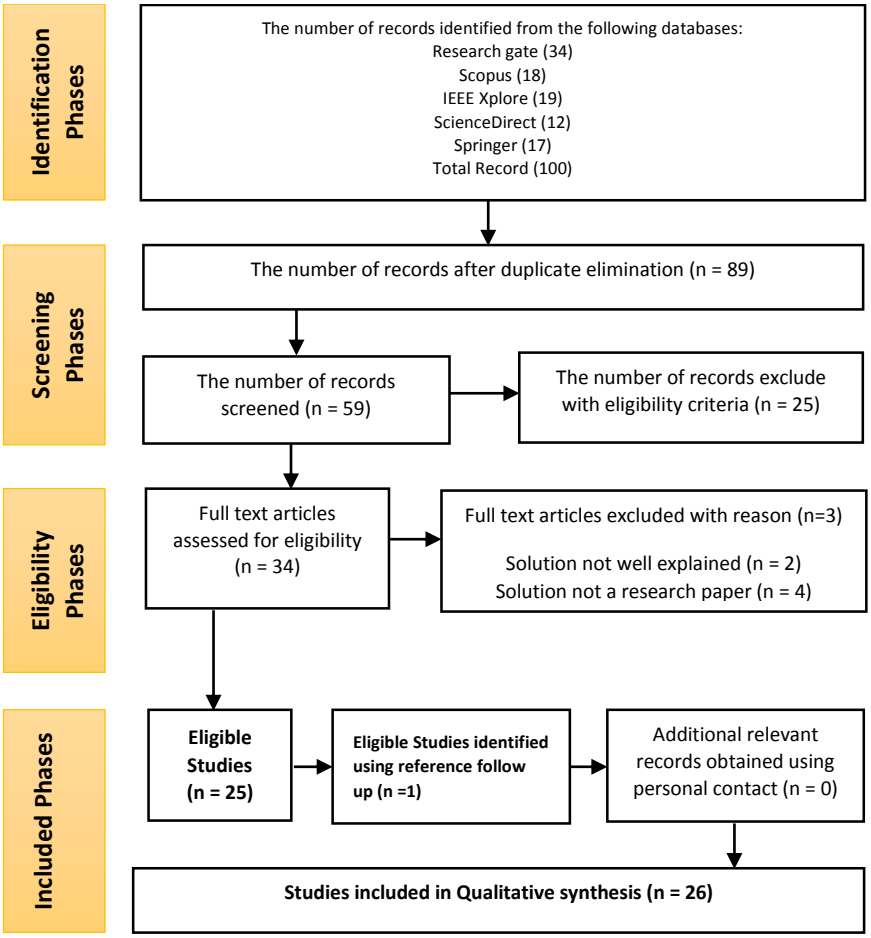

Figure 1: The Study Selection Workflow with PRISMA

Results

This research peer-reviewed publications that were published between 2011 and 2023. This was because the goal was to figure out what models/framework used in mobile forensic in the previous years. After screening the relevant review papers published between the year 2011 to 2023, the total numbers of publications that was reviewed is Twenty-Six (26). In 2011, two (2) papers was published; 2012 (1) paper published; 2013 (1) paper published; 2015 (3) papers published; 2016 (2) papers published; 2017 (3) papers published; 2018 (3) papers published; 2019 (3) papers published; 2020 (1) paper published. In 2021, only 4 studies were published, 2022 (2) papers published. Finally, in 2023, there were (1) published as shown in figure 2. Based on the survey in the research, there is no general framework or model that can support all the version of OS of mobile devices without building on the model to accommodate the new devices and also updating the tools for the newer version of the mobile devices for forensic investigation.

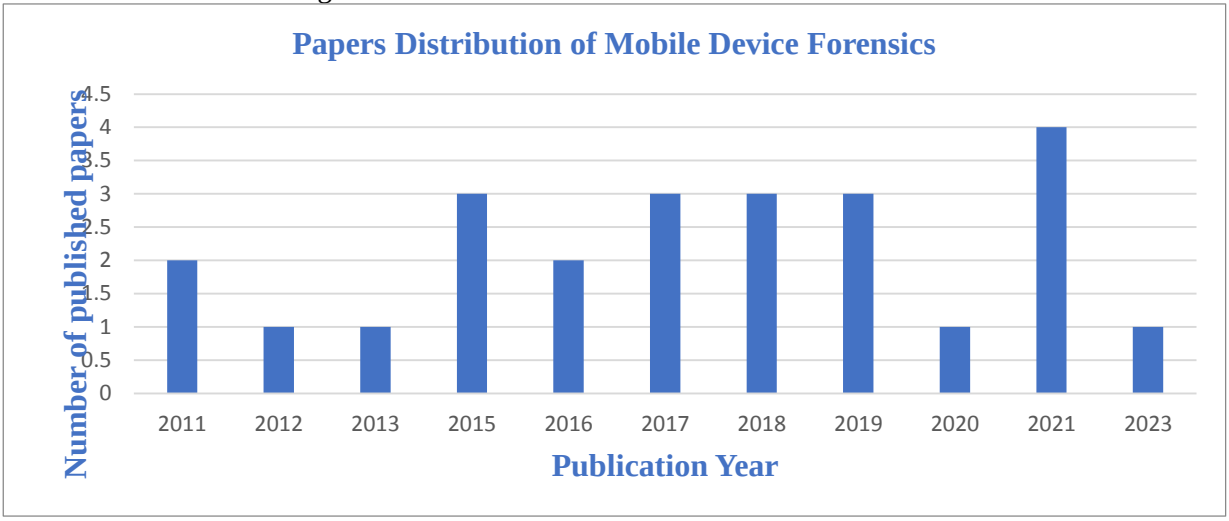

Figure 2: Number of MF Reviewed Published Articles Per Years

Conclusion

This research presents a systematic literature review on mobile/android forensic. Only article published between 2011 to 2023 were considered. Different framework/methodologies/approach/techniques adopted by forensic investigators were examined and investigation process reported. Finally, the paper detailed all the findings in the previous reviews which can be used as a reference to anyone interested in better understanding the facets of MF area. It is also expected to foster research efforts to the development of fully-fledged solutions that put emphasis mostly to the technological, but also to the standardization aspect.

Future Work

This study gives a systematic review of mobile forensic by providing detailed assessment of actions, methodologies taken throughout the last ten years. The publications that were studied discussed what mobile forensic is, the process and the tools used for conducting forensic investigation. Some of the studies proposed model/framework/technique for mobile forensic investigation such as preservation, acquisition, examination and analysis, reporting for evidence when crime is committed.

Further work is required in the area of file carvers designed for forensic work on mobile phones, and for the Windows Mobile platform specifically, the development of a dedicated carver to support recovery of artifacts from mobile devices without relying on information contained in the device file system according to previous review. Further research is also required on effectiveness of forensic tools to investigate mobile devices with higher version of operating system.

Finally, further research should be carried out on a general model/framework that will support all kinds of mobile devices for investigating and evaluating of the devices irrespective of the differences in the structure of their operating system.

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ASSESSING THE PROCEDURES FOR COLLECTION DEVELOPMENT AND THE IMPACT OF INFORMATION NETWORKING

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Abstract
This paper focuses on the procedures for collection development and how information networking is used in enhancing this procedures in libraries. Collection development process entails a complicated series of choices and procedures, such as choosing which materials to purchase, managing budgets, analyzing consumption statistics, and getting rid of obsolete or pointless products. As a result, it is necessary to investigate, assess, and determine ways to increase the efficiency of the collection creation procedures that libraries utilize, hence the need for information networking. This researched was carried out using Newgate University Minna and Midwifery nursing school Minna as a case study. The aim of the research was to identify the various means by which information networking can influence collection development processes. The research methodology used was the survey method, making use of questionnaire as the research instrument. A total of 80 questionnaires was distributed but 60 questionnaires were used for this research. Findings revealed that information networking plays a crucial role in collection development by improving resource sharing and the quality library's collection, it also keeps librarians abreast with new trends, innovations in their field.

Keywords: Information, Information Communication Technology, Collection Development, Networking, Librarians

Introduction

Collection development is a major aspect of library and is almost synonymous to the word library, because libraries are in fact collections of information materials in various formats. What then is collection development? Corrall (2012) defined it as the selection and acquisition as well as the deselection and de-acquisition of library materials. The processes for collection development includes; planning and policy making, collection analysis, selection, maintenance, fiscal management, user liaison, resource sharing and finally evaluation. ICT has affected the process of collection development just as it has done to any manual procedure for any organization. It enhances the effectiveness of the activities, save time, cost and so on.

Information is the driver and facilitator of the world today, much so in this digital age, information has become more accessible, interconnected and rapidly transmitted than ever before. Information networking is a process of communication, exchange of ideas, resource sharing and collaboration between individuals, organizations, institutions and libraries which is facilitated by ICT. It has brought about information explosion, rapid advancement in information communication technologies, inadequate funding and increased demand for quality information. Networks can be classified into local, national, regional, and international networks and are formed to serve different categories of user communities. Some of the benefits of information networking include resource sharing, on-line conferences and participation in programs at distant centers, collaboration among scholars in different countries. Library information networking started with the interlibrary loan which has metamorphosed into library consortia in which groups of libraries partner to coordinate activities, share resources and combine expertise. Information networking has greatly improved the sharing of resources in acquisition and dissemination of information resources since no single institution can acquire the overwhelming number of information resources in their various formats. In the digital age, sharing materials from one library or institution with users of other libraries or institutions is generally referred to as information networking or library collaboration. Those with the necessary infrastructure may access and use the worldwide information on the internet or web. Human progress has been facilitated through

communication, which has allowed us to share and enhance one another's experiences and advance culture, science, and technology.

Information and communication technologies, to a great extent, have impacted on every sphere of life including information availability such that users feel self-sufficient in information search, access, and sharing. The innovation of internet/web and communication technologies has led to information explosion but there is a mismatch of what is needed and what is available. Abubakar (2010) said that as no one provider, organization, or institution can be self-sufficient in the supply of information resources to their user community, information networking is vital for the provision of information.

Haber (2011) argued that their services have changed with the digital age to satisfy the shifting demands of their users. Consequently, Information networking has become necessary as a result of the usage of ICTs to make it easier for information users to search for, utilize, and share information.

Statement of the problem

Librarians and other information workers must make use of information networking tools and technologies to efficiently gather, organize, and manage the massive quantity of information that is available on the internet and other digital platforms. However, choosing and accessing pertinent and trustworthy information presents considerable obstacles due to the complexity and dynamic nature of the digital environment. In order to improve their collection creation processes, librarians and information professionals must be guided by efficient techniques and best practices for using information networking tools. Many organizations struggle to manage scarce resources while building their collections in an efficient and effective manner to satisfy the demands of their users. This entails a complicated series of choices and procedures, such as choosing which materials to purchase, managing budgets, analyzing consumption statistics, and getting rid of obsolete or unwanted products. A methodical and planned approach to collection creation is required to make sure the collection stays pertinent, helpful, and available to its target audience. However, Organizations frequently deal with problems like information overload, competing priorities, and financial limitations because they lack a clear grasp of the best techniques for collection creation. As a result, it is necessary to investigate, assess, and determine ways to increase the efficiency of the collection creation procedures that organizations utilize.

Objectives of the Study

The paper was carried out with the following objectives:

1. To define the functions of information networking in the creation of collections.
2. To determine the strategies being used in the collection development processes.
3. To define the role of the librarian in successful information networking.
4. To determine how information networking influences library's collection.

Research Questions

The following research questions guided the study;

1. What is the role of information networking in collection development?
2. What strategies are being implemented during collection development processes?
3. What is the role of a librarian for effective information networking?
4. How does information networking influence Library's collection?

Literature Review

Information networking is a method that uses ICTs and the internet to allow communication, idea exchange, resource sharing, and cooperation amongst people, groups, institutions, and libraries. According to Onwuchekwa (2015), library information networking entails using the information resources of one library to provide services for another library rather than just exchanging information resources across libraries.

Edmond (2018) supported the use of computer networks and other information communication technologies in businesses as the absence of it poses a threat to the data saved on the systems. He went

on to explain how the system is at risk of crashing due to large volumes of data saved on one system and lacks consistency since data could be updated on a particular system but would not be reflected on other systems. In summary, businesses or organisations will suffer increased cost of transaction, slower administrative work, poor decision making and general decrease in its effectiveness and efficiency. Khan and Bhatti (2016) identified certain factors such as; goals of collection development, user need, collection development policies, budget and resource sharing programs as factors that influence collection development management. Kasalu and Bernard Ojiambo (2012) discovered that ICT facilities could enhance library activities especially collection development processes but also observed that they weren't adequately utilized to meet users' needs. Khaur and Gaur (2017) examined digital collection development but discovered some disadvantages in its usage such as; copyright concerns, hardware and software compatibility issues, requires special equipment to access it which affected its utilization by users

Methodology

This paper employed a descriptive survey method to obtain the data used for the research.. Wimmer and Dominick (2014) suggested that this method is always preferred when looking to safe cost while trying to gather data from a range of sources. The population of the study was 80, which were the library staff of the Newgate University and school of midwifery. The sample size of the population was 60. Random sampling technique was used for the purpose of this study which suggests each person in the population has an equal and independent probability of getting chosen for the sample. The instruments used for this study was a closed ended questionnaire. Sixty copies of questionnaire were filled, returned and used for the analysis. The data collected was organized and analyzed using descriptive statistical tools involving frequency counts and percentages.

Result and Discussion

Research Question 1

Table 1 Responses on role of information networking in collection development

Statements	**SA**	**A**	**D**	**SD**	**TOTAL**
It enhances resource sharing	40 66.7%	20 33.3%	---	---	60 100%
Access to specialized resources	30 50%	28 46.6%	1 1.7%	1 1.7%	60 100%
Keeping up with emerging trends	45 75%	10 16.7%	2 3.3%	3 5.0%	60 100%
Facilities Collaboration	42 70%	13 21.7%	4 6.6%	1 1.7%	60 100%
Enhances Librarian's experience	32 53.3%	25 41.7%	2 3.3%	1 1..7%	60 100%

Key: Strongly Agree [SA], Agree [A], Disagree [D], Strongly Disagree [SD]

The examination of how information networking affects collection development is presented in Table 1 The results reveal that the majority of respondents with a very high proportion indicated yes, which suggests that it increases resource sharing. Of the data studied, 40 respondents (66.7%) strongly agree, and 20 respondents (33.3%) agree that it enhances resource sharing.

Research Question 2

Table 2: Responses on strategies being implemented during collection development processes.

Statements	SA	A	D	SD	TOTAL
Needs assessment	45 75%	10 16.7%	2 3.3%	3 5.0%	60 100%
Budgeting	30 50%	28 46.6%	1 1.7%	1 1.7%	60 100%
Collection analysis	32 53.3%	25 41.7%	2 3.3%	1 1..7%	60 100%
Selection	42 70%	13 21.7%	4 6.6%	1 1.7%	60 100%
Cataloguing and Classification	40 66.7%	20 33.3%	---	---	60 100%

Key: Strongly Agree [SA], Agree [A], Disagree [D], Strongly Disagree [SD]

Table 2 provides an examination of the tactics used in collection development procedures. 20 respondents (33%) and 40 respondents (66.7%) strongly believe that categorization and classifying is a key approach, according to the data reviewed.

The outcome reveals that the vast majority of respondents—with a very high percentage—said they concur, proving that cataloguing and categorization are tactics utilized in collection growth.

Research Question 3

Table 3: Responses on the role of librarian for effective information networking

Statements	SA	A	D	SD	TOTAL
Collaboration with other libraries and information providers	40 66.7%	20 33.3%	---	---	60 100%
Attend conferences and workshops	42 70%	13 21.7%	4 6.6%	1 1.7%	60 100%
Join professional organization e.g IFLA	45 75%	10 16.7%	2 3.3%	3 5.0%	60 100%
Be open to new ideas and perspectives	30 50%	28 46.6%	1 1.7%	1 1.7%	60 100%
Engage with colleagues on social media e.g LinkedIn	32 53.3%	25 41.7%	2 3.3%	1 1..7%	60 100%

Key: Strongly Agree [SA], Agree [A], Disagree [D], Strongly Disagree [SD]

Table 3 shows the analysis of the role of a librarian for effective information networking. From the data analyzed 40 respondents (66.7%) strongly agree, 20 respondents (33.3%) agree that it has collaboration with other libraries and information providers,

The results demonstrate that the majority of respondents expressed agreement, indicating that the primary responsibility of a librarian for efficient information networking is collaboration with other libraries and information providers.

Research Question 4

Table 4: Responses on how information networking influence collection development

Statements	SA	A	D	SD	TOTAL
Preservation via digitalization	42 70%	13 21.7%	4 6.6%	1 1.7%	60 100%
Increase demands for digital materials	40 66.7%	20 33.3%	---	---	60 100%
Changes collection management practices	32 53.3%	25 41.7%	2 3.3%	1 1..7%	60 100%
Identify user's need	45 75%	10 16.7%	2 3.3%	3 5.0%	60 100%
Currency and relevancy of materials	42 70%	13 21.7%	4 6.6%	1 1.7%	60 100%

Key: Strongly Agree [SA], Agree [A], Disagree [D], Strongly Disagree [SD]

Table 4 shows the analysis on how information networking influences Library's collection.
From the data analyzed 40 respondents (66.7%) strongly agree, 20 respondents (33.3%) agree that it has collaboration with other libraries and information providers. The majority of respondents confirmed their agreement that information networking has had a significant impact on the growth of collections.

Discussion of findings

Information networking enables librarians and information professionals to establish and maintain solid ties with other institutions, organizations, and people, it is a crucial tool for collection building procedures. The case study used has access to a variety of resources through information networking, including books, journals, and database.

Additionally, networking assist librarians in keeping abreast of new trends, innovations, and best practices in their organizations. Librarians may learn from one another and advance their own skills and knowledge through taking part in professional workshops, conferences, and interacting with other colleagues via network.

Information networking can also assist librarians fill in the gaps in their holdings and purchase new items that will better serve their users. The sources for resources that would be challenging to acquire through conventional acquisition procedures might be found by librarians through collaborating with other libraries and information providers.

Conclusion

In conclusion, information networking is a crucial tool for collection development processes in libraries and other information organizations. By networking, librarians and libraries may establish trusting connections with other institutions, groups, and people, have access to a variety of resources, and keep up with advancements in their field. Librarians can find gaps in their holdings and add new items that better serve their customers by working with other libraries and information sources. The research's findings, however, demonstrate that information networking plays a crucial role in collection development by improving resource sharing and having an impact on the library's collection, as demonstrated by the use of digital preservation in Newgate University library, which employ information networking for collection development processes. Further research could be carried out in investigating current issues encountered in the utilization of information networking in other sections of libraries.

Recommendations

Based on the findings of the study, the following recommendation were made:

1. Libraries should organize more conferences and seminars on emerging technologies that enhance collaboration between libraries.
2. Collection development procedures should be reviewed and adhered to, so as to improve its effectiveness and relevance.
3. Librarians should keep abreast with new trends in information networking and be actively involved in creating and maintaining relationships with their other colleagues.
4. Library materials should be stored in various format especially in digital formats to aid collaboration with other librarians and users.

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THE CONSTRAINTS ON THE ESTABLISHMENT AND MANAGEMENT OF QUALITY ASSURANCE IN EARLY CHILDHOOD EDUCATION IN NIGERIA

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Abstract

The constraints on the establishment and management of quality assurance in Nigeria early childhood education is the focus of the paper, since there is need to put adequate attention on this level of education as it serves as the foundation for all other levels of education all over the globe. Therefore, both the government, parents, teachers and other stakeholders in education should not leave any stone untouched for proper development and management of early childhood quality assurance education for both the scientific and other developments of the nation. The combinations of many factors such as lack of adequate facilities and infrastructure; textbooks production, mother tongue and foreign languages; over population of the learners; parents over exploitation by the proprietors; flagrantly abuse; inadequate control and mentoring; among others have constitute problems militating against proper development and management of this system of education as well bring about obstacles for appropriate intellectual and psychological development of Nigerian child. Proper solutions were put into consideration. It was recommended for the establishment of government-owned early childhood schools with adequate, qualitative and qualified teachers and to provide thorough supervision and mentoring on the private-owned school type to bring about quality assurance on the early childhood education in Nigeria so as to meet the 2030 Millennium Gold in education.

Keywords: Constraints, establishment, management, childhood education, quality assurance.

Introduction

The importance of home as fundamental in the education of the child cannot be over emphasized as it is often said that "the first teacher of any child is the mother". Therefore, there is need for quality education assurance in this level of education all over the globe. For more two decades, there had not be enough time for parents to carry out their traditional roles of rearing and bringing up children in the home with older relatives in the family.

Today, the pattern of early childhood education has changed with educated parents and those living in urban areas in paid employments spending much of their time outside home. Most of them can no longer cope with work and parental roles with each of these roles demanding full-time commitments. As a result, parental roles are transferred to early childhood education in schools. According to Ahia (2007), children have been raised throughout in history at homes by their parents and relatives. However, an increasing number of children around the world are enrolled in early childhood in order to guarantee their safety while parents are away at work in recent years. Today, more young children than ever spend part of the day in early childhood education. This has seriously mitigated the effect of the role of working mothers, especially in this present time schools and scarcity of house helps and has resulted in the establishment of more nursery schools and the increasing rate of enrollment of children in early childhood education in Nigeria (Ahia, 2007).

Education as a vehicle for change and prepares on individual for effective and efficient living within his community (Ekemizie, 2007). This preparation starts from the early childhood school in order to 'catch them young'. In recent times, the concept of pre-primary education has been expanded to include Early Childhood Care and Development Education (ECCDED) for children between 1-5 years. Lassa (1996) posited that pre-primary education incorporates kindergarten and day care practices at no-formal setting to formal nursery and primary school system. Whereas in Nigeria primary education is regarded as the foundation for other education system, the authors are of the view that early childhood education is the foundation of all other levels of education considering the fact that it facilitates learning at the stage of the child education. Early childhood education therefore, being the basic formative age of every child should be accorded adequate attention in terms of quality and quantity for improved standards, for any mishandle made this period will be indelible and has effect on the child's education throughout his life.

The Concept of Effective Preparation of Early Childhood Education in Nigeria

Early childhood education is the stepping-stone for all other levels of education. Performance in the other levels of education depends to a large extent on the foundation laid on this level. There is therefore, the need for efficient and careful planning and of pre-primary education. Effective preparation means careful planning, organization and administration of any programme to achieve its objective. According to Olaitan & Akpan (2003), no institution functions without proper organization and administration. Early childhood education according to Ekemezie (2007) is the education given to children in an educational institution prior to their entry into primary school. It is the education given to children between ages three (3) to five (5) years before primary school. It includes the nursery and kindergarten (FRN, 2004). According to Encyclopedia Americana (1989), early childhood education is a form of education for children of three through five years of age, prior to entry into the first elementary grade. This type of education help to build a background of experiment of academic skills. It is the foundation on which every other form of education is built, be it primary, secondary or tertiary. It is the bedrock of every other education system. Olaitan & Akpan (2003) defined early childhood education as a preparatory school which seeks and addresses itself to growth needs of children between the ages of three to five years such that they could successfully adapt to and satisfy the primary school need by the time they graduate out of the nursery school. It is specifically meant for children of preschool age and aims to achieve the objectives of the National policy on Education (FRN, 2004) in early childhood education such as: -

(i) To effect a smooth transition from home to the school
(ii) Prepare the child for primary level of education
(iii) Provide adequate care and supervision for the children while their parents are at work (on farms, in the markets, or office)
(iv) Inculcate social norms
(v) Inculcate in the child the spirit of inquiry and creativity through the exploration of nature, the environment, art, music and playing with toys
(vi) Develop a sense of cooperation and team spirit
(vii) Learn good habits especially, good health habits, and teach rudiments of numbers, letters, colors, shapes, forms etc. through plays.

As laudable and lofty as these objectives are, they cannot be achieved without proper implementation. No wonder the National Policy on Education (FRN, 2012) provided the following guidelines for proper implementation: The government is expected to;

a) Establish early childhood section in existing public schools and encourage both community/private efforts in the provision of pre-primary education.
b) Make provision in teacher education programs for specialization in early childhood.
c) Ensure that the medium of instruction is principally the mother tongue or the language of the immediate community.
d) Develop the orthography of many more Nigeria languages, and.
e) Produce text-books in Nigerian languages.

f) Ensure that the main method at this level shall be through play and that the curriculum of teacher education is oriented to achieve this; regulate and control the operation of early childhood education. To this end the teacher-pupil ratio shall be 1:25.
g) Ensure full participation of government, communities and teacher associations in running and maintenance of early childhood education facilities.

The proposed plans for proper implementation of the early childhood education are well articulated and laudable. However, there exist some discrepancies between government's initial intentions and what has so far been done. The simple fact that government is not actively involved in the management of this level of education has given rise to many problems in its implementation.

The Constraints to Effective Management of Early Childhood Education

Since the pre-primary schools are the foundation on which all other strata of education rest, care should be taken so that these levels of education perform their functions. Lack of enforced standards at this level has had several devasting consequences which if not checked can jeopardize the entire educational system in Nigeria.

1) **Non-Uniformity and Private Ownership**

Apart from operations in government-owned pre-primary schools, government cannot ensure and ascertain that the practice in privately owned pre-school institutions is uniform in terms of curriculum, books, methods and equipment. According to Obinaju (2003), government cannot even compare operations in these schools with the government-owned. There is so much disparity such that proprietors claim operations in their schools are better even when their knowledge of what is worthwhile is far from acceptable and recommended standard. Disparity is observed in the age of admission of children, number of hours spent in school, school subjects, quality of teaching, qualification of teachers, classroom space provision, outdoor games facilities and several other quality determinations.

Since most of early childhood institutions are owned by different private individuals, religion organizations and tertiary institutions hence, have profit-orientation and not character molding and transmission of formative knowledge as their aims. This level of education is not accessible and affordable to every Nigerian child because of high fees charged as a result. Despite several promises, government has not been able to establish pre-primary schools. Government has only been able to encourage private ownership and this has made access for children from the poor impossible.

2) Exploitation and The Use of Mother Tongue

Most parents have lost trust on many of the available early childhood institutions. Their lack of confidence on the ability of most of these schools to deliver forces them to 'scout for reliable schools' for their children. If accreditation were possible at this level of education, minimum academic standards would have been enforced and those unable to meet the required standards would be closed down. This is not presently the case as (those identified by parents as 'good schools' for their children take undue advantage of parental patronage to exploit them (Obinaju, 2003). Series of unreasonable levies and exorbitant fees are imposed on these parents who complain but pay all simultaneously since they do not have alternatives.

The use of mother tongue or the language of the immediate community as a medium of instruction in nursery schools according to Ede (2009) is a colossal failure. The use of mother tongue policy cannot be implemented due to the importance attached to English language in Nigeria. According to Ocho (2005) & Nwangwu (2003), interactions with parents make one to believe that most, if not all parents who send their children to any schools, do so for to speak English. It is erroneously believed that children who speak English from birth have undue advantage over those that speak mother tongue. Most nursery schools are privately-owned. Parents have freedom to send their children to school of their choice and nursery school

owners always make effort to please their clients. Government does not have the necessary wherewithal or have not deemed it necessary to enforce the mother tongue policy in nursery schools. As a result, English language and not mother tongue or language of the immediate community has become more popular in nursery schools in Nigeria. The use of mother tongue according to Nwangwu (2003) is tied up with the development of orthography of many more Nigerian languages and production of textbooks in Nigerian languages. But the importance attached to English language by Nigerian parents, the multilingual nature of Nigeria and the tendency of proprietors of nursery schools to satisfy the needs of parents who patronize them, have all constrained against the implementation of the mother-tongue policy.

3) Quality of Teacher and Infrastructure

Since the sole objective of establishing/opening nursery schools in Nigeria is profit making, proprietors engage all sorts of charlatans and unqualified personnel to teach in these schools. Most of those employed to teach are SSCE attempted, SSCE holders and on-the-job trainees. They do not have skills in pedagogy, yet this is a very important level in the education pyramid. The presence of unqualified teachers proves the simple fact that government has not made enough provisions for training of teachers for this level of education. This is confirmed by Ede (2007), when he asserted that;

One of the greatest banes of science education foundation at the nursery school level is the lack of qualified and committed teachers. Many nursery school teachers are school dropouts who themselves need to be taught. Many other teachers here are TCII and NCE holders, who teach all subjects (including science) at this level, and most of them are ill-equipped scientifically for such assignment, this issue of ensuring that play forms an important aspect of the teaching method is not being implementable since the right caliber of teachers are lacking.

The nature and quality of infrastructure in these nursery schools are not uniform but are of low standard in terms of the emotional, physical, social and psychological development of these children. Most of these nursery schools are located in the wrong places such as noisy unconducive and inaccessible area, some in uncompleted residential buildings or village halls. They are located sometimes near main roads with attendant incessant traffic noises, rubbish dumps on nearby waste land. There is absence of large green spaces for movement, and for physical and health education, building without decoration inside, narrow passages and darkrooms. The lack of all these is inimical to the general wellbeing and aptitudes of the children for learning.

4) Instructional Materials/Methods of Teaching

Instructional materials and methods according to Ekemezie (2007) imply all things provided by the teacher to the child in cause of teaching and learning and the methodology applied to make sure that the expected knowledge is passed to achieve the desired outcome. At this stage of a child, independent activities are encouraged through the provision of materials which the child can touch and play with. Children at this age learn concepts, skills and attitudes both consciously and unconsciously. As a result, Osuji (2005) recommended the play method as the best for teaching children at the nursery school level. According to Osuji (2005), young species of both animals and man learn to live in society through plays. Puppies and Kittens, even when along jump about, somersault and catch imaginary flies in the air. Osuji (2005) concluded that play for a child is like making an instruction practical for an adult. Most proprietors of these schools are untrained in pedagogy hence do not know the usefulness of play method in teaching. Children are therefore uncared-for and unattended to, most of the time.

5) Lack of Supervision by Government and Essential Services and Accountability

The management/operators of these nursery schools are not properly supervised. Government agencies do little or nothing as far as supervision of nursery schools is concerned. Operators are left to their whims and caprices with adequate control. They operate anyhow and this constitutes a challenge to this important level of education in Nigeria.

Most essential services like guidance/counselling services, transport services, clinic library and free-meal services are not provided in most nursery schools. All these helps to stimulate the learning environment of children hence when lacking, the child's learning pace may stagnate and he may suffer 'delayed milestone'.

Due to inadequate control and supervision by government and their agencies as discussed so far, private schools generally and nursery schools in particular have the problem of accountability. In the first place, to whom are they accountable? Those who have the idea of accountability at all try to render shoddy accounts at Parents Teacher Association meetings of their schools. These meetings most often are under the direct control of school operators (proprietors). To the government who is supposed to be in direct control of education of its citizenry, it is not clear what account is rendered by these sets of proprietors. Where it is suggested that regular reports be sent by proprietors to government, what is the assurance that contents of the report are not compromised. According to Obaniju (2003), if government primary schools could have the offertory to operate three (3) enrolments registers simultaneously for one school-one for federal inspectors, one for state inspectors and one for the day-to-day running of the school, what is the guarantee that private nursery operators will not surpass this level of dishonesty?

6) Inability of the Proprietors to Fulfillment of Government Promises

Most strategies promised by government in order to achieve the objectives of early childhood education in Nigeria are mere rhetorical without any concrete steps taken to actualize them. Such policy as provision of teacher education programme for specialization in early childhood education has not been actualized. Presently, most colleges of Education and faculties of Education in Nigeria with departments of early childhood and care education are not adequately equipped. The policy on mother tongue has equally been flagrantly abused without qualms. English language instead of mother tongue or the language of immediate community is still being widely used as a medium of instruction. Both the development of orthography and production of textbooks in Nigerian languages for this level of education are yet to be actualized, the teacher-pupil ratio of 1:25 which government specified is yet to be put into practice since nursery school proprietors/proprietresses have this insatiable desire for higher school population for them to make more profits, not minding the influence of this on the development of the children. As was discussed above, government has failed to guarantee adequate control and supervision of nursery schools in Nigeria since it has abdicated its responsibility to create an inspectorate division that should be charged with these responsibilities.

Conclusion

Early childhood is a very important aspect of child education to the Nigerian society. It does not only prepare the child for easy transition to primary school, it equally affords the working-class parent's opportunity to worry less of what becomes of their children when they are off to work. Recognizing the position of nursery education as the foundation for all other levels of education, government should strive to do the following: establish government-owned nursery schools, subsidize the training of qualified and the right caliber of teachers in nursery education and pedagogy, ensure proper supervision and control of private-owned nursery schools, ensure adequate accountability in the arcas of staff strength, population of pupils, infrastructure and facilities the enforcement of the use of mother-tongue/language of the immediate community.

Recommendations

The following recommendations were made:

1) Government should ensure that Colleges of Education and Faculties of Education with departments of early childhood and care development for training of nursery school teachers are well equipped.
2) Adequate efforts should be directed at effective monitoring and supervision of both the managerial and instructional services at this level of education. An inspectorate services at this level of education should be created for this purpose.

3) Adequate infrastructure and facilities necessary for running of early childhood schools should be provided by government and private initiatives to ensure standard and quality.
4) Government should make early childhood education accessible and affordable Nigerian by defraying the cost through either establishing government –owned nursery schools or giving quarterly grants privately owned schools.
5) The use of mother-tongue or language of immediate community should be enforced at this rung of our education ladder because people learn better, retain more and recall more if taught in the mother tongue (Ocho, 2005).
6) Adequate support and encouragement should be given to those who author textbooks in Nigerian language for this level of education.
7) Regular accountability to government by proprietors / proprietresses / managers of nursery schools should become a routine, to check standards.
8) One-year early childhood education should be made compulsory for every Nigerian child of ages between 3 – 5 years.

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PROSPECTS AND PROBLEMS OF COOPERATIVE SOCIETY ON THE SUSTAINABILITY OF SMALL AND MEDIUM ENTERPRISES (SMES) IN MINNA METROPOLIS

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Abstract
This paper delves into the critical nexus between Small and Medium-sized Enterprises (SMEs) and cooperative societies in the context of Minna Metropolis, Niger State, Nigeria. SMEs hold universal recognition for their pivotal role in job creation, economic stability, and poverty alleviation. Despite their immense potential, SMEs in Niger State grapple with systemic and managerial challenges, underscoring the need for sustainable solutions. Cooperative societies, on the other hand, stand as potential enablers of SME sustainability by offering financial support, knowledge sharing, and collaborative networks. Two substantial gaps in the extant literature were identified and are intended to be addressed by this study. Firstly, a methodological gap is rectified by employing a quantitative research approach, allowing for statistical generalization. Second, a geographical gap is bridged as research on cooperative societies' impact on SMEs in Northern Nigeria, particularly Minna Metropolis, remains limited, notwithstanding the region's unique cultural context. In conclusion, this paper underscores the importance of cooperative societies in bolstering SME sustainability in a dynamic economic landscape. It offers insights into the challenges faced by SMEs in Niger State, highlighting the need for cooperative support. Ultimately, the findings of this research will contribute to a broader understanding of SME sustainability and cooperative society engagement in the region, offering valuable guidance for policymakers, business owners, and researchers.

Keywords: Business sustainability, cooperative society, performance, Minna

Introduction

Cooperative society is an autonomous association of persons united voluntarily to meet their common economic, social and cultural needs and aspirations through a jointly owned and democratically-controlled enterprise (ICA, 2015). Cooperatives are based on the values of self-help, self-responsibility, democracy, equality, equity, and solidarity (Aremu & Adeyemi, 2020). In the tradition of their founders, cooperative members believe in the ethical values of honesty, openness, social responsibility, and caring for others. They adhere to a code of practice enshrined in the Universal Cooperative Principles (Open and Voluntary membership; Democratic Member Control; Member Economic Participation; Autonomy and Independence, Education, Training and Information; Cooperation among Cooperatives and Concern for the Community).

Cooperatives, as economic enterprises and as autonomous self-help organizations, play a meaningful role in uplifting the socioeconomic conditions of their members and their local communities, as well as running major international businesses (Ejeakanonu, 2017). They are found in practically all countries of the world, covering almost all the major sectors – including agriculture, forestry, fishery, finance (banking, microfinance and insurance), electricity (generation and supply), construction, mining housing, transport, manufacturing, trade and a wide range of social services. They help create, improve and protect income as well as they generate employment opportunities and contribute to poverty reduction (Aremu & Adeyemi, 2020).

Cooperatives focuses on the individual who wishes to start or expand a business including small and medium enterprise (SME) to better their socio-economic life and this is led by individuals who can be considered entrepreneurial (Agbasi, 2014). Clearly, cooperative societies from their antecedents have not only contributed to the development of small-scale business but are in themselves small scale businesses.

Over the years, cooperative enterprises have successfully operated locally-owned people-centered businesses while also serving as catalysts for social organization and cohesion. Cooperatives have over one billion members worldwide and can be found in sectors ranging from agriculture to finance to health (Philip, 2013). In Germany, the cooperative business model is seen to provide stability and security in tough times ', and is expanding into new fields within the SME sector.

Features of Cooperative Societies

The cooperative society is a legal identity to the society, a voluntary association which does not affect the entry or exit of its member. It is compulsory for the cooperative society to get registration because there is also limited liability of the members of cooperative society with an elected managing committee which possesses the powers to take decisions. Irrespective of tribe, gender and religion membership is open to all which also gives members right to vote, by which they elect members that constitute the managing committee (Oluyombo, 2013). The sole aim of cooperative society is to help the welfare of its members hence, the principal of service dominates it's working. Also, if any surplus is generated, it is shared among the members as a dividend in alliance with the bye-laws of the society.

Types of Cooperative Societies

In a study conducted by Ijaya (2022) he identified 7 distinct types of cooperative societies, of these cooperative societies are thus discussed in the succeeding paragraphs;

i. Producer cooperative society: This is the type of cooperative society formed in respect to the interest of small producers consisting of farmers, owners of fishing operations, land owners with the sole aim of increasing marketing possibilities and production efficiency.
ii. Consumer cooperative: This consist of businesses governed by consumers of a particular region for their mutual benefit with the view of providing daily necessary commodities at favorable prices rather than earing pecuniary profit.
iii. Marketing cooperative society: Producers who wish to gain reasonable prices for their output are the members of this society with an aim of helping small producers sell their product
iv. Housing cooperative society: They solve housing problems of members with limited income to construct houses at favorable costs. They allow members to make installment
v. Transport Cooperative Societies: Transport cooperative societies cater for the transit problems of their members as well as the external transportation of their goods. Sometimes, they carry out some activities for non-members for a price
vi. Input Service Cooperatives: These societies exist to supply its members with seasoned inputs at reasonable costs. It is mostly operated on Agro-business line payment of the houses the members purchases.
vii. Cooperative Thrift and Loan Society: The Roman Catholic teachers in Abeokuta started the first cooperative thrift and loan society in 1940. This type of society was designed for salary earners and primarily to take care of their old age and retirement. Members make regular thrift savings during the period they are under employment and an individual could also make other savings for special purpose if he wishes. Such savings could be children's school fees, vacation, leave, etc.

Cooperatives Societies and Promotion of Small and Medium Enterprises in Nigeria

Akinbode and Imhonopi (2015) cited ways cooperatives promote Small medium enterprises in our societies; cooperatives are known to have assisted in the establishment and development of SMEs through its entrepreneurship promotion; sustainable strategies, raising capital; provision of infrastructural facilities; small scale industrialization; and developing small holder agriculture.

Entrepreneurship Promotion: Entrepreneurship is seen here as the practice of starting a new business or reviving an existing business, in order to capitalize on new found opportunities. Cooperatives have long been identified and associated with promoting entrepreneurship not only on their jointly owned businesses but also in the individual business units of their members. Cooperatives by their nature and antecedents

have always been pro-entrepreneurship. The cooperative efforts in this regard, the former United Nations Secretary-General Boutros Boutros-Ghali, in his 1994 Report to the General Assembly, stated: Cooperative enterprises provide the organizational means whereby a significant proportion of humanity is able to take into its own hands the tasks of creating productive employment, overcoming poverty and achieving social integration.

Raising of Capital: Small enterprises have a great difficulty in obtaining capital, due to the poor match between their capital needs and the operating rules of the capital markets. Of all financing options available to SME, including a reluctant financial market and cash strapped government; cooperatives appear to be a most reliable option. Cooperatives, particularly financial cooperatives are response of the market itself to mobilize resources and make same available to SME and other users through appropriate institutional arrangement, thus explaining the recourse of some development agencies to channel funds meant for SMEs through cooperatives (OECD, 2015).

Provision of Infrastructural Facilities: Inadequate infrastructure has been a problem to SMEs in Nigeria like in other countries. Cooperatives have often been able to provide some of these facilities by establishing joint production facilities for members with full compliments of tools, electricity, and access road among others. Cooperative society as a common workplace, In other words, members have formed the cooperative society primarily as a form of "organized self-employment". Typical examples are collective agricultural cooperatives, small industrial cooperatives and entrepreneur's cooperatives. A good example of this can be pointed out in Anambra State traders and businessmen established an international market with all the necessary infrastructural facilities such as electricity, access roads, water supply, and security, among others. In some cases, cooperatives had integrated vertically to establish such common workplaces at the secondary cooperative levels.

Small Scale Industrialization: Cooperatives are also known to have increasingly promoted and supported small production and manufacturing enterprises, such as oil palm mills, maize processing facilities are often established as common work facilities or production cooperatives, in South East Nigeria. The handicraft and other local art ventures are also increasingly receiving the support and assistance of cooperatives in such states like Cross River and Akwa Ibom States. In production cooperatives that are established to promote industrialization members are usually the employees or workers of the cooperative.

Developing Smallholder Agriculture: Historically, agricultural cooperatives have been a successful and common aspect of rural life in Nigeria. These cooperatives have allowed for economic stability and provided a framework for local investment that is community based. Aside from traditional agricultural and livestock ventures, agricultural activities focusing on livestock, fishing, forestry, and other natural resource-based activities have also been effectively promoted. The attraction of agricultural cooperative to farmers is largely because of its role in farm inputs supply, marketing and processing and credit disbursements.

Challenges of Cooperatives in SMEs Promotion in Niger State

Admittedly, substantial evidence abound that has the Cooperative movement to be a formidable vehicle for wealth creation among its members prior and an antidote to most problems of SMEs. However, reports of failures of cooperatives in many states suggest that something has gone wrong. A visit to cooperative departments will show that substantial number of cooperatives that were formed ten to fifteen years ago have gone moribund as a result of poor performance and of being no longer relevant to the need of members. Some of these are as follows:

i. Lack of Proper Management: One of the major setbacks in establishing and running businesses in Nigeria is the lack of appropriate leadership and suitable management. For a Cooperative to succeed it is important that proper leadership be identified from its inception. It is the quality of leadership that is displayed at the Committee or Board level, which determines the success or failure of the Cooperative.

In Nigeria, the lack of proper leadership and management amongst cooperatives is among the principal reasons for their failures. It is sometimes very difficult to identify leaders at the grass-root level, and even if this is done, one will find that the same set of people dominate the rank-and-file membership, and are returned to office year after year. Also, employment of qualified and experience management is often handicapped because most primary societies do not have the funds to do so.

ii. Lack of Adequate Financing: Traditionally, Cooperatives have developed around persons of limited means who lacked the financial strength to adequately capitalize their organizations. Until recent years, the commercial banking sector had no faith in the Cooperative Movement, and credit from this sector to Cooperatives was virtually impossible. Government provided only minimal assistance through its lending agencies. It is agreed that self-financing is a hallmark of the cooperative movement. But self-financing has not helped much because the bulk of the membership is financially weak. In any case cooperatives without a functional self-financing feature and no reliable external finance will obviously not prosper.

iii. Poor Cooperative Integration: Cooperatives particularly local rural cooperatives developed in isolation of each other. In addition, inability of some state cooperative federations and other apex bodies to galvanize the producers and services cooperatives into efficient and effective business entities has retarded the development of the Movement (Ajayi, 2022). As a result, the stronger societies were not willing to help the weak, and the latter were left to the mercy of the private sector to seek finance at exorbitant interest rates and harsh terms of repayment.

iv. Government Policy: Cooperative legislation and the department of cooperatives have been put in place since 1935. This was followed later by the regional cooperative laws and regulations. The various legislations were meant to engender a vibrant and self-reliant movement (Edelia and Aslami, 2022). But this has not happened and most of cooperatives in Nigeria are only active when there are government projects or programs to benefit from. This problem of over reliance on the government stems from a faulty cooperative promotion model: The formation of cooperatives was not as a result of the felt needs of the people. Ejeakanonu (2017) has noted that there were two contradictory strands in the policy towards cooperatives. There was to be development from below, with learning by doing, mutual aid, fostering self-reliance, yet the development was to be planned, and carried out by government departments. The result has been the birth of a cooperative movement that is bereft of cooperative spirit.

v. Inadequate Utilization of Education and Training Facilities: Education and training, undoubtedly, holds the key to further and future development of the cooperative sector. The Nigerian cooperative movement are not maximally benefiting from education and training facilities available in the country. The economic and management of cooperatives is being taught in universities, polytechnic and several cooperative colleges at both federal and state levels but most primary societies lack the resources to take advantage of these, worse still, the societies leaders and administrators are seldom sponsored by the government and the apex cooperatives to avail themselves of these opportunities offered in the various institutions (Oluyombo, 2013).

Necessity for Cooperative Societies in Niger State

The economic insufficiency and social inadequacies gave rise to emergence of various cooperative societies among professions and trades. Examples of such cooperative societies can be found among men and women in different trades and businesses. Through the formation of cooperative societies, it becomes easy for people to come together and contribute to finance their businesses (Hussain, 2014). Cooperative society can be described as a form of business organization whereas body of persons with familiar passion jointly decided to establish an enterprise to advance their economic undertakings in term of manufacturing, circulation, buying and selling of commodities and offering of services for the supplying of welfare gains to the members (Effiom, 2014). According to Adedayo, et al. (2020) cooperatives perform an essential duty in aiding connection to capital, procurement, stockpiling and circulation of inputs and marketing of commodities, this invents jobs most especially for those living in agrarian communities and also permit less privilege people to organize for communal and economic assistance that could improve their ways of living.

Specifically, cooperative societies were established to provide social, economic value and administrative support to the members. One of the areas cooperative societies has impacted is SMEs and major area of intervention has been SME financing (OECD, 2015). This is because conventional bank sources of finance are often difficult for interested entrepreneur to access. Mobilizing individual funds for promoting enterprise formation became an option for cooperative societies since it fundamentally safeguards interest of members (Bakare and Akinbode, 2016). Despite that cooperative exist to provide members with better alternative services such as regular savings, business finances, short- and long-term loan, mentoring, education and entrepreneurial training including buying and selling of goods at reasonable prices (Nembhard, 2014; Oluyombo, 2013), its impact on the promotion of small and medium enterprises in Niger State has not been deeply explored. Most studies conducted on cooperative society focused on the membership development thus leaving a considerable knowledge gap regarding its impacts on the small and medium scales enterprises in developing economies.

Roles of Cooperatives in the Nigerian Economy

Nigeria's economy is based on cooperatives. With the formulation and enactment of cooperative law in 1935, the colonial masters began the cooperative movement in Nigeria. During this time, Western Region cocoa producers founded marketing associations with the sole purpose of curbing middlemen's excesses and insuring the marketing of pure and unadulterated cocoa. Mr. C.F. Strickland's report on the potential of cooperatives in Nigeria was accepted by the Colonial Administration in 1934, prompting the project. Mr. E.E.G. Haig was subsequently appointed as the first Registrar of Cooperatives (Okone and Ijere, 1986). The Cooperative Department was established in September 1935 at Moore Plantation in Ibadan, with a total workforce of one. The Cooperative Regulation was passed the next year, in 1936, and the Cooperative Department was separated from the Department of Agriculture. The registration of Gbedun Cooperative Produce Marketing Society Ltd in 1937 marked the beginning of the first Nigerian cooperative. While it is true that the expansion of Nigerian cooperatives has been sluggish, with membership expanding from 12 in 1935 to 400 to 500 in 1949, and 450,000 in 1975, with significant increases in membership in successive years, there is still room for more and faster improvement (Okorie and Ijere, 1986). In 2005, for example, there were 4.3 million members in 5000 Nigerian clubs. This very fact has gone deep into helping greatly to rekindle more interest in the study of cooperatives since it looks as if one has to be a member of a cooperative society before one can obtain any scarce and essential commodity. From 1935 to 1952, there was one central cooperative societies division located in the Department of Agriculture in Ibadan. The movement extended to other parts of the country from there, thanks to cooperative registration. However, as time passed, cooperative development became a regional issue, and the Cooperative Society Division of the Federal Ministry of Labor for the Federal Territory of Lagos was founded. Farmers' cooperatives flourished in the erstwhile Western Nigeria, which erected the famed Cocoa House, while cooperative credit societies and unions prospered in the Eastern half, which later metamorphosed into Cooperative and Commerce Bank Nigeria Limited. In the historic regions of the country, the establishment of cooperative societies and agricultural institutions contributed to some of the great achievements credited to the good leadership of each region between 1950 and the early 1960s (Ejeakanonu, 2007). Nigerian cooperatives are divided into two types: service and producer cooperatives. The producer cooperative's goals are to encourage the adoption of contemporary technologies and to use production to contribute to national development. Procurement, marketing and expansion services, loan disbursement, consumer products sales, and member education are all handled by service cooperatives. Agriculture, banking, credit, ago-processing, storage, and other cooperative activities have achieved significant growth. Individual members of organizations voluntarily operating in a given geographic area create service cooperatives, which are the closest to communities and are organized on a shareholder basis. Cassava farmers' cooperatives at the primary level, for example, provide a collection location for the farmers' production and negotiate per ton pricing of cassava (Frank *et al*., 2012).

Business Sustainability

Business sustainability is a multifaceted concept, encompassing various dimensions that are crucial for the long-term success and impact of businesses (Sivarajah *et al.*, 2020). The first definition revolves around environmental sustainability, emphasizing the responsibility of businesses to minimize their adverse impact on the planet. This dimension of sustainability involves implementing practices and policies that reduce carbon emissions, conserve natural resources, and promote eco-friendly processes throughout the supply chain. Companies committed to environmental sustainability aim to align their operations with ecological considerations, recognizing that a healthy environment is essential for their own continuity as well as the well-being of future generations (Yusoff *et al.*, 2019). In essence, environmental sustainability seeks to harmonize economic activities with the preservation of the planet's ecosystems.

The second facet of business sustainability is economic sustainability, which focuses on the financial health and resilience of a business over time. This definition centers on a company's ability to maintain profitability, generate consistent revenue, and effectively manage its financial resources. Achieving economic sustainability involves practices such as cost optimization, efficient resource allocation, and diversification of income streams. Businesses that prioritize economic sustainability strive to ensure that they can withstand economic shocks, sustain growth, and create value for their stakeholders in the long run. By maintaining financial stability, they are better equipped to invest in environmental and social initiatives, thus reinforcing the interconnectedness of the three sustainability dimensions.

Social sustainability, the third dimension of business sustainability, places a spotlight on the ethical and societal responsibilities of companies. It underscores the importance of fostering fair labor practices, promoting diversity and inclusion, and engaging positively with local communities (Rana, 2019). Businesses committed to social sustainability aim to create a positive societal impact while ensuring their operations contribute to the betterment of the societies in which they operate. This involves actions such as ethical sourcing, community development programs, and initiatives that improve the quality of life for employees, customers, and stakeholders. Social sustainability recognizes that businesses are not just economic entities but also integral parts of the communities they serve, and their actions can significantly influence social well-being. Business sustainability encompasses a range of dimensions that reflect an organization's commitment to operating in a socially responsible and environmentally friendly manner while ensuring long-term economic viability. These dimensions are often referred to as the "Triple Bottom Line (Khan *et al.*, 2023).

This proposed study therefore conceptualized business sustainability along the economic dimension which favors the ability of a business to meet its economic obligations and remain in operation for a long period of time. Considering this, a three years benchmark is considered by this study to assess the sustainability of the businesses under consideration.

Cooperative Society and Business Performance

Establishing the nexus between cooperative society and business sustainability as a measure of performance is imperative considering the need to enhance the survival, development and sustainability of SMEs in Minna, Niger state. In doing so the review of extant studies are presented as thus;

Mathias (2017) carried out study on relevance of business education and cooperative society to the performance of small and medium scale enterprises in Ekiti State. The article identified some challenges and suggested ways of strengthening this role. The paper argued that small and medium enterprises are the key to Nigeria's prosperity. Cooperative societies have not only contributed to the growth and development of small and medium scale business, and they are also seen as small-scale businesses. They have always promoted small business through entrepreneurial development, promoting the establishment of small-scale industries and so on. In spite of these factors, cooperative societies still faced with several challenges which include lack of adequate funds, illiteracy among its members, lack proper training/educational opportunities

which inhibits cooperative to contribute maximally in business promotion activities. It is therefore, opined that intensified efforts be made to overcome these aforementioned problem

Ezekiel and Sheriff (2018) investigated impacts of cooperative thrift and credit facilities on members' business output in Ogun State Both primary data and secondary data were used for the study. Multi–stage random sample was used to sample108 cooperative members. Data collected were analyzed using descriptive tools, budgetary analysis, log it and multiple regression model. The findings shows that majority (50.9 %) of the cooperators are male, 77.8 % were married, 59. 3 % were Christians while 98.1 % were educated. Majority (87.9 %) had experience ranging from 1 – 10 which is good in business. The total variables cost from business was estimated at N70, 983. 47, total fixed cost was N276, 271 and this accounted for only 79.56percent of the total cost. Returns on Investment (RRI), Profitability Index (PI), Return on Variable Cost (RRVC) and Operation Ratio (OR) were 181.62%, 0.63, 173.42% and 0.21 respectively. Also, some (48.1percent) of the respondents enjoyed loan benefit, while 40.7percent enjoyed business improvement benefit. The results showed that startup capital, labor and credit obtained were significant to cooperative members' access to credit. The result revealed that majority (72.2 %) of the respondents suffered from non-remittance of deduction by the government as their own challenges. The study concluded that cooperative credit societies is very productive and effective in helping members achieving their goals and also improve their standard of living. Cooperatives societies should encourage members in quick accessibility to loan.

Ogunmuyiwa et al. (2020) investigated the influence of cooperative financing on the performance and survival of micro scale businesses, in Ogun State, Nigeria. A survey research design was adopted to generate cross-sectional data, using a structured questionnaire as the research instrument. From a population of 1,165,848 a sample size of 384 was obtained using the Rao soft sapling size formulae. Regression analysis was used to analyze the data. The findings revealed that cooperatively sourced finance has a positive and significant effect on operational performance of micro scale enterprises but no significant effect on business survival. This implies that survival of micro scale enterprises is beyond financing. The study recommends that cooperative societies, beyond financing should assist members in the area of general management of activities such as records keeping to improve the operational performance as well as the survival rate of businesses in Ogun State, Nigeria.

Ojiagu and Ezemba (2021) investigated cooperative entrepreneurship and the social empowerment of rural dwellers in Anambra state, Nigeria. The objectives are to determine the nature of the relationship that exists between entrepreneurial orientation and self-actualization of rural dwellers and to ascertain the nature of the relationship between risk-taking and autonomy of rural dwellers in Anambra state. A descriptive survey research design was employed and data were analyzed with frequency distribution, mean, and standard deviation. Pearson Product Moment Correlation (PPMC) was used to test hypotheses at a 5 % level of significance. Findings revealed that there is a statistically significant relationship between entrepreneurial orientation as well as risk-taking and autonomy, the results of the findings showed that exploitation of new business opportunities by cooperative entrepreneurs contributes to the realization of their abilities. It was recommended among others that Cooperative Entrepreneurship should be encouraged at all levels (local, regional and national levels) because it remains a viable strategy in achieving self-actualization and reducing unemployment.

Michael (2021) investigated impact of cooperative and thrift societies on small business performance in Nigeria. The study was conducted among cooperative and thrift members in Six (6) Local Government Areas in Ogun Central Senatorial District (Ifo, Ewekoro, Obafemi/Owode, Abeokuta North, Abeokuta South, and Odeda). The study adopted survey research design and a sample size of 369 was drawn from a population of 4,836 members of cooperative societies in the Six (6) Local Government Areas using judgmental sampling technique. Descriptive statistics (DS) and Ordinary Least Square (OLS) were employed to test the hypotheses formulated using 5% level of significance. Result: Result revealed that

Financial Services (FIS) has significant effect on small business performance (β = 0.4131; tc = 5.7988; p < 0.05). Also, non – Financial Services (NFIS) has significant effect on small business performance (β = 0.2708; tc = 3.2023; p < 0.05). In addition, Socio-economic Factor and Membership (SEF/MEM) has significant effect on performance of small businesses (β = 0.1817; tc = 2.6416; p < 0.05). Patronage (PAT), also has a significant effect on performance of small business (β = 0.7919; tc = 15.8113; p < 0.05). Implications: Based on these findings, the study concluded that FIS, NFIS, SEF/MEM and PAT have significant effect on the performance of small businesses in Nigeria. Thus, these elements are the critical factors influencing the performance and growth of small businesses in Nigeria. Value: Small businesses as well as SMEs in general can leverage on the dimensions of cooperative used in this study to improve performance of their enterprises.

Olalekan et al. (2021) examined the role of cooperative societies in advancing small and medium scale enterprises in Osun State. The study adopted qualitative research method through in-depth exploratory design to explain 'what' and 'how' rather than mere prediction. A comparative multiple case study was used as it closely links empirical observations with existing theories to explore the effect of cooperative societies on enterprise creation and expansion and its impact on the advancement of SMEs in Osun State, Nigeria. Four cooperatives were selected and studied. Findings affirmed the significant role played by cooperative societies in advancing SMEs in Osun State. The study concludes that cooperative society's intervention in providing micro loans to members for investment purpose in the area of enterprise formation and expansion is encouraging and should be sustained to improve the prosperity of individuals in Osun State. It was recommended that the promoters of cooperative societies in the State and Nigeria must sustain and increase efforts towards advancing SMEs through the provision of financial facilities to members.

Sule (2021) this study investigated the impact of loan on agriculture artisan and fisheries business. In this paper questionnaire was used for data collection and the data collected were analyzed using descriptive statistics.150 agriculture artisans including fishermen participated in the study. The result of this study indicated that identified various sources of finance available to agricultural artisans including bank, non-bank financial institution, families and friends, personal savings, and retained profit. The result of the study further identifies some challenges faced by artisans in accessing loan facilities among which are interest rate, inadequate experience, high collateral, lack of information flow, among others. Also, the result from this study revealed that loan has on agriculture artisans and fisheries business. Finally, the result indicated the poor access to loan affect artisans' operations in Nigeria. Based on these findings' conclusions were drawn and recommendation made.

Garandi and Hassan (2020) investigated the effect of participation in cooperative society on SMES activities of members in Mubi metropolis, Adamawa state, Nigeria. In order to achieve the objectives, this study was guided by three research hypotheses. Structured questionnaire was used to collect data from randomly selected 376 SMEs operators comprises both members and non-members of cooperatives society in Mubi metropolis. The data collected were analyzed with simple percentage, frequency table and t-test analysis. The results of analysis established that the members of cooperative that operating SMEs in Mubi metropolis have significant access to finance such as loan facilities than other SMEs operators. Also, those SMEs operators that were members to cooperative society gained significant access to modern tools and raw materials than non-members. However, the SMEs operators in Mubi metropolis were found less effective in accessing market information for positioning their business. The study concluded that being members of cooperative offers positive advantages for the SMEs operators to develop their enterprises. The study recommends among others that others non-members of cooperative that operate SMEs in Mubi should be encouraged to join the cooperative. Also, there should be training of SMEs operators on how to use information technology for the positioning of their business.

The review of extant study in this area presented two important gaps namely; i) Methodological Gap; large number of the reviewed studies adopted qualitative approach in the investigation of cooperative society

operations, programs and facilities on the impact of SMEs. This study seeks to address this important gap by adopting a quantitative approach which will allow for generalization due to its statistical approach, ii) Geographical gap; what the second gap would seek to address is a geographical gap in the sense that very few articles of cooperative review took place in Northern Nigeria, the gap is important because culture has effect on cooperative societies in Niger State and how members of the societies utilize the money that will be collected might be differ from their southern counterparts.

Conclusion

In summary, the primary objective of this proposed study is to bridge existing gaps within literature and contribute valuable insights towards addressing the issues relating to the sustainability of SMEs in Minna, Niger state. Employing a quantitative research design and a survey method, the study aims to gather data from members of cooperative societies through face to face administration of structured research questionnaire, the study will conceptualize cooperative society activity into three important dimensions, each of which will be graded on a point Likert scale. Additionally, business sustainability will be regarded as a composite construct and assessed through a set of three items. The collected data will be analyzed using both descriptive and inferential statistics in order to establish the effect as intended by the research. It is anticipated that the findings of this research will furnish significant insights into critical matters, specifically those pertaining to SMEs sustainability in Minna and Nigeria at large.

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EXPLORING THE NEXUS BETWEEN ORGANIZATIONAL ETHICS AND JOB SATISFACTION: A CASE STUDY OF EXAMINATION AGENCIES IN NIGERIA.

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Abstract
In the context of a global paradigm shift like work, employee satisfaction has emerged as a crucial concern for organizations across various sectors. The repercussions of employee dissatisfaction, including absenteeism, poor work quality, low productivity, and psychological distress, have underscored the significance of addressing this issue. This paper delves into the intersection of organizational ethics and job satisfaction, recognizing the pivotal role of employee contentment in achieving organizational goals and objectives. Organizations strive to cultivate a satisfied workforce to eliminate barriers to work satisfaction and ensure the commitment of their employees. Job satisfaction encompasses monetary rewards and factors such as contentment with supervisors, co-workers, and the work itself. This study particularly emphasizes the importance of employee satisfaction in non-governmental organizations (NGOs) and governmental bodies, highlighting their role in fostering an entrepreneurial mindset that drives innovation, collaboration, and social impact.

Drawing on previous research, this paper identifies three significant gaps in the existing literature: a conceptual gap, a geographical gap, and a population gap. To address these shortcomings, the proposed study aims to investigate the causal relationship between organizational ethics and employee satisfaction in Nigeria's examination bodies, focusing on branches in Minna Metropolis. The proposed study adopts the conceptualization of Brooks and Cunn (2012) to assess the ethical behavior of the management of examination bodies in Minna and its impact on employee satisfaction. Job satisfaction is conceptualized in line with Smith et al. (1969), incorporating three additional dimensions: recognition, working conditions, and management and company policies. These dimensions are deemed critical in evaluating the extent to which examination body management fulfills its contractual obligations to staff. In conclusion, this paper provides a conceptual foundation for exploring the relationship between organizational ethics and job satisfaction, laying the groundwork for a forthcoming study in the context of Nigerian examination agencies in Minna. The proposed study aims to contribute significantly to the existing body of knowledge, informing best practices and policies in the realm of employee satisfaction. The study will utilize a structured questionnaire and employ linear regression analysis to draw insights and implications for both academia and practice.

Keywords. Organizational ethics, Job satisfaction, Fairness, Compassion, Integrity, Responsibility.

Introduction
Considering the global paradigm change in the nature of work, issues such as boredom and frustration resulting from lack of interest and involvement have led to absenteeism, poor quality work, low productivity from the manager's point of view, and psychological distress on the part of the employees (Karatepe *et al*., 2021). In the face of these global changes and the need for highly sustainable performance by organizations, employee satisfaction has become a greater point of discussion among vital internal and external components of organizations in all spheres of life. Employee satisfaction is therefore imperative in achieving goals and objectives set by organizations (Memon *et al*., 2020).

In this vein, organizations try to create a pool of satisfied workforce to ensure that work-related obstructions are eliminated as a means to ensure satisfied and highly committed employees who drive their operations

and ensure that set goals and objectives are met. Job satisfaction is hence considered a critical subject in both study and practice as the opposite of this: job dissatisfaction abruptly ushers' negative behaviours such as quitting and negligence, absence, and strike actions, hence negative impact on organizations (Wang *et al.*, 2020). Employees are often satisfied when they are adequately compensated for their completed work (Kang and Lee, 2021). Other than monetary rewards, job satisfaction encompasses a number of benefits and requirements such as contentment with supervisors, co-workers, and work (Norbu and Wetprasit, 2021). In NGOs and governmental organizations, employee satisfaction remains crucial for fostering an entrepreneurial mindset that drives innovation, collaboration, and social impact. Satisfied employees who are passionate about the organization's mission, empowered to take initiative, and supported in their efforts can contribute to entrepreneurial endeavors within these organizations, ultimately leading to positive social change and public service delivery (Ingsih*et al*., 2020). Employees with better job satisfaction believe that their employer recognizes the quality of their work and that the company has a bright future ahead of it; as a result, they are more devoted to the company, are more productive, and have higher retention rates (Naseer *et al.*, 2021). Considering the importance of job satisfaction in achieving a firm's goals and objectives, it is therefore important that job satisfaction is treated accordingly by giving attention to organizational ethics as an antecedent of organizational and behavioural outcomes.

Organizational Ethics

Organizational ethics (OE) refers to a set of rules and principles that determine how employees should act in the organization (Juneja, 2022). OE are the standards that organizations and businesses promote and follow when it comes to human behavior (Fletcher, 2022). OE is a philosophy of moral principles and the application of ethical norms under which a firm operates (Bhasin, 2021). Organizational ethics (OE) can also be defined as the values, norms, principles, regulations, and strategies linked with organizational activities and business situations that impact and guide moral choices in organizational activities and business situations (Marie-Catherine, 2015).

Naeche (2021) considered Organizational ethics (OE) as a construct that encompass the management, employees, and customers of an organization and defined it as a set of moral principles that govern how a firm management handles its customers and employees. Finally, Vocino and McClaren (2021, emphasis added) adopt a more legalistic definition of Organizational ethics (OE) by describing it as the extent to which the management of an organization communicates honestly and in good faith, as well as completes *contractual responsibilities (to employees)* in a timely fashion. Furthermore, values such as fairness, compassion, integrity, honuor, and responsibility are manifested in organizational structures and behaviours.

Organizational ethics (OE) has garnered greater research and practical interest in the past decades considering the complexity in organizations, a sequel to this has led to numerous conceptualizations of the concept, this is aimed at grasping more understanding of it within different context. This ubiquitous concept was discussed as a driver of job satisfaction in line with the organizational ethical climate of Victor and Cullen (1990), it was emphasized that ethics significantly influence the act of employees at all level within an organization. In view of this, Ahmed et al. (2012) also drawing from Kohlberg's (1981) ethical theory conceptualized organizational ethics into three dimensions that is i) Egostic; this ethical dimension depicts the consideration for self over others. An organization entirely designs its policies, procedures and practices in line with the fundamentals of deriving maximum benefit which is usually profit maximization without consideration for the motives of others ii) benevolence; this climate emphasizes on caring as an ethical criterion where individuals show interest in the well-beings of others and decisions are totally made base on the interest of others within the organization and, iii) principled, this climate focuses on the general acceptance of rules, law and codes determined by the organization and competent authorities. These established laws and codes serve as criteria for decision-making in an organization (Lee *et al.*, 2018). These three sub-constructs are the critical factors that influence behaviour in an organization.

In furtherance of the conceptualization of Organizational ethics (OE) by Ahmed et al. (2012), Wesarat et al. (2017) conceptualized organizational ethics into two distinct dimensions that are i) ethical climate; this generally emphasizes common insights on ethically acceptable behaviours and in dealing with issues related to ethics through organizational practices and procedures and ii) ethical culture, this conceptualization clearly groups the dimensions of Ahmed et al. (2012) along ethical climate as discussed by Victor and Cullen (1981) and further identified ethical culture as an integral aspect of OE. Ethical culture encompasses "the experiences, presumptions, and expectations of how the organization is preventing unethical behavior and promoting ethicality" reflects a set of formal and informal organizational control mechanisms that aim to influence ethical behaviuor of an organization's members, It simulates ethical conduct (i.e. positive behaviuor), foster individuals to perform ethically and avoid wrong doing, it plays a crucial role in enhancing an organization's ethical performance as well as monitoring sustainable ethical business practices and satisfaction.

Another notable conceptualization of Organizational ethics (OE) is that of Brooks and Cunn (2012), they considered OE as a construct consisting of ethical values which include i) fairness, this relates to justices in both work output and work process that is, distributive and procedural justice. There should be fair treatment of workers in relation to their pay, incentives, opportunity for growth, and work distribution ii) Integrity, is a moral concept that requires leaders to act according to moral values, norms and rules (Bauman, 2013). Given that most employees look to their leader for direction on how to behave, it is a highly regarded as a quality trait. Setting expectations for appropriate behaviuor is made easier when the firm's leader exemplifies the company principles in their conduct. This ensures that leaders are reliable, trustworthy, and honest in carrying out their responsibilities. iii) compassion; leaders who are compassionate constantly exhibit emotional intelligence and prioritize the needs of others over their own. For the purpose of fostering positive relationships and ensuring a more empathic work environment, they develop a tuning with other people's ideas and feelings (Sharma, 2022), and iv) responsibility; responsible leadership emphasizes the concern for all stakeholders as a means to enhance the economic, social and environment objectives advance by an organization. These are largely shared by an organization and provide a framework for an organization's ethical disclosure across the entire organization and an extensive nature of its being; its impact positively and negatively on others through management dictates. These are demonstrated by business owners, executives, top-level officials, or managers in a bid to create emphatic work environment. Organizational ethics (OE) are best demonstrated through fairness, compassion, integrity, honuor, and responsibility (Suttle, 2019).

Job Satisfaction

The term job satisfaction was brought to the limelight by an American Vocational Counsellor Robert Hoppock in the year 1935 (Rafferty and Griffin, 2009). Hoppock (1935) described job satisfaction as any combination of psychological, physiological, and environmental circumstances that causes a person truthfully to say "I am satisfied with my job". From a human resources perspective, job satisfaction refers to a person's feeling of satisfaction on the job, which acts as a motivation to work. It is not the self-satisfaction, happiness, or self-contentment but the satisfaction on the job (Santos, 2020).

Job satisfaction represents the positive emotional reactions and attitudes an individual has toward their job (Aznan *et al.*,2019). Job satisfaction can also be defined as an individual's behaviour at work, and it is further postulated that employees enter an organization with certain expectations and desires that must be met, and it is compared in terms of rewards and recognition, resulting in a positive and negative attitude toward their work (Mittal and Bhakar, 2018).

Organizational behaviour studies consider satisfaction to be a crucial determinant of performance, with strong job satisfaction expected to have a favourable impact on overall organizational performance (Che *et al.*, 2018). Job satisfaction is hence considered a critical subject in both study and practice as the

opposite of this, that is job dissatisfaction abruptly ushers' negative behaviours such as quitting and negligence, absence, and strike actions, hence negative impact on organizations (Wang *et al.*, 2020).

Smith *et al.* (1969) conceptualized job satisfaction into five dimensions that is i) Pay: This refers to the extent to which employees are satisfied with their remuneration packages (Celluci and DeVries, 1978). ii) Supervision: This dimension refers to the extent to which employees are satisfied with how their immediate supervisor or manager treats them (Celluci and DeVries, 1978). iii) Work: This dimension refers to the extent to which employees are satisfied with the kind of work they perform on a daily basis at their organization (Celluci and DeVries, 1978). iv) Promotion: This refers to the extent to which employees are satisfied with their ability to advance up the ranks at their organization (Celluci and DeVries, 1978). v) Co-worker: This dimension refers to the extent to which employees are satisfied with their relationship with other co-workers within the organization (Celluci and DeVries, 1978). These five dimensions are measured using Celluci and DeVries's (1978) 16-item job satisfaction scale.

Following the conceptualization of Smith *et al.* (1969) is the conceptualization by Locke (1976). In line with the globally recognized five facets of job satisfaction by Smith *et al.* (1969). Locke (1976) recognized three additional facets which are i) recognition; which depicts the act of acknowledging and appreciating an employee's work. The main goal of employee recognition is to let employees know that the effort they put into their job and the work results they achieved are valued and appreciated, ii) working conditions: this dimension depicts the influence of environmental and organizational factors on employee's well-being. This includes the provision of the necessary work atmosphere which aids employees in effectively carrying out their jobs, and iii) company and management; this facet refers to the extent to which employees are satisfied with their leadership and organizational policies (Locke, 1976).

Finally, the conceptualization of job satisfaction by Robbin and Coulter (2009). Robbin and Coulter (2009) also conceptualized job satisfaction into five dimensions as follows: i) Wages: Wages refers to the extent to which employees believe their wage is reasonable, that accepted benefits in addition to salary are reasonable, and the level of well-being provided is reasonable (Robbin and Coulter, 2009). ii) Work: Work refers to the extent to which employees find the work they do exciting and enjoyable (Robbin and Coulter, 2009). iii) Promotion: Promotion refers to the extent to which employees believe they are part of a transparent promotion system in which promotions are based on merit and are available to all employees without prejudice (Robbin and Coulter, 2009). iv) Leadership: This dimension refers to the extent to which employees believe that the organization's leadership has their best interests at heart (Robbin and Coulter, 2009) v) Co-workers: This dimension refers to the extent to which employees believe that their co-workers are willing to work together to achieve the organization's goals and objectives (Robbin and Coulter, 2009). Robbin and Coulter (2009) described these five dimensions as representing the financial and non-financial aspects of work satisfaction.

Organisation ethics and Job satisfaction

Ahmed et al. (2012) investigated the relationship between Organizational Ethics and Job Satisfaction among 230 banks employees working in both public and private sector in Faisalabad, Pakistan. Organizational Ethics was conceptualized by using three dimensions (i) egostic (ii) ethical climate and (iii) principled. Organizational ethical climate was measured using ethical climate scale of Cullen et al., (1993). Job Satisfaction was conceptualized by job satisfaction pay, supervisor, Work, promotion and co-worker and was measured using a 20-item scale developed by Cellucci and Devries (1978). The study used a survey method to collect data from 230 bank employees in Faisalabad, Pakistan. The data collected was analysed using correlation analysis. The study revealed no relationship between a principled climate for ethics and job satisfaction. Job satisfaction has a negative relationship with an egoistic climate and it is passively related to a benevolent climate. The study recommended that organisations should enhance the care climate in order to ensure a greater number of employees.

Taking the lead from Ahmed et al. (2012) Muhammed et al., (2012) examined the relationship between Islamic Work Ethics and Job Satisfaction among 80 public nurses in Islamabad, Pakistan. The IWE was conceptualized using 17 item instruments (i) Laziness is a vice (ii) dedication to work is a virtue and (iii) Justice and generosity in the workplace are necessary conditions for societal welfare etc developed Ali (1992). Job Satisfaction was measured using a 3-items scale developed by Dubinsky and Harley (1986). The study used a self-administered questionnaire method. Data was collected from 80 health care nursing staff from ten private hospitals, in Islamabad, Pakistan. Data collected was analysed using regression analysis. The study revealed that there is a direct, positive, and significant relationship between IWE and job satisfaction, and organization ethics should be emphasized as a means to ensure employee satisfaction.

Marri et al., (2012) investigated the effect of Islamic Work Ethic (IWE) on Job Satisfaction among 397 government institutions in Islamabad, Pakistan. In the study job satisfaction was measured using five item scale used by Dubinsky and Herley (1986), Seventeen items were used to measured Islamic Work Ethic (IWE) the instrument was developed by Ali (1992). Data was collected from 25 public and private research extension in agriculture sector in Islamabad, Pakistan. Data collected was analysed using correlation analysis. The findings indicate a positive relationship between IWE and job satisfaction.

Dimitriou Christina (2012) this study examined the impact of hotel business ethics on job satisfaction among 217 hotel employees United States and Europe. Business ethics was measured using the ethical climate scale developed by Schwepker (2001) consisting of seven items. Job satisfaction was conceptualized using six dimensions (i) satisfaction with pay, (ii) company policies and support, (iii) supervision, (iv)fellow workers (v) chances for promotion, (vi) customers by Walker, Churchill, and Ford (1977). The study used a survey method. Data was collected 217 hotel employees in, the United States and Europe. The data collected was analysed using correlative analysis. The study a revealed positive relationship between hotel employee's perception of their organization's ethical climate and their job satisfaction.

Hafiz et al., (2013) investigated the Islamic Work Ethics and Employee Job Satisfaction among 80 employees in Islamabad, Pakistan. IWE was conceptualized using 13-item instruments (i) I believe dedication to work is a virtue and justice and generosity in work workplace are necessary conditions for society's welfare, I think human relations should be emphasized and encouraged etc and 13 short version instruments were used also developed by Ali (1992). Employment Job Satisfaction was measured using six six-item scale (i) I am satisfied with my present job (ii) I find real enjoyment in my work and, (iii) most days I am enthusiastic about my work. Developed by Agho, Prince and Mueller (1992). The study used a questionnaire method. Data was collected from 80 full-time employees from both public and private organization in Islamabad, Pakistan. Data collected was analysed using both regression and correlation analysis. The study revealed a direct relationship between IWE and EJS.

Najjari and Seyed (2013) analysed the relationship between Islamic Work Ethics and Job Satisfaction among 132 employees, Payan Noor, Iran. Job satisfaction was conceptualized using nine dimensions (i) working conditions (ii) interaction with patients/co-workers/manager (iii) the work itself (iv) Remuneration (v) self-growth and promotion (vi) Praise and recognition, (vii) Control and responsivity (viii) Job security and (ix) leadership styles and organizational policies developed by Adamson (1995) IWE was conceptualized using 4 dimensions (i) Laziness is a vice (ii) dedication to work is a virtue developed by Ali (2005). Or (i) pay, (ii) autonomy, (iii) interaction, (iv) professional status, and task requirements and organizational policies. The study used a survey method. Data collected 132 employees of manufacturing companies in Payan, Iran. Data collected was analysed using SEM analysis. The study revealed that IWE has a positive influence on the Job satisfaction of manufacturing employees.

Gap in Literature

The review of extant studies with regards to this study's variables revealed three important gaps namely; conceptual gap, geographical gap, and population gap. Firstly, the conceptual gap, gap relates to the various ways in which the concept of OE was conceptualized. More than 70% of the studies reviewed

conceptualized OE in line with the conceptualization of Victor and Cullen (1981) and as such assesses OE along egoistic, benevolence, and principled culture, this study intends to bridge this gap by assessing OE through the core constructs of ethical values which are fairness, integrity, compassion, and responsibility.

This will allow the researcher to assess the extent to which the leadership of these examination agencies uses internalized ethical values in discharging their duties and ensuring the satisfaction of their staff. Secondly, the majority of the studies reviewed were carried out in the Middle East or Asia, with little evidence from the African and Nigerian context, this study seeks to bridge this gap by surveying the managers and junior cadre staffs of the examination agencies in Minna metropolis. Lastly, the population gap was identified, this gap relates to the population considered for the study, a large number of the studies reviewed took samples from the private sector therefore grossly neglecting the importance of ethics in public sector organizations. Considering the need to keep the public sector employees satisfied, improve efficiency and productivity, and ensure that justice is enacted, this study seeks to investigate the impact of OE on the satisfaction of examination agencies employees in Minna metropolis.

Proposed study

There seems to be growing dissatisfaction among employees of Nigeria's various examination bodies in recent times. This is evidenced by the fact that as recently as 2020, employees of the West African Examinations Council (WAEC), as well as the National Examinations Council (NECO) threatened to go on strike due to "stagnation of officers in the council" and the management's "nonchalance" in implementing "the policy on non-grata among others" (Inside Business, 2020). This growing level of dissatisfaction among employees of Nigeria's examination bodies does not bode well for the long-term performances of these bodies particularly as it relates to ensuring the integrity of examinations which is their paramount mandate.

A review of recent studies on these examination bodies revealed that their employees are a forgotten stakeholder. Most of the studies focused on the performance of students in the various examinations administered by these organizations (e.g., Afolabi *et al*., 2017; Ogechukwu, 2019; Odobo and Egbuchu, 2020) as well as recommendations on how these organizations can improve their service delivery to their clients (e.g., Okafor *et al.,* 2018). By neglecting the condition of employees in these organizations, extant studies have overlooked the fact that employees are critical for ensuring the integrity of examinations being administered as well as the quality of any auxiliary services being provided by these examination bodies.

This proposed study seeks to address this significant gap in existing Nigerian literature by investigating the causal relationship between organizational ethics being practiced in Nigeria's examination bodies and the satisfaction of the employees of these bodies. Specifically, this investigation will take place among the branches of these examination bodies in Minna Metropolis.

This proposed study will therefore adopt the conceptualization of Brooks and Cunn (2012), this conceptualization was selected among others due to its identification of leadership role as a critical factor for the implementation and practice of ethics. This will enable the researcher to assess the extent of ethical behaviour of the management of the examination bodies in Minna and how this has influenced the satisfaction of their staff.

In this proposed study, job satisfaction will be conceptualized in line with Smith *et al.* (1969) eight dimensions of job satisfaction. The three added dimensions which are recognition, working conditions, and management and company policies will be adapted. These three dimensions are critically assessed to be management-level duties and influences and so, therefore, will give a clear insight into the extent to which the examination bodies management meets the contractual obligations of their staff. This is considered a vital path in answering this study's question and meeting its aim and objectives.

Proposed Conceptual Framework

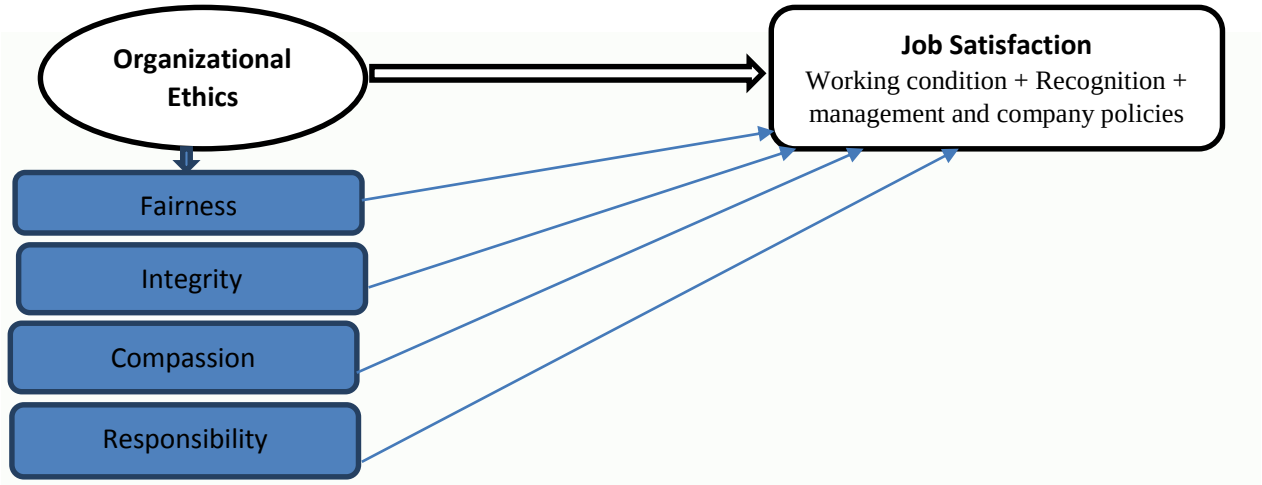

Figure 4.1 Proposed Conceptual Framework

As it can be seen from Fig 4.1 which presents the study's proposed conceptual framework, Organizational ethics (OE) will be conceptualized into 4 dimensions i.e., fairness, integrity, compassion, and responsibility, while Job satisfaction (JS) will be conceptualized in 3 dimensions. The three dimensions of Job satisfaction (JS) will be concatenated and the cumulation will be treated as a single construct for Job satisfaction (JS). Each variable of Organizational ethics (OE) will be assessed alongside the cumulative Job satisfaction (JS). This will allow for a deeper, more critical, and logical assessment of how the management of the examination bodies in Minna Metropolis fulfil the contractual rights of their staff considering ethical values of fairness, integrity, compassion for staff, and responsibility, and the resultants of this on their self-assed satisfaction.

In order to theoretically establish and confirm this relationship which will serve as an underpin for this proposed study, a critical evaluation of each of three important theories; Organisational Justice Theory, Cognitive Dissonance Theory, and Ethical Climate Theory (ECT) will be done, this is aimed at ensuring a pick that will clearly explain the relationship between the variables considered in this study.

In terms of methodology, a survey method will be employed by this study, a sample will be drawn from the larger population to represent the entire population. In doing this, Taro Yamane (1967) was employed to statistically draw the sample size from the population frame, 2-stage sampling will be employed with the first being cluster sampling indicates that each examination will be identified as a cluster with unique characteristics then followed by systematic simple random technique in selecting the respondents for the study. The proposed questionnaire (see Appendix) consists of two major parts; the first section is drafted to collect primary data from the study's respondents while the second part will collect data in regards to the study's main variables. Sub-sections with items for each dimension of organizational justice: Fairness, Integrity, Compassion, and Responsibility as well as the construct of employee satisfaction (overall satisfaction; working environment, support, appreciation, reward, policies, and procedure). The reliability and validity of which will be determined using Cronbach alpha and Average variance extracted respectively. Data collected for the study will be analyzed using regression analysis.

Conclusion

This conference paper assesses the relationship between organizational ethics and job satisfaction from a conceptual perspective of which the findings from this and gaps found in extant literature has informed the proposal of a study to seek the investigate the impact of organizational ethics on the satisfaction of examination agencies staffs in Minna, Niger state. The proposed study will draw its sample using Taro Yamane from the non-management staff of both WAEC and NECO working in Minna Metropolis. The

proposed study will employ the use of a structured questionnaire and the collected data will be analyzed using a linear regression model. The finding of the study is intended to significantly contribute to the body of knowledge, practice, and policies.

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DEVELOPMENT OF COMPUTER ANIMATION INSTRUCTIONAL PACKAGE FOR TEACHING AND LEARNING ECONOMICS IN SENIOR SECONDARY SCHOOL IN MINNA METROPOLIS

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Abstract
This study developed and evaluated the effect of computer animation instructional package for teaching and learning economics in senior secondary school in Minna metropolis This study explored four research objectives with corresponding research questions and four research hypotheses tested at the 0.05 level of significance. In order to obtain the pertinent information for the study a pre-test post-test non-equivalent, non-randomized quasi-experimental design. The population of the study was the entire Minna Metropolis Senior Secondary School Students in Niger State. The total student population comprises 13011, consisting of 6312 males and 6699 females. The sampling technique adopted to select four co-educational public secondary schools in Minna was purposive sampling technique to allow the researcher to make her judgement and choice. The Economics Achievement Test (EAT) were used to collect data. Reliability coefficient of EAT was 0.802 using Pearson Product Moment Correlation. Research questions were answered with mean and standard deviation, while research hypotheses were tested with t-test at 0.05 level of significance. The findings of the study revealed that students taught Economics using computer animation instructional package, performed better than those taught using conventional method; students' taught Economics using computer animation instructional package and conventional method do not retain equally. The researcher there by recommends that: Teachers should be encouraged to use Computer Animation Instructional Package to teach Economics in secondary schools since it has been proven to be effective for learning most especially in teaching Economics; Curriculum developers should incorporate the use of instructional facilities like Computer Animation Instructional Package at all level of education so as to improve students' academic performances and retention; and School authorities should regularly organise hands-on and professional training programmes and retreat for teachers to teach them how to effectively Computer Animation Instructional Package.

Keyword: Computer Animation, Instructional Package, Teaching, Learning Economics and Senior Secondary School.

Introduction

Education is a process that involves teaching and learning which are the basis for development and empowerment of every nation. It builds people's character and plays a significant role in transmitting one's culture, belief and values in the society. Education helps in creating innovations and meeting the growing needs of every nation. The development of a nation is not measured through the number of buildings it has built, the roads it has constructed, bridges it has constructed but by the human resources, the nation has developed through a well-defined system of education. The physical facilities are usually important although they are perishable and valuable (Adedoja & Fakokunde, 2018). In the absence of good education, a nation can hardly develop. Education is therefore more crucial not only to equip the new generations with skills so essential for earning a livelihood but also to create among them an awareness to social and environmental realities and inculcate in them scientific temper, independence of mind and spirit which are of paramount importance for them to become responsible citizens.

Innovation in education is not just about technology but how to use technology to empower students to become lifelong learners and agents of change. Innovations become imperative in designing approaches

that would help meet the needs of the contemporary and ever evolving society. Such innovation includes the design and use of animations in impacting knowledge to students. As a result of development that come with education, innovations on Information and Communication Technology including computer animation were introduced.

A computer animation is a computer programme that creates animated, interactive, game- like environments, which focuses on connecting real-life phenomena to the underlying science. Within this process, it makes the visual and conceptual models of experts and scientists simple, so that they can be understood by learners (Chen *et al*., 2017). In 2000, Hartel conducted a study about an animation program called "xyZET" for Physics teaching. In his study, Hartel believed that animations could be considered as basic tools to enhance understanding of Physics. Although computer animations are virtual, they give students the opportunity to observe and study physical, chemical or biological phenomena in a situation where it is impossible to carry out research, due to time restrictions, safety requirements or lack of proper equipment. They also reduce the gap between the real and theoretical worlds (Kozielska & Kedzierski, 2017).

Computer animations have been given different meanings by different authors; however, in a broad sense, animations are imitations of systems (Chen *et al*., 2017). Computer animations are therefore computer-generated versions of real- world objects. Computer animations 'provide near-authentic environment, context and situation for task-based learning'. For example, demonstrating the trend of demand and supply graphs and processes take place can be observed on a computer screen in many different forms, ranging from 3-dimensional geometric shapes to highly interactive, computerized classroom (Strangman and Hall, 2015). The use computer assisted learning instrument for learning social science subject is now trending, especially in Economics.

The study of Economics plays an important role throughout our life. Today, economic issues are drawing the attention of every citizen directly or indirectly (Anis, 2019). It is therefore; appropriate to include Economics as a distinct area of study in the system of open school learning particularly because for most of the students it will be a terminal stage (Dalam, 2018). At the same time, it fits within the frame of open schooling wherein it is advocated that education should be relevant to the needs of students. The learning of Economics further helps students to participate effectively in economic and social affairs and make intelligent decisions in day-to-day life. At the same time, the democratic system which is adopted in Nigeria will succeed only when Nigerians win the race on economic fronts. In the interests of Nigerians survival and of the nation, there is no education more important than that which helps Nigerians to understand the economic problems and reflect on them.

The poor performance of students in Economics could be attributed to their attitudes towards Economics and the style of evaluation. It was observed that the teaching of Economics is often analyzed using students' evaluations or tests to determine the level of knowledge of the students at the end of the term or end of the semester in tertiary institutions (Stephan & Christoph, 2020). According to Nwokocha *et al*. (2020), teachers should improve their teaching methods in order to enhance better understanding so that their interest could be aroused. Thus, there is need to explore approaches that will improve students' achievement as current results indicate that the conventional teaching approach is deficient in meeting the needs of majority of learners. The conventional teaching approach is described as teacher centered and didactic with learners simply listening, copying notes, doing class work and doing assignments. Furthermore, with conventional teaching approach (CTA), gap between high and low ability students is very wide.

The use of traditional teaching methods in teaching Economics may be linked to a number of challenges faced by Economics teachers in the classroom, ranging from how to properly teach the complex concepts of Economics for effective understanding to how to cover the syllabus with so many topics in Economics. As a result, teachers usually try to explain everything in detail as required by the curriculum, and many

pupils are unable to connect the themes and comprehend the knowledge. As a result, students are exposed to a large number of concepts, terminology, or information in a short period of time, which contradicts the nature of the Economics curriculum (Nkok, 2019).

It is in the light of this, that there is a need to develop animations for effective teaching of abstract concepts in sciences in the senior secondary school; bearing in mind that to build a technologically developed nation, the foundation of science education begins in the secondary schools. It is in consolidating such mind-set, that science teaching should inculcate the use of computer animations that will enhance better conceptualization of abstract concepts in science. One of largely accepted model in the development of animated packages is the ADDIE model (Nwokocha *et al*., 2020).

The principles of Computer Animation focus on the utilization of entertainment as a learning booster which can enhance learning in subjects like Economics are offered. Dutuma (2015) stated that Economics prepares one to deal with issues in variety of fields, including business, law, politics, history and accounting. As a result of the importance of economics in several fields, it is important that students perform well in external examination. But the performance of students at every level of education is dependent on teaching approaches which can be measured by students' academic achievement, attitudes and interest. Academic achievement refers to an expression used to represent student's scholastic standing. According to Adieze (2016), it is the measure of accomplishment in a specific field of study. However, the achievement and retention of students in the subject at secondary schools in Nigeria have not been encouraging.

Academic achievement is the performance in a school subject as designated by a score obtained in an achievement test. An achievement test is an instrument administered to an individual as stimuli to elicit certain desired and expected responses, as demanded in the instrument, performance on which the individual is assigned a score representing his achievement. It is concerned with measuring what a candidate has learned (Nwokocha *et al*., 2020). They added that other unforeseen circumstances notwithstanding, the score measures his possession of the characteristics. In other words, academic achievement is always denoted by a score which represent the amount of learning acquired, knowledge gained or skills and competencies developed, learner's mental ability and learner's level of intelligence. Also, could be termed as the score obtained by a test measured against an expected score. Blazar (2016) maintained that academic achievement is dependent upon several factors namely: teaching method, intelligence, background, organization, opportunity and ability to retain.

Retention is very important in teaching and learning; it is perceived as an act of recalling what was taught after certain period of time. Eze *et al*. (2016) observed that poor performance of student is due to poor retention. Retention of knowledge shortly after lesson delivery has been a serious challenge that tends to discourage most students from offering science related subjects. Reports have shown that students are characterized by poor retentive memory as such; they can hardly remember what they have learnt. Maduabum (2015) reported that stimulating learning environment, retention, and activity-oriented teaching strategies are all that the learners need to retain new learned information. Thus, knowledge retention is an essential component of learning. But the question here is what contributes to student's poor retention? And in what ways can knowledge retention be enhanced? Retention therefore is viewed as students understanding and retaining level of knowledge dependent on learner's interest and motivation, the learning environment, the teachers' knowledge level and instructional approaches. Recent research by Hob *et al.* (2017) supported the idea that visual communication can be more powerful than verbal communication, suggesting in many instances that people learn and retain information that is presented to them visually much better than that which is only provided verbally. Students' attitude towards learning is one of the major factors contributing to poor retention. Additionally, the gender interplay on achievement and learning retention; has revealed in most literatures (Hob *et al.*, 2017). Therefore, this study focuses on development and evaluation of Computer Animation Instructional Package for teaching Economics among secondary school students in Niger State.

Literature is filled with evidence that teachers are using ineffective methods and strategies in teaching mathematics, which among other factors, have contributed to the students' poor achievement in mathematics especially at the Junior Secondary School Certificate Examination (JSSCE) (Eleje *et al.*, 2017). Secondary school student's performance in external examination in Economics (WAEC/NECO/NABTEB), from the report of 2012 - 2019 chief examiner's report has shown that students performed on averagely and inconsistently in some concepts in Economics which could be attributed to their attitudes towards Economics and method of teaching. The method of teaching in secondary schools today is conventional method where instructed media are rarely used and the teacher is also faced with a large class size and this really affect the student.

It is pertinent to say that classes in our present-day Secondary Schools are large and thus students of various ability levels constitute such classes (Davies, 2018). Classrooms in Nigeria primary and post primary Schools constitute students of varied ability levels of high, average and low leading to unequal permanence among them. Every class in Nigeria educational system should therefore be considered as being composed of mixed ability level. Research reports indicated that many reasons account for students' poor achievement in science subjects, among these are poor teaching approach, lack of confidence in the subject, poor learning environment (Anunobi *et al.*, 2010). In a heterogeneous class where students of different abilities are taught together, only a few of the students achieve high scores in achievement test. Also, research reports by Nwokocha *et al*. (2020). The advent of technology has reshaped all human activities on earth which include educational activities through the use of software like animation, games, films, cartoons and so many others.

A lot of researchers are speculating optimistically about the potential effects of Computer Animation on the quality of educational experience and outcomes (Nwokocha *et al*., 2020), but some are still cautious on the effect that certain Computer Animation instructional package might establish on students due to their respective learning levels. It therefore becomes imperative that more interactive teaching strategy needs to be adopted. Hence, the package that may salvage the problem may be the use of Computer Animation instructional package which could ensure high achievement, and contents retention towards Economics there is need to urgently address the stated problems using Computer Animation instructional packages that could actually ensure high achievement, contents retention and positive attitude towards Economics. This, therefore, calls for social science educators to intensify efforts in research to proffer solution that will ameliorate the situation. Based on the above assertions, this study focuses on development and evaluation of Computer Animation Instructional Package for teaching Economics among secondary school students in Minna metropolis.

Aim and Objectives of the Study

The aim of this article is to develop a Computer Animation instructional package for teaching Economics among secondary school students in Minna, Metropolis. Specifically, the study achieved the following objectives to:

1. determine the effect of Computer Animation Instructional Packages on achievement in Economics.
2. examine the effect of Computer Animation Instructional Packages on retention in Economics.

Research Questions

The following research questions will be answered in this paper.

1. What is the effect of Computer Animation Instructional Packages on achievement in Economics?
2. What is the effect of Computer Animation Instructional Packages on retention in Economics?

Research Hypotheses

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

HO_1**:** There is no significant difference in the mean achievement scores of Economics students taught using Computer Animation Instructional Packages and those taught using conventional method

HO_2: There is no significant difference in the mean retention scores of Economics students taught using Computer Animation Instructional Packages and those taught using conventional method

Methodology

Research Design

The research design to be adopted for this paper is a pretest, posttest quasi-experimental research design, which involves non-randomized, nonequivalent samples. There was one independent variable and two dependent variables namely: Computer animation Instructional Package and achievement and control. The research design layout is shown in Table 1.

Table 1: Research Design Layout

Groups	Pre-test	Treatment	Posttest	Retention
Experimental Group	O_1	X_1	O_2	O_3
Control Group	O_1	X_2	O_2	O_3

O_1,; O_2;: Observation of pre-test and posttest for the Experimental groups
O_2; O_2: Observation of post-test for the Control groups
O_3; O_3: Observation of retention for the Experimental and Control groups
X_1; Computer Animation Instructional Package
X_2; Conventional Method

The table above shows the experimental group and control group that was involved in the study. The experimental group was taught Economics using Computer Animation Instructional Package, while the control group was taught using Conventional, method.

Population of the Study

The population of the study was all senior secondary school Economics students in Minna metropolis of Niger State in the 2022/2023 academic session, 2nd term. The total students' population comprises of 13011 economics students consisting 6312 males and 6699 females, as retrieved from Niger State Ministry of Education. This study is thereby targeted at SS 2 Economics students in Minna metropolis, Niger State.

Sample and Sampling Techniques

The sample size used for the study captured in the randomly selected intact class of the purposively selected secondary schools totalling 79. Purposive sampling technique was used to select two senior secondary schools that were used for the study out of 45 senior secondary schools in the Minna metropolis Niger state. The experimental classes were taught using the developed package while the control was taught using the lecture method. Thus, intact classes were used. This is because they satisfied the following conditions: co-educational senior secondary schools that is well-equipped with computer facilities and manpower.

The study made the use of intact class where all the students in each class was involved in the study. Two intact classes were randomly selected and used for the study. The intact classes, of SS 2 Economics students among selected Secondary School, in Minna was randomly classified into the experimental group (Computer animation instructional package) and control (conventional method) group respectively.

Table 2 Sample size of subjects in the classes

School	Intact class	No	M	F	Total
School	A	75	50	25	75
School	B	62	40	22	62
Total					137

Research Instruments

Two instruments were used for data collection in this study. They include: Computer animation Instructional Packages (CAIP) and Economics Achievement Test (EAT).

Development of computer animation instructional packages (CAIP)

This animation package was developed by the researcher in collaboration with a computer programmer for the purpose of the study. The CAIP was structured to teach Demand and supply concepts. The CAIP was designed and produced using Powtoon official website (https://www.powtoon.com/). The final packaging into the CD was done using Macromedia flash after the content and the instructional objectives for the lessons have been selected. The following steps was duly followed for the design and production of the instructional package:

1. Sign up for a Powtoon account: Visit the Powtoon website (https://www.powtoon.com/) and sign up for a free account.
2. Choose a template: Powtoon offers various templates for different video styles. Browse through the available options and select a template that suits your needs.
3. Customize the template: Once you've chosen a template, you can customize it badding or removing elements, changing colours, fonts, and backgrounds, and adding your own content such as text, images, and videos.
4. Add animations and effects: Powtoon allows you to add animations and effects to make your video more engaging. You can animate text, characters, and objects, and add transitions between scenes.
5. Record or import audio: Powtoon provides options to record your own voiceover or import pre-recorded audio. You can also add background music from the Powtoon library or upload your own.
6. Preview and finalize: After customizing your video, you can preview it to see how it looks and make any necessary adjustments. Once you're satisfied, you can finalize the video and save it.

The guide on the usage can be found in Appendix C, 76.

Development of economics achievement test (EAT)

This instrument was developed by the researcher and the researcher followed the table of specification. Total number of 20 multiple choice questions was developed A -E. The instrument follows the six levels of cognitive domain of learning.

Validation of Research Instruments

The Computer Animation Instructional Package (CAIP) was trial tested by supervisor and three selected senior lecturers of the Department of Educational technology, Federal University of Technology, Minna, Niger State. The lecturers used the package to teach the students in order to be sure of the computer animation instructional package functioning well. This instrument was validated by two lecturers from the Department of Educational Technology, Federal University of Technology, Minna, Niger State and two teachers from Zarumai Secondary School, Minna Niger State, because these teachers are the people that teach the Economics in the schools. These experts would have accessed the face and content validity of the instrument in relation to the background of secondary school curriculum. Also, experts examined all the items in the test instrument with reference to the appropriateness of the content that is the extent to which the content cover the topics which it is supposed to cover. The opinions and suggestions of the experts was used to make necessary amendments on the instruments.

Reliability of the Instruments

After the validation of the instruments, the modified lesson material and economics achievement test was trial tested using SS 2 economics students from Zarumai Secondary School that is, school that are part of the population but not part of the sample size. Test-Retest method was used to determine the reliability of the data generated from the pilot study using Economics Achievement Test (EAT) was analysed using Pearson Product Moment Correlation formula to determine the reliability. The scores obtained were correlated using Pearson Product Moment Correlation (PPMC) which revealed a reliability of 0.802 (Appendix D, 76).

Method of Data Collection

The researcher visited the sampled schools with a written letter to seek for permission two weeks before carrying out the study and also to inspect the facilities, teachers and the students that determined their suitability for the study. During the visit, the objectives of the study was discussed with the appropriate authorities. After obtaining permission to carry out the study, in the first week of study the researcher was trained the economics teachers who stand as research assistants on how to use computer animation instructional packages for teaching senior secondary school economics students.

Two economics teachers (one from each of the selected schools) was trained as research assistants in the use of the computer animation Instructional Packages. Before this training, the objectives and the modalities of the use of the packages was specified. Subsequently, there was orientation with the SS2 Economics teachers (Research Assistants), School Net coordinators, and students who was involved in the study. Furthermore, the overall activities in the schools were carried out in this order: Visitation and inspection of facilities lasted for two weeks; training of research assistants (SS2 Economics teachers) on the use of the treatments with the EIP guides to instruction for the training session lasted for two weeks. When the teachers, the School Net coordinators, and the students had been adequately briefed, trained and demonstrated competence in the successful implementation of the packages, the students were heterogeneously divided into three groups.

Method of Data Analysis

The data obtained from the administration of EAT at the pre-test, post-test & retention test was collated, marked and subjected to data analysis. The research questions were answered using mean and Standard Deviation while the hypotheses were tested using t-test using Statistical Package for Social Sciences (SPSS) version 21 at 0.05 level of significance.

Result

Analysis of research question

Research Question One: What is the effect of Computer Animation Instructional Packages on achievement in Economics?

In answering research question one mean and standard deviation were utilised as shown in Table 3.

Table 3: Mean and Standard Deviation of Pre-Test and Post Test Achievement Score of Student taught using Computer Animation Instructional Package and Conventional Method

Group	N	Pre-test		Post-test		Mean Gain
		$\bar{X}$	SD	$\bar{X}$	SD	
Computer Animation Instructional Package	37	29.40	13.61	48.68	6.40	19.28
Conventional method	42	28.11	10.07	36.34	9.73	8.23

Table 4.1 reveals the mean achievement score and standard deviation of students taught Economics using Computer Animation Instructional Package and conventional method. Experimental Group (Computer Animation Instructional Package) had the highest mean achievement score of 48.68 with Standard Deviation of 6.40. The Control Group (Conventional Method) mean achievement score of 36.34 with standard deviation of 9.73. There was a mean gain of 19.28 and 8.23 for experimental groups and control group respectively. This implies that Economics students taught with Computer Animation Instructional Package had higher mean achievement score as compared to those taught conventional method.

Research Question Two: What is the effect of Computer Animation Instructional Packages on retention in Economics?
In answering research question two mean and standard deviation were utilised as shown in Table 4.

Table 4: Post Test and Retention Score of Student taught using Computer Animation Instructional Package and Conventional Method

Group	N	Post-test		Retention		Mean Difference
		$\bar{X}$	SD	$\bar{X}$	SD	
Computer Animation Instructional Package	37	48.68	6.40	47.92	4.83	- 0.76
Conventional method	42	36.34	9.73	30.05	8.04	- 6.29

Table 4 reveals the mean retention score and standard deviation of students taught Economics using, Computer Animation Instructional Package. Table 4.2 showed that the mean retention score of the two groups at post-post-test differ. Computer Animation Instructional Package had the highest mean retention score of 47.92 with Standard deviation of 4.83, while the control group had mean retention score of 30.05 with standard deviation of 8.04. There were mean differences of 0.76 for Computer Animation Instructional Package, and 6.73 for conventional.

Analysis of research hypotheses
In answering research hypothesis one - four, t-test was used and tested at 0.05 level of significance shown in Table 5 – 6 respectively.

Research Hypothesis One (HO_1): There is no significant difference in the mean achievement scores of Economics students taught using Computer Animation Instructional Packages and those taught using conventional method.

Table 5: T-test Post test Scores of Computer Animation Instructional Packages and those taught Using Conventional Method

Participants	N	$\bar{X}$	SD	t-cal	Df	p-value
Computer Animation Instructional Packages	37	48.68	6.40			
				43.022	77	0.00
Control	42	36.34	9.73			

Table 5 shows the t-test analysis of Achievement test scores of Economics students taught using computer animation instructional packages and conventional instructional strategies. Computer Animation Instructional Packages achievement test scores $\bar{X}$ = 48.68, SD = 6.40 and the mean for conventional instructional strategies $\bar{X}$ = 36.34, SD = 9.73. The table show that t-cal 43.022, df = 77, with p = 0.00. Since p<0.05, null hypothesis one is hereby rejected. Therefore, there was statistically significant difference in the achievement scores of Economics students taught using Computer Animation Instructional Packages and conventional method.

Research Hypothesis Two (HO_2): There is no significant difference in the mean retention scores of Economics students taught using Computer Animation Instructional Packages and those taught using conventional method

Table 6: T-test Analysis of Mean Retention Scores of Students Taught Economics using Computer Animation Instructional Packages and those taught using conventional method

Participants	N	$\bar{X}$	SD	t-cal	Df	p-value
Computer Animation Instructional Packages	37	47.92	4.83			
				1.56	77	0.01
Control	42	30.05	8.04			

Table 6 shows the t-test analysis of retention test scores of Economics students taught using computer animation instructional packages and conventional instructional strategies. Computer Animation Instructional Packages achievement test scores $\bar{X}$ = 47.92, SD = 4.83 and the mean for conventional instructional strategies $\bar{X}$ = 30.05, SD = 8.04. The table show that t-cal 1.56, df = 78, with p = 0.01. Since p <0.05, null hypothesis two is hereby rejected. Therefore, there was statistically significant difference in the retention scores of Economics students taught using Computer Animation Instructional Packages and conventional method.

Discussion of Findings

Based on the outcome of the study on evaluation of effect of computer animation instructional package on academic achievement and retention of senior secondary school economics in Minna, Niger State. The findings of the study revealed that computer animation instructional package had high positive impact on mean achievement score of students taught Economics as compared to those taught using conventional method. This finding could be as a result of the fact that computer animation is known as integration between amusement and education using various multimedia and improve many skills for children such as, strategic planning, analytical skills, working within a team and decision making. Edutainment give users important skills like working within a team, creativity, the ability to explore, and interactivity (Omoniyi, 2021). The finding on research hypothesis one revealed that there was statistically significant difference in the achievement scores of Economics students taught using Computer Animation Instructional Packages and conventional method.

The finding also corroborates with the finding of Okolo and Oluwasegun (2020) who conducted a study on the effect of Computer- Simulation on Achievement and Interest in Cell Division Among Male and Female Secondary School Students in Abuja, Nigeria. The findings of their study revealed the edge in the use Computer- Animation Packages in teaching. The findings of the study are in line with Ese and Oludare (2020) investigated the effects of computer animation package on academic performance of senior secondary school students in some science concepts in Ekiti State, Nigeria. The findings showed that the use of computer animation package (CSP) has significant effect on students' academic performance.

The finding of the study also disclosed that Computer- Animation Packages also improved the level of retention of student when exposed to it. The findings on research hypothesis two revealed that was statistically significant difference in the retention scores of Economics students taught using Computer Animation Instructional Packages and conventional method. This agrees with the findings of Tava and Ismail (2019), who investigated the effects of 3D computer animation on biology students' achievement and memory retention. The results showed that realistic animation is a more effective 3D computer animation-based teaching method than the other methods and it improves Biology students' achievement and memory retention.

Conclusion

Based on the findings of the study on the development of computer animation instructional package for teaching Economics among secondary school students in Minna, metropolis of Niger State. The study explores the effect of Computer Animation Instructional Packages on achievement in Economics, examine the effect of Computer Animation Instructional Packages on retention in Economics and investigate the influence of gender on achievement and retention of secondary school student in Economics while exposed to Computer Animation Instructional Packages. It could be concluded that Computer-Animation Instructional Package is effective instructional packages that can enhance academic achievement and retention of secondary school students in Economics. It is recommended that teachers should be encouraged to use Computer Animation Instructional Package to teach Economics in secondary schools since it has been proven to be effective for learning most especially in teaching Economics. Curriculum developers should incorporate the use of instructional facilities like Computer Animation Instructional Package at all level of education so as to improve students' academic performances and retention.

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ASSESSMENT OF SENIOR SECONDARY SCHOOL STUDENTS' ACCEPTANCE OF BLENDED LEARNING APPROACH USING TECHNOLOGY ACCEPTANCE MODEL IN MINNA, NIGER STATE, NIGERIA.

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Abstract
This study investigated the assessment of senior secondary school students" acceptance of blended learning approach using the technology acceptance model in Minna, Niger State, Nigeria. This study explored three research objectives with corresponding research questions and three research hypotheses. In order to obtain the pertinent information for the study, a correlation survey research design was adopted. The population of the study was the entire Minna Metropolis Senior Secondary School Students in Niger State. The total student population comprises 13011, consisting of 6312 males and 6699 females. The multi-stage cluster sampling technique was used to select six (6) senior secondary schools that were used for the study out of 85 Senior Secondary Schools in Minna. The target population for the study was senior secondary school (SS2) students, namely: ST. Clement's School Gbaiko, HIMMA International College, MYPA Secondary School, FUT-Staff School, Redeemers International Schools, and Brighter International School. A self-structured questionnaire titled "Questionnaire on Assessment of Senior Secondary School Students Acceptance of Blended Learning Approach Using Technology Acceptance Model in Minna, Niger State (QASSSABLATAM)". was used for data collection, which was subjected to face and content validity by two experts from the Department of Educational Technology, Federal University of Technology, Minna, Niger State. A pilot study was conducted on 25 students at NECO Staff School in Minna, Niger State. The reliability coefficient of 0.84 Cronbach's alpha cleared the instrument for data collection. Descriptive statistics of mean and standard deviations were used to answer research questions, while correlation analysis Pearson product Moment Product (PPMC) inferential statistics was used to test the null hypotheses with the aid of the Statistical Package for Social Sciences (SPSS version 25.0). It could be concluded that self-efficacy (knowledge of computers and electronic devices) influences the use of blended learning. The findings of the study revealed that experience with various technological devices directly influences the perceived Ease of Use of blended learning. and finally, enabling environments affect Secondary School students' perceptions of the ease of using blended learning. The researcher recommended that that secondary school management should prioritize the provision of necessary technology infrastructure for blended learning. This includes ensuring students have access to the devices and internet connectivity required for online learning. Schools should invest in training teachers on the full integration of blended learning. Educators need to be equipped with the skills and knowledge to effectively implement this approach in the classroom.

Keywords: *Secondary School, Students, Acceptance, Blended Learning Approach and Technology Acceptance Model*

Introduction

In this contemporary age, in which technology is fast advancing and information rapidly increasing and refreshing, teachers working in educational environments require more efforts to provide students with information by using effective technology-based methods. It is a basic educational principle that teaching and learning are best achieved when generalizations and theoretical concepts are developed through the experience of a vivid and realistic approach. The effect of blended learning in the classroom presentation is also vital in every aspect of teaching and learning for good academic performance and retention (Al-Emran *et al*., 2018).

The national policy on education regards education as an instrument for effecting national development (Federal Republic of Nigeria, 2014). The Nigerian philosophy on education is based on the development of the individual into a sound and effective citizen and the provision of equal education opportunities for all citizens of the nation at the primary, secondary and tertiary levels both inside and outside the formal system. The secondary school which is six years' duration, the student must study and perform excellently to be admitted to tertiary institutions.

Since Nigeria's independence in 1960, conscious efforts towards improving the teaching of secondary school students and the review of curriculum have been put in place. Education in Nigeria is the shared responsibility of the Federal, State, and Local Governments. According to Oyetunde (2016), The Federal Ministry of Education plays a dominant role in regulating the education sector, engaging in policy formation, and ensuring quality control. However, the Federal government is more directly involved with basic school education, which is largely the responsibility of the state (secondary) and local (primary) governments.

The common core curriculum at the senior secondary level consists of English, one Nigerian language, mathematics, one science subject, one social science subject, and agricultural science or a vocational subject. In addition, students must take three elective subjects, one of which may be dropped in the third year. The national policy on education (FRN, 2014) identified that students take the Senior Secondary Certificate Examination (SSCE) at the end of SS III. The Senior Secondary Certificate (SSCE) is awarded to successful candidates. The certificate lists all subjects in which the student is successful. The SSCE is issued by the West African Examination Council(WAEC) or the National Examination Council (NECO), depending on the examination board used. An average grade of" credit" level (C6) or better is required for access to public universities; however, some require higher grades for admission. The standard of the two examinations is essentially the same. Students register for a maximum of nine and a minimum of seven subjects, which must include English language and Mathematics. A student must get at least a C (Credit) in English and four other courses relevant to his or her major to sit for the University Tertiary Matriculation Examination (UTME). A student applying for admission to course of study like medicine, computer science, or accounting, for example, will be required to have a minimum of a Credit in English language as well as in Mathematics whereas a student applying for a program in history will not necessarily require a Credit in mathematics.

The method for transmitting knowledge skills has remained too theoretical and devoid, and the use of technology to stimulate the learners" interest and sustain their necessary skills is required. Therefore, undermining the spirit and the fundamental objectives of the subject matter; English Language. This assertion is drawn from the perspectives of failures in school examination which may be ascribed to factors guiding teaching and learning which include archaic pedagogical approaches that are not in tune with global practices (Sahin, 2019). A stronger learning environment has emerged by combining the strongest aspects of the two available approaches to remove the deficiencies of traditional learning and Web-based learning. This new learning approach is blended learning, it is also referred to as hybrid learning and mixed learning and it is used in very different ways by many researchers. Kumar and Pande (2019) defined blended learning as integrating face-to-face learning and electronic learning or distance learning, using different learning theories, methodologies, and techniques in the same place, and supporting the learning with various online technologies during the learning process in the classroom. Blended learning can also be defined as combining of two different education models, traditional face to face learning and distance learning (Klentien & Wannasawade, 2019).

Kitchenham and Charters (2020), on the other hand, defined blended learning as an education model which can integrate e-learning which has improved in parallel with new and technologic developments with

traditional learning which provides interaction in the classroom. Kaur (2019) see blended learning as the implementation of the most effective learning solutions in a coordinated way to achieve the desired learning targets and also defines blended learning as combining some strong and advantageous aspects of online learning and learning in the classroom. Ismail *et al.* (2018) explain that blended learning is conducted to blend the best aspects of online learning and face to face learning. Blended learning is a new type of education prepared for a certain group by combining the positive aspects of different learning approaches. Blended learning will provide a big convenience for the course to achieve its target by combining the face-to-face interaction in traditional learning and time, place, and material richness provided by Web-based learning.

Davis Fred developed the technology acceptance model (TAM) in 1989 to predict an individual's use and acceptance of information systems and technology. It is one of the major models that came across with the extension of Theory of Reasoned Action developed by Fred Davis and Richard. The importance of TAM is that it is specifically designed to address the acceptance of Instructional Systems technology. Furthermore, it is seen that the TAM model is much simpler than the primary two models Theory of Reasoned Action and Theory of Planned Behaviour. TAM consists of two main concepts "Perceived Usefulness" and "Perceived Ease of Use". Perceived Usefulness defines as the "degree to which a person would think that particular system would enhance his or individual job performance". Perceived Ease of Use refers to "the degree to which a person believes that using a particular system would be free of effort". These two factors are influenced by external factors, such as social factors, cultural factors, and political factors. Language, skills, and facilitating conditions are the main concerns in social factors, while political factors consist of politics and political crisis. The "attitudes" refers to the user's evaluation of employing a particular technology, while "Behavioral intention" is the measure of the likelihood of a person using the technology.

Many researchers have used TAM to describe different types of information systems. For example, E-learning systems by teachers, online shopping acceptance, acceptance of e-commerce, online banking systems, e-service adoption, acceptance of Radio Frequency Identification (RFID) used TAM and modified TAM models to describe the user behaviour. Hence, the need to use Technology Acceptance Model (TAM) to assess secondary school students' acceptance of blended learning in Minna, Niger State, Nigeria. For the past two decades, the Technology Acceptance Model (TAM) has been dominant in system usage studies. The popular theory provides an explanation that is comprehensive and yields great explanatory power (Spring *et al.,* 2016). The TAM has been proven to apply to the case of blended learning instruction (Antonio *et al.,* 2019). Perceived usefulness and performance expectations have been considered the most relevant effects of advanced technology on Information Technology System usage (Opeyemi *et al*., 2019).

The convergence of global technology has produced an environment in which the medium for instruction could change (Murphy *et al* ,2019). The 21st Century philosophy of teaching and learning is child-centred as such; the blended technique is organized to compliment the teacher whose role is that of a guide on the side, not a sage on the stage (Schmidt, 2019) as it was the practice. However, most Secondary School teachers in Nigeria are used to the traditional (chalk-talk) method of teaching which renders students' passive listeners and make teaching ineffective, consequently affecting the students‟ performance in all ramification.

On the other hand, the state of knowledge explosion with increasing specialization, increase in student-teacher ratio and increase in the workload of teachers, classroom instruction alone does not in most cases bring out the desired goals from the teaching and learning process, this has resulted in drawback in student performance. From the few kinds of research carried out in the area of the Technology Acceptance Model in Nigeria, there is none specifically in the area of blended learning for Secondary School students Minna, Niger State. Antonio, et al (2019) investigated the variability, effectiveness, and appropriateness of computer programming to the needs of Nigerian secondary school students. Hence, looking at the pandemic holidays especially COVID'19 that affected all Nigerian students by restricting the students at all

Educational cadre from going to school and having their regular conventional learning process depriving them of their immediate learning environment, the students syllabus were disrupted with students repeating sessions instead of progressing in cases where blended learning was applied effectively to the points of evaluating and grading the students even without attending a full conventional traditional classroom teaching and learning process and environment. It is in light of this that the researcher seeks to conduct a study on the Assessment on Senior Secondary School students' acceptance of blended learning approach using Technology Acceptance Model in Minna, Niger State.

1.2 Aim and Objectives of the Study

The aim of the study is to conduct assessment on Senior Secondary School students' acceptance of blended learning approach using Technology Acceptance Model in Minna, Niger State.

Specifically, the objectives of this study are to:

1. Determine the influence of secondary school students experience with technological devices on the perceived ease of use of blended learning approach in Minna, Niger State.
2. Examine the extent to which secondary school students enabling environment influence the perceived usefulness of blended learning approach in Minna, Niger State.
3. Assess the extent to which secondary school students' attitude towards blended learning approach influence the utilization of blended learning approach for teaching and learning processes in Minna, Niger State.

Research Questions

The following research questions were formulated to guide the study:

d. What is the influence of secondary school students experience with technological devices on the perceived ease of use of blended learning approach in Minna, Niger State?
e. What is the extent to which secondary school students enabling environment influences the perceived usefulness of blended learning approach in Minna, Niger State?
f. What is the extent to which secondary school students' attitude towards blended learning approach influences the utilization of blended learning for teaching and learning processes in Minna, Niger State?

Research Hypotheses

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

HO_1 There is no significant relationship between secondary students' experience with technological devices and the perceived ease of use of blended learning in Minna, Niger State.

HO_2 There is no significant relationship between Secondary School students enabling environment and the perceived usefulness of blended learning approach in Minna, Niger State.

HO_3 There is no significant relationship between the Secondary School students' attitude towards blended learning and the utilization of blended learning in Minna, Niger State.

Methodology

Research Design

A correlation survey research design was used for the study. Creswell (2019) asserted that the correlation survey method of research is to gather detailed information and measure the existing relationship between variables without the researcher controlling or manipulating any of the variables. Hence, the correlation survey research design was used to measure the relationship between variables. The researcher distributed questionnaires to seek information and a detailed opinion from the student (respondents) on students' attitude towards utilization, experience with technology and effect of enabling environment in order to assess their acceptance of the use of the blended learning approach using Technology Acceptance Model among secondary schools' students in Minna, Niger State.

Population of the Study

The population of the study was the entire Minna Metropolis Senior Secondary School Students (SS2) in Minna, Niger state. The total student population comprises 13011 consisting of 6312 males and 6699 females, as retrieved from Niger State Ministry of Education annual school census 2022.The target population for the study was Senior Secondary School (SS2) students in Minna, Niger State, namely; ST Clement" s School Gbaiko, HIMMA International College, MYPA Secondary school, FUT-Staff School, Redeemers International Schools, and Brighter School Minna.

Sample and Sampling Techniques

Multi -stage cluster sampling technique was used to select six (6) senior secondary schools that was used for the study out of 85 Senior Secondary Schools in Minna as retrieved from Niger State Ministry of Education, 2022. This is because they satisfied the following conditions: co-educational senior secondary schools that are well-equipped with computer facilities and manpower. Simple random sampling technique was used to select students from each secondary school respectively. A total of three hundred and seventy -eight (378) respondents was considered which is sufficient to be used as sample for targeted population using Krejcie and Morgan (1970) population/sample table.

Research Instrument

A structured questionnaire was used for data collection. The questionnaire was designed by the researcher and titled "Questionnaire on Assessment of Senior Secondary School Students Acceptance of Blended Learning Approach using Technology Acceptance Model in Minna, Niger State (QASSABLATAM)". The questionnaire consisted of two parts. Part one seeks information on the personal data of the respondents while part two of the questionnaire was divided into five sections (A-E). Section A: Contains items on assessing the influence of students' experience with technological devices on the perceived ease of use of blended learning in Minna, Niger State. Section B: Addresses the impact of students enabling environment on perceived usefulness of blended learning approach by Secondary School Students in Minna, Niger State. Section C: effect of students' attitude towards the utilization of blended learning by Secondary School students in Minna, Niger State. Section D: addresses the effect of student behavioural intentions on the perceived usefulness of blended learning approach in Minna, Niger State and Section E: addresses the influence of Secondary School Students self-efficacy with various technological devices on perceived ease of use of blended learning approach in Minna, Niger State.

A five-point rating scale of measurement was used for sections A, B, C, D and E in order to give the remarks of the Mean scores as shown in Table 1. A Decision Mean of 3.0 was considered acceptable while a Mean below 3.0 was considered not acceptable.

Table 1Mean Rating Scale

Scale of RQ5	Rating
Strongly Agree (SA)	5
Agree (A)	4
Disagree (D)	3
Strongly Disagree (SD)	2
Undecided (U)	1

Validation of the Instrument

The questionnaires developed in line with Technology Acceptance Model variables was subjected to face and content validity by two experts from the Department of Educational Technology, Federal University of Technology, Minna, Niger State. The experts were requested to add or remove any item, suggest modifications to the structure of the items, organization and assess appropriateness according to their suitability for the research questions of the study. Modifications were effected where necessary on some items of the questionnaire in line with the view of the experts.

Reliability of the Instrument

A pilot study was conducted on 25 students in NECO STAFF School Minna, Niger state. The Senior Secondary School used for the pilot study is part of the population but not constituent of the samples selected for the study. The administration was done once and the data collected were subjected to statistical analysis using Cronbach's Alpha to determine the internal consistency of items used. Reliability coefficients of 0.88 for section A on experience with technology, 0.87 for section B on enabling environment, 0.84 for section C for students' attitude, 0.89 for section D on students' behavioural intentions and 0.75 for section E on self- efficacy respectively. Hence, the instrument was considered reliable to be used for data collection.

Method of Data Collection

The researcher got an introductory letter from the department (Educational Technology, Federal University of Technology Minna). After then, permission was taken from the school management of the sampled school to get approval in order to sample students in their respective institution for the research and once the permission is granted, students were briefed on the aim and objectives of the study. The researcher clearly explained the concept of the study to the two research assistants for the purpose of this study. The questionnaires were then administered to the respondents by the researcher with the aid of two research assistants so as to facilitate the administration. The researcher along sides the research assistants after sometime retrieved completed copies of the questionnaires from the respondents directly. The questionnaires were administered and retrieved from the respondents (students) after a one-week interval from the date of administration so as to allow the respondent to attend to the items in the questionnaire at their convenient time.

Method of Data Analysis

Data collected for this study was organized and analyzed using descriptive and inferential statistics. Specifically, Mean and Standard Deviations was used to answer research questions while inferential sample correlation analysis Pearson Product Moment Correlation (PPMC) was used to test the null hypotheses. The decision on the research question was based on the resulting Mean score of which Mean response of 3.0 was considered acceptable while Mean response below 3.0 was not acceptable. Statistical Package for Social Sciences (SPSS version 25.0) was used to carry out the data analysis and the significance levels of the hypotheses was ascertained at 0.05 alpha level of significance.

Results

Analysis of research questions

Research Question One: What is the influence of secondary school students experience with technological devices on the perceived ease of using blended learning approach in Minna, Niger state? The responses of secondary school student on the influence of experience with technological devices on the perceived ease of using blended learning approach is presented in Table 2

Table 2 Mean and Standard Deviation Responses of influence of Secondary School Students Experience with Technology on the Perceived Ease of Using Blended Learning Approach in Minna, Niger State

Items	Mean	Standard Deviation	Remark
Learning via blended learning approach is easy for me	3.99	0.50	Agreed
It is easy to access the blended learning -online teachings using my devices and doing/sending my assignment	3.35	0.70	Agreed
Online teaching which is part of blended learning takes less time	3.94	0.20	Agreed
Using blended learning approach for learning is less frustrating.	4.62	0.81	Agreed
I found it easy connecting to the online teaching using access code	3.38	0.38	Agreed
I feel that using my devices to connect for blended learning will be easy for me	3.36	0.16	Agreed
I feel that it would be easy for me to become skillful at using computer using blended learning approach for learning	3.69	0.57	Agreed
Blended learning would impose using technology which would improve my speed in using and operating my devices	4.39	0.39	Agreed
Grand Mean	3.84	0.46	Agreed

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Table 2 shows the Mean and Standard Deviation responses of secondary school students on the influence of experience with technological devices on perceived ease of use of blended learning approach for teaching and learning processes in Minna, Niger State. The table reveals the computed grand Standard Deviation of 0.98 while the Mean responses for the eight items as responded by the students are 3.64, 3.65, 3.67, 3.65, 3.64, 3.64, 3.6, and 3.68 respectively.

The grand Mean of 3.65 which was greater than the Decision Mean of 3.00. This implies that Students experience with technological devices used for blended learning can influence students' perceptions on the perceived ease of use of blended learning approach for instructional delivery in secondary schools in Minna, Niger State. More so the grand Standard Deviation of 0.98 implies that there was no much disparity in secondary school students' response on the influence of their previous experience with technological devices on the perceived ease of use of blended learning approach in Minna, Niger State.

Research Question Two: What is the extent to which secondary school students Enabling Environment influences the perceived usefulness of blended learning approach in Minna, Niger State?
The responses of secondary school student on the influence of Enabling Environment on the perceived usefulness of blended learning approach in Minna is presented Table 3

Table 3 Mean and Standard Deviation Responses of secondary school students Enabling Environment on the Perceived Usefulness of Blended Learning Approach in Minna, Niger State

Items	Mean	Standard Deviation	Remark
Blended learning using online teaching mode along sides face2face teachings provide useful and interesting contents.	3.72	0.49	Agreed
Online teachings provide sufficient educational contents for all my required subjects.	3.74	0.50	Agreed
Learning using blended learning approach will increase my academic productivity.	3.51	0.68	Agreed

Learning the contents through online platform is much more interesting which makes me feel comfortable studying by myself independently.	3.03	0.34	Agreed
Students enhanced performance using blended learning approach encourages it usage	3.41	0/76	Agreed
Blended learning approach helps me to manage my time	3.29	0.35	Agreed
Blended learning encourages learners to pursue thorough information using online websites.	4.11	0.77	Agreed
Grand Mean	3.54	0.52	Agreed

Table 3
Shows the mean and standard deviation responses of students. with mean responses of the eight items as 3.66, 3.67, 3.67, 3,67, 3.68, 3.68, 3.67 and 3.64 respectively. The table reveals the computed mean score of 3.64 and grand standard deviation of 0.92 which implies the secondary school students in Minna, Niger State agreed that having a well conducive enabling environment can directly influence the perceived usefulness of blended learning approach in Minna, Niger State. More so the grand standard deviation of 0.92 implies that there was no much disparity in secondary school students' response on the influence of enabling environment on students perceived usefulness of blended learning approach in Minna, Niger State.

Research Question Three: What is the extent to which secondary school students' attitude towards blended learning influences the utilization of blended learning approach for teaching and learning in Minna, Niger State?

The influence of the attitude of secondary school students on blended learning approach utilization for teaching and learning is presented Table 4.

Table 4 Mean and Standard Deviation Responses on the influence of secondary school students' attitude towards Blended Learning Approach on the Utilization of Blended learning for teaching and learning in Minna, Niger State

Items	**Mean**	**Standard Deviation**	**Remark**
My school now use the blended learning in their teaching and learning process.	2.97	0.54	Disagreed
The use blended learning for instructional delivery is highly recommended for usage.	3.90	0.67	Agreed
Learning and submitting my assignment through my devices is a good idea.	3.18	0.50	Agreed
I think blended learning will positively influence the teaching and learning in my school	3.58	0.49	Agreed
I think blended learning will always serve the purpose of learning.	3.72	0.41	Agreed
I think blended learning will enhance optimum performance for students	3.36	0.48	Agreed
I think blended learning will offer adequate academic performance relevance in teaching and learning.	4.43	0.50	Agreed

I think accepting blended learning for its wide usage in teaching and learning is high.	3.64	0.48	Agreed
I have positive feelings towards the use of blended learning	3.69	0.32	Agreed
I believe it would be a good idea adopting the blended learning approach in my school	4.12	0.29	Agreed
I am comfortable with self-directed learning	3.78	0.49	Agreed
Grand Mean	3.67	0.47	Agreed

Table 4 Shows the Mean and Standard Deviation responses of student on the extent to which students attitudes can affect or influence the utilization of Blended Learning approach by Secondary School students in Minna, Niger State. with the Mean responses of 3.73, 3.73, 3.67, 3.70, 3.71, 3.71, 3.69, 3.79, 3.70, 3.72, 3. 72 and 3.71 respectively for all the twelve items. The grand Mean of 3.71 implies that secondary school students in Minna, Niger State affirms that students' attitude can affect their acceptance and utilization of blended learning Approach in Minna, Niger State. More so the grand standard deviation of 0.81 implies that there is no much disparity in the responses of secondary school students on the influence of attitude on the effective utilization of blended learning for instructional delivery.

Analysis of research hypotheses

Research Hypothesis One (H_{o1}) There is no significant relationship between experience with technological devices on secondary school students' perception on ease of use of blended learning in Minna, Niger State.

Table 5 presents correlational analysis of experience with technological devices of secondary school students on the perceived ease of use of blended learning in Minna, Niger State.

Table 5 Correlation Analysis between Experience with Technological Devices and Perceived Ease of Use of Blended Learning in Minna, Niger State

Variable	N	df	Mean	STD	R	*p*	Remark
Experience with technology	378	376	3.97	0.79	0.878	0.000	S*
Ease of Use	378		3.64	0.98			

S*: Significant

Table 5 shows that there is positive significant relationship between students' experiences with technological devices and their perceived ease of use of blended learning. The relationship was found to be significant ($r = 0.878$; $p < 0.05$). It implies that there is significant positive relationship between experience with technological devices and the perception of students on the ease of use of blended learning, therefore the null hypothesis was rejected since there is a significant relationship between experience with technology and students perceived ease of use of blended learning Minna, Niger State

Research Hypothesis Two (H_{O2}) There is no significant relationship between secondary school students enabling environment and their perceived usefulness of blended learning in Minna Niger State is presented. Table 6 presents correlation analysis of influences of enabling environment on secondary school students perceived usefulness of blended learning approach in Minna, Niger State.

Table 6 Correlation Analysis between Enabling Environment and Students Perceived Usefulness of Blended Learning in Minna, Niger State

Variable	N	df	Mean	STD	r	*p*	Remark
Enabling Environment	378	376	3.97	0.79	0.602	0.000	S*
Perceived Usefulness	378		3.67	0.98			

S*: Significant

The result from Table 6 shows that that there is significant relationship between students Enabling Environment and their Perceived Usefulness of blended learning by secondary school students in Minna, Niger State. The relationship was found to be significant since ($r = 0.602$; $p < 0.05$). It implies that there is significant relationship between secondary school students enabling environment and the perceived usefulness of Blended Learning Approach in Minna, Niger State, therefore the null hypothesis was rejected.

Research Hypothesis Three (H_{o3}) There is no significant relationship between attitude of secondary school students and utilization of blended learning for teaching and learning processes in Minna, Niger State. Table 7 present correlational analysis of students Attitude and Utilization of Blended Learning in Minna, Niger State.

Table 7: Correlation Analysis between Students Attitude towards Blended Learning and Utilization of Blended Learning Approach in Minna, Niger State

Variable	N	df	Mean	STD	*r*	*p*	Remark
Students Attitude	378	376	3.97	0.79	0.523	0.000	S*
Utilization	378		3.73	0.98			

S*: Significant

The result from Table 7 shows the relationship between students' attitude and utilization of blended learning by secondary school student in Minna, Niger State. The relationship was found to be significant since ($r=0.523$; $p<0.05$). It implies that there is significant relationship between secondary school students' attitude towards blended Learning and the utilization of blended learning for teaching and learning processes in Minna, Niger State, therefore the null hypothesis was rejected and alternate hypothesis retained.

Discussion of Findings

This study is targeted at the assessment of senior secondary school students" acceptance of blended learning approach using technology acceptance model in Minna, Niger State, Nigeria. The findings of the study on research question one revealed that experience with technological devices influences students perceived Ease of Use of blended learning by Secondary School students as it was opined that knowledge of computer and electronic devices enhance their usage of blended learning devices, ability to use computer and electronic devices help in trouble shooting blended learning devices which makes using computer and electronics devices more convenient for students. Similarly, the findings on research hypothesis one depict further that there was statistical significant relationship between experience with technology and perceived ease of use of blended learning for teaching and learning. This supports the findings of Opeyemi *et al.* (2019), their finding revealed that that ease of use, perceived usefulness, and self-efficacy are significant predictors of the intention on adopting digital game-based learning in the classroom. These findings also affirm that of Azizi *et al.* (2020) that concluded in their study on the factors affecting the acceptance of blended learning in medical education, that ease of use and conducive environment are important factors influencing acceptance and adoption of blended learning.

The findings on research question two also disclosed that enabling environment directly influences the students perceived usefulness of blended learning approach and there was significant relationship between students enabling learning environment and the perceived usefulness of blended learning. This agrees with

the findings of Opeyemi *et al.* (2019), their finding revealed that that ease of use, perceived usefulness, and self-efficacy are significant predictors of the intention on adopt digital game-based learning in the classroom. These findings also agree with that of Azizi *et al.* (2020) that concluded in their study on the factors affecting the acceptance of blended learning in medical education, that ease of use, and environment as important factors influencing acceptance and adoption of blended learning. This also agrees with Liu (2022) and Shakeel *et al.* (2023) identified enabling environment as important factor affecting the acceptance of blended learning by teachers. Finally the findings of the study on research revealed enabling environment affect Secondary School students use of blended learning, that is the availability e-Classroom facilities (computers, projection systems, lecture capture systems, SMART boards), well-equipped Computer laboratory (for practical and Internet access), Email services (institutional), Learning Management System (Moodle), Network bandwidth/speed of Internet (download and upload), Wi-Fi access, Online or virtual technologies (network or cloud-based file storage system, Web portals.) among other will improved the optimum use of blended learning approach.

The findings of the study on research question three unveiled that the attitude of secondary school students towards adoption of blended learning directly affects its utilization for teaching and learning processes in secondary schools. It was revealed that expense of adopting blended learning is relatively affordable, blended learning positively influences the teaching and learning in my school, it gives adequate academic performance relevance in teaching and learning and lastly applicable in all range of usage. There was strong statistically significant relationship in the students' attitude towards blended learning and and the use of blended learning inn secondary schools in Minna, Niger State. This findings corroborates that of Liu (2022) who investigated the primary science curriculum student acceptance of blended learning, as the study also focuses on the analysis of perceived usefulness (PU), perceived ease-of-use (PE), perceived playfulness (PP), community support (CS), and other factors that affect the acceptance of Chinese students (SA) in Blended learning of primary science curriculum, with the finding highlighting perceived usefulness (PU), perceived ease-of-use (PE), and perceived playfulness (PP), as an important factors influence student acceptance of blended learning.

Conclusion and Recommendations

Based on the findings of this study on assessment of senior secondary school students" acceptance of blended learning approach using technology acceptance model in Minna, Niger State, Nigeria. It be concluded that experience with technology directly influences the use of blended learning. The implications, perceived usefulness influence blended learning acceptance and utilization by student of secondary schools. The findings of this study further asserted that enabling environment affect the perceived usefulness of blended learning by students, as blended learning positively influences the teaching and learning and gives relevance adequate academic performance. Based on the findings the attitude of secondary school students towards blended learning can influence or impact the utilization of blended learning for teaching and learning processes. Based on the study the following recommendations are pertinent:

1 syllabus connectedness should also be considered for proper integration of blended learning in senior secondary schools, in order to ensure its acceptance by student this will positively influence the perceived Usefulness of Blended learning approach and as such motivates students' attitude towards accepting and actual usage.
2 The student should be exposed to handling technological devices since their experience with various technological devices affects perceived ease of use of blended learning approach. Computer studies should be considered paramount in the process integrating blended learning in secondary school curriculum.
3 Enabling environment should be provided or available in the secondary schools in order to enhance students perceived Usefulness of blended learning this will build students mind about the positive sides of the acceptance and adoption of blended learning approach.

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USING PEDAGOGICAL AGENT-BASED VIDEO INSTRUCTIONS FOR ENHANCING THE INTEREST OF ABDU GUSAU POLYTECHNIC STUDENTS IN THE ATTAINMENT OF TVET OBJECTIVES

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Abstract

This study focused on using Pedagogical Agent-based video instructions to enhance the interest of Abdu Gusau Polytechnic students in the attainment of TVET objectives. The study adopted a quasi-experimental research design with pre-test, post-test and control group. Two intact classes of ND II OTM were used in Zamfara State. One Hundred and Sixty students were used from the two intact classes. The instrument used for the study was Shorthand interest questionnaire which was subjected to reliability check using Cronbach alpha. A reliability coefficient r=.87 was obtained for the instrument. Two research questions and two corresponding null hypotheses were generated and tested using descriptive and inferential statistics. The findings of the study showed that students in the experimental group recorded high interest score than those in the control group, interest scores of male and female students in experimental groups varied. There is statistically significant difference in the interest scores of male and female students in the experimental group. Based on these findings, it was recommended among others that school authorities in Zamfara State should guide Deans to organize conferences, seminars and workshops at school and departmental levels periodically to educate Shorthand instructors on the preparation, production and use of instructional videos in teaching and learning of Shorthand so as to ensure the attainment of TVET objectives on the contemporary education.

Keywords: Video, Pedagogical agent, Shorthand, Interest.

Introduction

One fundamental focus of Technical and Vocational Education and Training (TVET) is to ensure that present students are equipped with transferrable vocational skills that would enable them meet up with the contemporary organizational and economic needs (lugga *et al.*, 2017). Office Technology and management Students, who were the subjects of study to this research, require Shorthand Skills which enable them to speedily and accurately handle office correspondences. Such skills enable the graduates to be employable to every sector of the economy – where administrative roles exist. To enable Shorthand students, grasp these skills, the need to improve their interest on the subject (Shorthand) is important. Resorting to the use of technological means for this crave is paramount.

The influx of Information and Communication Technologies (ICTs) has revolutionized the field of education in the 21st century classroom teaching and learning. These technologies are portrayed in the form of pictures, animated graphics, audio players, video players, and other digitized resources that are used to facilitate teaching and learning. The use of digital resources has not only eased the instructional delivery but also makes teaching and learning interactive and appealing to learners' senses in a more effective manner than is obtainable in conventional classrooms. Researchers such as Poh-sun and Gary (2018) stated that the more the number of learners' senses involved in an instruction, the more concrete the learning becomes. Thus, instructors need to understand the effect of instructional materials, and how to prepare, present, and utilize them in their instructional delivery.

Preparation, presentation, and utilization of instructional resources require instructors' clear understanding of the importance of appealing to learners' senses in instructional delivery. This was clarified by David Berlo's (SMCR) model of communication as he identified the senses of individuals as the means of collecting information (Businesstopia, 2018). By this, we may say that the craving to appeal to multiple senses of learners in instructional delivery presupposes the use of multimedia in teaching and learning. Multimedia integrates various elements such as audio, video, graphics, text, and animation into one synergistic and symbiotic whole that results in more benefit to learners than any one of the media elements can provide individually (Andrew, 2014). This however revealed that one of the important elements of multi-media is video.

A video is an audio-visual resource that provides recorded information for classroom activities. It provides instructors' explanations and demonstrations of ideas, concepts, and theories to enliven teaching and learning. It combines sounds with pictures, animations, and moving images of characters and humans to present classroom activities. Video as an instructional resource is of great significance to classroom instruction as it appeals to learners' senses of seeing and hearing (Brame, 2015). It has the advantage of utilizing sight and audition of the learners which are powerful sources of balance in the classroom as it enhances learning outcome. The use of video concretizes the abstract nature of teaching and learning in the 21st century by bringing forth experiences and resources that are far away from the reach of the learners into the classroom (Brame, 2015). The video also offers the advantage of follow-up drills for students' private practice and self-study patterns by closing the barrier of pace, place, and time. Video provides the opportunity of quizzing students' performance thereby enabling them to self-assess what is learned and what is not (Abubakar *et al.*, 2019).

The availability of video recording and editing facilities led to the creation of videos in a number of ways. Santos (2016) posits that the increasing use of technology to manipulate video recording for classroom instruction over the years made it possible the creation videos in a number of ways. For example, instructor made video (using video clips from camcorders, iPhones, iPods, Smartphone, webcam and digital cameras); re-creating video content from existing ones; direct use of already prepared educational videos (mostly found over the net from YouTube Edu, TEDEd, iTunes and modern libraries); Instructor recorded demonstration videos (where direct classroom recording of instructors' demonstration is done) and animated videos (where inanimate objects, screen shot, images, graphics and other computer generated characters (agents).

Pedagogical agent-based video is a video format that combines pedagogical principles and is presented by a character-like animated object called agent. Pedagogy refers to instructions, teaching, educating processes; while agents on the other hand are computer generated characters developed in an electronic environment to portray human behavioural attributes. Pedagogical agents are intelligent agents with a pedagogical agenda of accomplishing instructional process. Pedagogical agents are commonly presented in image and voice forms. These images come in many different appearances, including humans, animals, and inanimate objects (Meij *et al.*, 2015). Pedagogical agents are designed to support instructions by interacting with learners in an electronic environment. Besides being potentially beneficial for learning, pedagogical agents can decrease anxiety, make interactions with the learner more life-like, direct students' attention to key elements, refine the user experience in virtual environments, and can also exude social interaction schema that can positively influence student motivation (Meij *et al.*, 2015).

To serve a purpose, pedagogical agents are incorporated into visual media such as video. In a pedagogical agent-based video, a computer generated character such as cartoon does the teaching, by demonstrating, illustrating and explaining the instructional contents to learners. Therefore, a pedagogical agent-based video is the incorporation of characters in animation form who deliver instructions as could be performed by the teacher in a conventional classroom. Agents used in instructions aimed to raise students' interest.

Interest is defined as a feeling of curiosity or concern about something that makes one's attention turn towards it. It is a quality that attracts attention, concern or curiosity and readiness to engage in a topic which is sustained by pleasurable activities (Okoronkwo, 2016). Interest in Shorthand is the curiosity of learning the symbolic structure of the Shorthand outlines with the feeling of learning a new way of writing which others could not ordinarily read. Interest in Shorthand occurs when learner exhibits the zeal to learn the art of Shorthand writing through regular attendance, participation in class drills and engaging in private study (Ibegu, 2013). Thus, the way each student learn Shorthand depends on their inherent motivational forces which continue to propel their interest toward devoted learning. These forces collectively drive students' interest towards action especially when such action could bring direct benefits to their intending career (Akaneme & Onyeabor, 2011). But students' interest often differs across gender.

Gender is a socio-cultural phenomenon that divides students into categories of "male" and "female", with each having associated dress, roles, stereotypes and preferences. Some roles or behaviours that differentiate girls from boys are as a result of how their brains work. The differences that exist in how boys' and girls' brains work are as a result of differences in the way their brains develop; the brain development processes in girls begins with their language areas, while in boys the visual-spatial areas of the brain develop first (Ibegbu, 2013). To apply variant instructional methods capable of sustaining students' interest in shorthand, researchers advocated for the use of technology oriented approaches such as pedagogical agent-based video embedded with drill and practice exercises.

Shorthand is the art of representing spoken sounds by written signs. Pitman Shorthand provides a way of representing every sound heard in English words. With little exceptions, every sign used in Shorthand is meant to represent a distinctive sound. Learning shorthand signs requires high level of students' interest; thus the researcher tends to investigate the impact of pedagogical agent-based video on Polytechnic students' interest in Shorthand in Zamfara State.

A comprehensive review of related literature into the field of video, pedagogical agent-based video and other related disciplines regarding interest development of students revealed conflicting results. Studies by Meij *et al*. (2015), that from Serkan and Ahmet (2015) revealed that students in the experimental groups reported higher motivation scores than those in the control group in both science inquiry learning environment and computer assisted instructions respectively. Other studies from Ibegbu (2013), Nworgu and Okereke (2011) reported students in the experimental group having higher interest than those in conventional method group when using DVD content package in teaching Shorthand and constructive instructional model in teaching Biology respectively. Lijia *et al.* (2019) study from China also revealed that students who were taught using pedagogical agent had more interest scores than those taught without an agent when pedagogical agent was used to deliver conversational style of instruction. On the other hand, Danjuma *et al.* (2019) revealed consequently that students in the experimental groups recorded higher interest than those exposed to conventional method of teaching when laboratory techniques enriched with training was used in teaching Biology in Lere.

Statement of the Problems

The task of jotting down executives' speeches, minutes of meetings, and conference proceedings are part of the functions of secretaries. Secretaries achieve this through the use of Shorthand skills. Shorthand skills are speedy and accurate writing skills of representing speech sounds by written signs. Unfortunately, most organizations today complain about the incompetence of secretaries in utilizing their Shorthand skills which allows them to take notes effortlessly at a great speed in their places of work. This problem is attributed to their poor achievement of Shorthand in schools which also resulted from their lack of interest in the course. Students perceived Shorthand as the most difficult and boring course in the curriculum of secretarial training. Evidence revealed that as lecturers lament on poor achievement of students in Shorthand, students on their own part complain bitterly about the total lack of interest in Shorthand even after offering it as a

course for a number of years. To remediate for this, the researcher investigated Pedagogical Agent-Based Video Instructions for Enhancing Polytechnic Students' Interest in Shorthand in Zamfara State.

Objective of the study

The objective of this study was to investigate on Pedagogical agent-based video instructions for enhancing Polytechnic students' interest in Shorthand in Zamfara State. The study's objectives were to:

- Ascertain the impact of pedagogical agent-based video instructions and conventional methods of teaching Shorthand on Polytechnic students' interest in Shorthand in Zamfara State.
- Find out the impact of Pedagogical agent-based video instructions on Polytechnic students' interest in Shorthand in Zamfara State based on gender.

Research Questions

1. What are the mean Gain scores of Polytechnic Students' Interest taught Shorthand using Pedagogical agent-based video instructions and conventional class demonstration method?
2. To what extent do the mean interest scores of male and female polytechnic students taught Shorthand using Pedagogical agent-based instructions vary?

Research Hypotheses

1. There is no significant difference in the mean interest scores of Polytechnic students taught Shorthand using Pedagogical agent-based video instructions and conventional class demonstration method.
2. There is no significant difference in the mean interest scores of male and female Polytechnic students taught Shorthand using Pedagogical agent-based video instructions.

Research Methodology

A quasi-experimental research design with pre-test, post-test and control group was used. Two intact classes of N DII OTM were used from all the two Polytechnics in Zamfara State (Federal Polytechnic Kaura Namoda and Abdu Gusau Polytechnic, Talata Mafara). The Polytechnics were assigned to treatment and control groups through simple random selection. The sample of the students used consists of 98 ND II OTM students (70 Males and 28 Females) of Federal Polytechnic and 62 ND II OTM students (44 Males and 18 Females) from Abdu Gusau Polytechnic, Talata Mafara. The instrument for data collection was Shorthand Interest Questionnaire (SHIQ). SHIQ was a 20-item interest questions on five five-point Likert scale which was validated by educational technology experts and Shorthand lecturers. Cronbach alpha was used to check the reliability of SHIQ and a reliability coefficient of (r) = .87 was found; making the instrument to be reliable. The data gathered from the field was computed using mean and standard deviation (for research questions) and the t-test (for hypotheses). SPSS version 23 was used for the computation.

Results

Research Question One: What are the mean gain scores of Polytechnic students' interest taught Shorthand using pedagogical agent-based video instructions and conventional class demonstration method?

To answer research question one, means and standard deviations were employed; the result is presented in table 1 below:

Table 1: Mean Gain scores of Polytechnic Students' Interest Taught Shorthand using Pedagogical Agent-Based Video instructions and Conventional Class Demonstration Method

	Pre-test			Post-test		Mean Gain
Variables	**N**	**Mean** ($\overline{X}$)	**SD**	**Mean** ($\overline{X}$)	**SD**	
DEMVID	98	43.83	10.468	69.39	13.441	25.56
Control	62	55.32	14.686	66.37	13.506	11.05

Table 1 revealed means and standard deviations of Polytechnic students' interest scores for the experimental and the control groups as: $\overline{X}$=43.83 (SD=10.468); and $\overline{X}$= 69.39 (SD=13.441) for experimental group on

pre-test and post-test scores respectively. The table also revealed $\overline{X}$=55.32 (SD=14.686), and $\overline{X}$=66.37 (SD=13.506) for control group on pre-test and post-test scores respectively. This portrayed that students in experimental group reported high interest score than those in the control group with a mean gain score of 25.56. This however stated that Zamfara State Polytechnic students are more interested in learning Shorthand through pedagogical agent-based video instructions than the human instructor (as is the case with the conventional classroom). Thus, the agent-based video instruction brings a novel situation into classroom which ignites and sustains students' interest.

Research Question Two: To what extent do the mean interest scores of male and female Polytechnic students taught Shorthand using pedagogical agent-based video instructions vary?
To answer research question two, mean and standard deviation were employed. The result is presented in table 2 below:

Table 2: Means and standard deviations for the mean interest scores of male and female Polytechnic students taught Shorthand via Pedagogical Agent-Based Video instructions at Post-test

Groups	Gender	N	Mean ($\overline{X}$)	SD
PABVID	Males	70	71.77	12.458
PABVID	Females	28	63.43	11.606

Table 2 shows means and standard deviations for the mean interest scores of male and female Polytechnic students in the experimental group as: Males $\overline{X}$=71.77, (SD= 12.458); and Females $\overline{X}$= 63.43, (SD= 11.606) at post-test. The table therefore reported that the mean interest scores of male and female students in experimental group varied. The table revealed that male students in the experimental group recorded more interest score than the female students in the group at post-test. This revelation could be as a result of the fact that females are often more indisposed to technologies than their males counterpart.

Hypothesis One (Ho_1): There is no significant difference in the mean interest scores of Polytechnic students taught Shorthand using Pedagogical Agent-Based Video instructions and Conventional Class Demonstration Method. To answer hypothesis one, t-test statistics was employed and the result is presented in table 3 below:

Table 3: T-test Comparison of Mean Interest Scores of Experimental and the Control Group

Variable	N	Df	Mean $\overline{X}$	SD	t- value	p-value
PABVID	98		69.39	13.441		
		158			1.381	.006
Control	62		66.37	13.506		

*Significant at the .05 level.

The t-test result in table 3 indicated that there is no statistically significant difference in the mean interest scores of Polytechnic students taught Shorthand using Pedagogical Agent-Based Video instructions and Conventional Class Demonstration Method (t=1.381, df = 158, P. 0.006). Therefore, the null hypothesis failed to be rejected. This implies that Zamfara State Polytechnic students taught Shorthand using pedagogical agent-based video and those taught through the use conventional classroom demonstration method bear almost the same interest level.

Hypothesis Two (Ho_2): There is no significant difference in the mean interest scores of male and female Polytechnic students taught Shorthand using Pedagogical Agent-Based Video instructions.
To answer this hypothesis, t-test statistics was conducted and presented in the table 4 below:

Table 4: t-test Comparison of Mean Interest Scores of Male and Female students in Experimental Group

Variable	N	Df	Mean (χ)	SD	t- value	P-value
PABVID Males	70		71.77	13.458		
		96			2.878	.005
PABVID Females	28		63.43	11.606		

*Significant at the .05 level.

Table 4 shows the result of t-test comparisons for the mean interest scores of male and female students in experimental group. The result revealed a significant difference of 0.005 (F (3, 243) =16.954, P<=0.05). Therefore hypothesis six (Ho_6) was rejected. This means statistical significant difference existed between the mean interest scores of male and female students from the experimental group in favour of male students. Cohen's d value of (d=0.66) indicated that the difference existed with a medium effect size.

Discussion of results
This research investigated on Pedagogical agent-based video instructions in enhancing Polytechnic students' interest in Zamfara state. The finding of research question one in table one revealed that students in experimental group reported high interest score than those in the control group. This can however be stated that Zamfara State Polytechnic students are more interested in learning Shorthand through Pedagogical agent-based video instructions than with the human instructor (as is the case with the conventional classroom). Thus, the agent-based video instructions bring a novel situation which ignite and sustain students' interest. The findings of hypothesis one in table 3 however indicated that statistical difference obtained in the mean interest scores of Polytechnic students taught Shorthand using Pedagogical Agent-Based Video instructions and Conventional Class Demonstration Method in Zamfara state was not significant.

This implies that Zamfara State Polytechnic students taught Shorthand using Pedagogical agent-based video instructions and those taught through the use conventional classroom demonstration method bear almost the same interest level; although the difference existed but it was marginal. The findings of this study is in line with studies from Ibegbu (2013), Nworgu and Okereke (2011) who reported that students in the experimental group had higher interest than those in conventional method group when using DVD content package in teaching Shorthand and constructive instructional model in teaching Biology respectively. The outcome of this study is also in line with Lijia *et al.* (2019) study from China and Danjuma *et al.* (2019) study from Lere who reported students in experimental group recorded high interest scores than those in the control group when taught with pedagogical agent to deliver conversational style of instruction and when laboratory techniques enriched with training was used in teaching Biology respectively.

The findings of research question two in table 2 reported that the mean interest scores of male and female students in experimental group varied. The table revealed that male students in the experimental group recorded more interest score than the female students in the group at post-test. This revelation could be as a result of the fact that females gender are often more indisposed to technologies than their males counterpart. Consequently, the outcomes of hypothesis 2 in table 4 revealed that the difference that existed between Males and females in the experimental group was statistically significant in favour of male students

with a medium effect size. This finding is in agreement with the study of Okoronkwo (2016) who reported that a significant difference exists between the mean interest scores of male and female students taught History of education using Digital Video Discs Instruction with female students recording high interest scores. The finding has also contradict the findings of Ngedu *et al.* (2019) which reported that no significant difference was obtained between the mean interest scores of students taught Biology using 7Es constructivist instructional strategy based on gender.

Conclusion

Based on the findings of this study, it was concluded that:

1. Zamfara State Polytechnic students are more interested in learning Shorthand through pedagogical agent-based video instructions than the human instructor (as is the case with the conventions classroom).
2. Male students in the experimental group recorded more interest score than the female students in the group at post-test.
3. There is no a statistically significant difference in the mean interest scores of Polytechnic students taught Shorthand using Pedagogical Agent-Based Video instructions and Conventional Class Demonstration Method in Zamfara state
4. Statistical significant difference existed between the mean interest scores of male and female students from the experimental group in favour of male students.

Recommendations

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

1. Shorthand instructors should be familiar with the use of instructional videos especially pedagogical agent-based videos in order to make appropriate selection of the best ones that may increase students' interest in the course.
2. School authorities in Zamfara State should guide Deans to organize conferences, seminars and workshops at school and departmental levels periodically to educate Shorthand instructors on the preparation, production and use of instructional videos in teaching and learning of Shorthand so as to ensure the attainment of TVET's objectives.
3. Shorthand instructors should as much as possible use videos that would remove gender biases in their classes to ensure that both male and female students' interests are catered to enable them both learn the subject with a high degree of expertise as enshrined in the TVET objectives.
4. Zamfara State government and school administrations should aid Shorthand instructors with funds and other supports in the production of educational videos so that the sole aim of technical and vocational education would be achieved greatly by the students.

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EFFECT OF BLENDED LEARNING ON ICT PERFORMANCE AMONG NIGERIAN UNDERGRADUATE TEACHER TRAINEES

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Abstract

The effect of blended learning on ICT performance among Nigerian undergraduate teacher trainees was studied using one-group, pre-test post-test quasi-experimental design. Four research questions and three hypotheses guided the study. The study had a census sample of 467 undergraduate teacher trainees at Benue State University, Makurdi who offered EDU 205 (Application of Information and Communication Technology in Education) Information and Communication Technology Performance Test (ICTPT) with a reliability coefficient of 0.86 was used for data collection. After, pre-test, the undergraduate teacher trainees were exposed to blended learning using marker and board, Google Classroom and emailing for six weeks before being post-tested. Mean, standard deviation and percentage were used to answer the research questions and the hypotheses were tested at 0.05 level of significance using ANOVA. The Study's findings revealed that blended learning improved the ICT performance of the students regardless of their gender. Also, both male and female students have equal access to online based platforms and tools used for the study. It was recommended that blended learning should be employed to improve undergraduate teacher trainees' access to Computer Based Learning (CBL) as well as ICT performance.

Keywords: Blended-learning, ICT (Information and Communication Technology), Gender, Performance

Background to the Study

There is increasing discourse in education about how best to integrate Information and Communication Technology (ICT) into the wholesome activities which define teaching and learning in tertiary institutions. The crux about these discussions center on how best to achieve learning goals and to achieve greater access and inclusion which may be achieved through blended learning. Blended learning is a teaching method which combines traditional in-person classroom instruction with online learning components within the same educational course or program (Commonwealth of Learning, 2023) which some have hailed as the "new normal" in ICT including collaboration which is a skill that aims to develop collective intelligence in terms of helping, suggesting, accepting, assessing and negotiating through interactions with other people that are mediated by technology (Dziuban, Graham, Moskal, Noberg, & Sicilia, 2018; Sohaya, 2020). This means that blended learning entails a strategic integration of both face-to-face and online learning experiences to enhance the learning process and provide undergraduate teacher trainees with a more flexible and diverse learning environment. This learning approach aims at leveraging over the advantages of both traditional and online learning methods to cater for different learning preferences and needs.

Science Technology, Engineering and Mathematics (STEM) or Science and Mathematics Education (SME) has formed a considerable part of teacher training in most tertiary institutions in Nigeria. Other areas include Arts and Social Sciences, Foundations and Management, Human Kinetics, Library and Information Science. Meta-analyses have shown that the growing number of students in Higher Education have problems understanding the course content in science and mathematics education, due to poor grasp of the subject matter attributed to instructional approaches and learners' perceptions of the learning environment (Akpan, 2015). The scenario is replete among other courses of study in universities with high dropout rates leading to low graduation percentages. Therefore, supplementing conventional face-to-face learning in the classroom with technological-based tools could stimulate learners' interest and give them control of their learning task and may also increase the number of students taking science and mathematics courses. These

ICT collaborative tools include for communication, content delivery, assessment, content exchange and group work.

Currently in Nigeria, there continues to be a widening educational gap between the so-called lower class of student population and those communities with greater financial and technological resources as is the case with many other countries. Equal access to education is a critical need, one that is particularly important for those in our local communities. The answer to whether blended learning can help increase access thereby alleviating some of the issues faced by our lower income students while resulting in improved educational quality and equality at the moment, remains to be determined. ICT adoption creates increased access to education, promotes user interfaces, provides technical support, as well as active student interaction and engagements (Ode, Ayua & Alagwu, 2019; Ibnzaid, 2022; Tong, Uyen & Ngan, 2022). *This implies that in integrating ICT in the teaching-learning process in the classroom, teachers could give undergraduate teacher trainees feedback on assignments, which involve long-term projects and have the teacher trainees assess the quality of the work.* Most Virtual Learning Environments (VLEs) require specific software to be installed on the users' electronic devices which operate across the World Wide Web. Thus, learners often need internet connectivity to access learning thereby posing huge constraints on them. This underscores the need for Nigerian universities to provide internet facilities that are blended learning compliant and suitable for sustainable development.

The 2030 agenda for Sustainable Development Goals adopted by all United Nations Member States in 2015, provides a shared blueprint for peace and prosperity for people and the planet, now and into the future. There are 17 Sustainable Development Goals (SDGs), which are a crucial call for action by all countries whether developed or developing - in a global partnership (United Nations, 2023). Gender and inclusiveness as captured in the Sustainable Development Goals number 4 (SDG4) stipulates that inclusive and equitable quality education is ensured to promote lifelong learning opportunities for all category of leaners.

Research Questions

The following research questions guided the study:

1. What is the level of access to blended learning among undergraduate teacher trainees?
2. What is the effect of blended learning on the ICT performance of undergraduate teacher trainees?
3. What is the mean difference in ICT performance based on the discipline among undergraduate teacher trainees exposed to blended learning?
4. What is the mean difference between the ICT performance of male and female undergraduate teacher trainees exposed to blended learning?

Hypotheses

HO_1. Blended learning has no significant effect on the ICT performance of undergraduate teacher trainees.
HO_2. There is no significant difference among the ICT performance of undergraduate teacher trainees exposed to blended learning based on discipline.
HO_3. There is no significant difference between the ICT performance of male and female undergraduate teacher trainees exposed to blended learning.

Materials and Methods

The study adopted the one-group, pre-test post-test quasi-experimental design. The population for the study comprised all the 467 (196 males and 271 females) undergraduate teacher trainees at Benue State University, Makurdi, who offered EDU 205 (Application of ICT in Education). The sample for the study was drawn by census sampling, which equals the population. This sampling was necessary to get information about every member of the population to give its complete picture. Information and Communication Technology Performance Test (ICTPT) was used for data collection. The researchers-made ICTPT, had sections A and B. Section generated biodata. Section B had 60 multiple choice test items, which were entered into Google Forms. ICTPT was validated by two experts at Benue State University and

pilot-tested on 341 students who offered the course in previous academic year (2020/2021) with a reliability coefficient 0.86 determined by Kuder-Richardson (K21) statistical tool (formular).

The pre-test was administered on the respondents in the first week of the semester after introducing the course outline to the students. The students' biodata and emails were collected using Google forms, which was used to enrol them onto a Google Classroom created for the purpose of the course. There were 6 weeks of 2-hour lectures using a mix of face-face, board and marker lectures as well as interactions using emails and the Google classroom, which included sharing of course materials, videos and links related to the course. At the ended of the blended learning, the post-test was immediately administered by sending the Google Forms link for post teaching evaluation (post-test). The data was collected and analysed using mean, standard deviation as well as simple percentages to answer the research questions, while ANOVA was used to test the hypotheses at 0.05 level is significance. Although the target sample was 467 undergraduate teacher trainees, there was a sample under-representation due to participants dropping out of the study, missing data and teacher trainees' lack of access to internet. Therefore, the analysis and results were based on the accessed sample, which was reasonably enough for valid results.

Results

The results of the study are as presented in Tables 1-7:

Table 1: Percentage Level of Teacher trainees' Access to Blended Learning by Gender

Gender	Total (N)	%N	Pretest	% N	Posttest	%N
Male	196	41.97	109	23.34	177	37.90
Female	270	57.83	179	38.33	249	53.32
Total	**467**	**100**	**288**	**61.67**	**426**	**91.22**

Data in Table 1 show that of the total population of 467 teacher trainees, 196 were male (41.97%) and 270 were female (57.83%). A total of 288 (61.67%) of the population participated in the pretest while 416 (91.22) participated in the posttest. The also show that 109 (23.34%) and 177(37.90%) were male students at the pretest and posttest respectively, while 179 (38.33%) and 249 (53.32%) were female students at the pre and posttest respectively. This indicates that as the percentage access to blended learning among the male students increased, a similar trend was elicited by the female students, which implies that blended learning is encouraged across gender.

Table 2: Mean and Standard Deviation for Pre-test and Post-test

Test	N	Mean	Std. Deviation
Pre-test	288	27.53	9.418
Post-test	426	38.25	11.831
Mean difference		10.72	

Table 2 show data for the mean obtained by the students in the pretest was 27.53 with a standard deviation of 9.42, while the posttest gave a mean of 38.25 with a standard deviation of 11.83, which gave a mean of difference between the two tests of 10.72. Also, the standard deviations indicated that both data set were homogenously similar in their spread. This implies that blended learning improved the ICT performance of the students.

Table 3: ANOVA for the Effect of Blended Learning among Teacher Trainees

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	19733.580	1	19733.580	165.415	0.000
Within Groups	84939.777	712	119.297		
Total	104673.357	713			

Analysis of Variance of the data obtained from the pretest and posttest showed that there was a significant difference between the scores where $F_{(1,712)} = 165.415$, $p = 0.00 < 0.05$. This led to the rejection of the null hypothesis which states that Blended learning has no significant effect on the ICT performance of undergraduate teacher trainees.

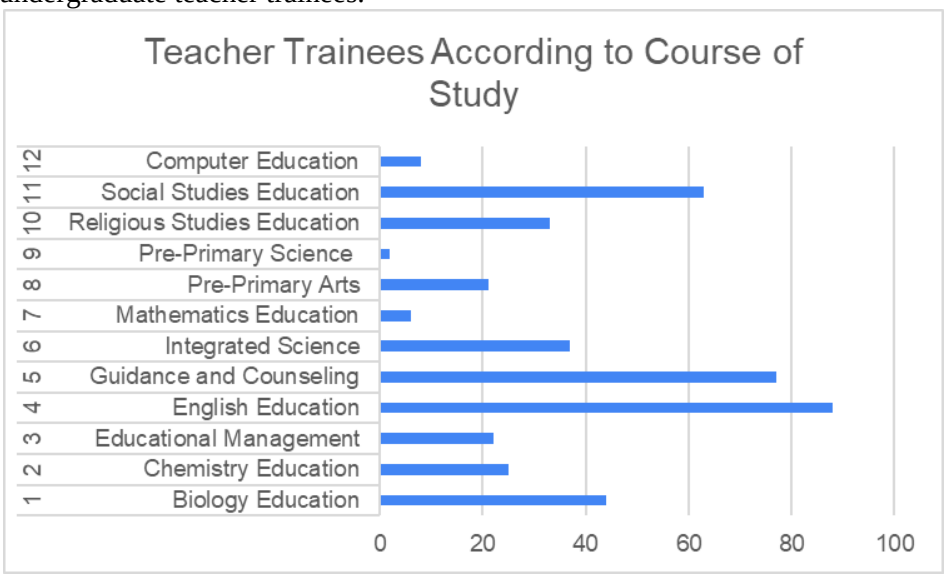

Figure 1: Teacher Trainees According to Course of Study.

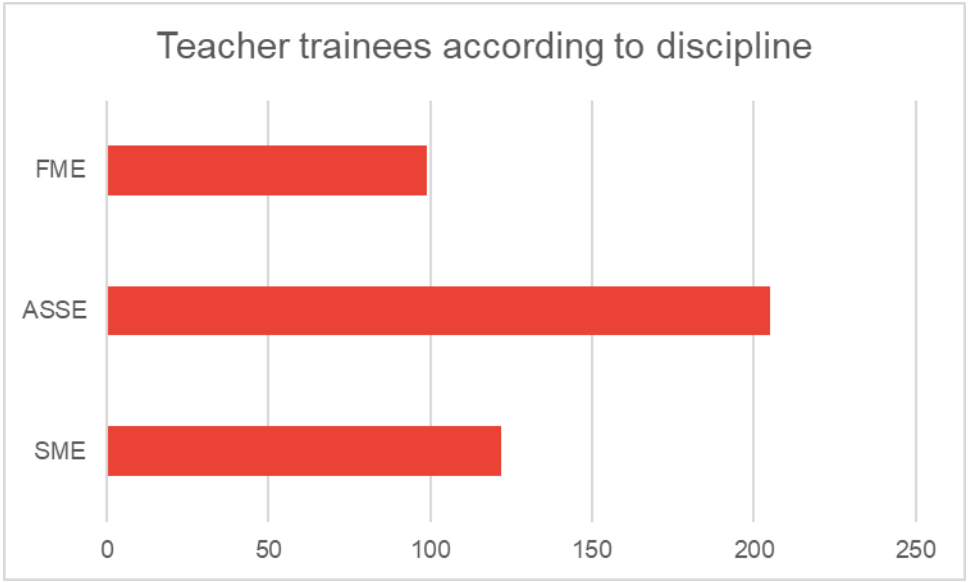

Figure 2: Teacher Trainees According to Departments

Key: Science and Mathematics Education (SME), Arts and Social Science Education (ASSE), Educational Foundations (EF)

Table 4: Mean and Standard Deviation of Teacher Trainees' ICT Performance Based on Departments

Departments	Mean	N	Std. Deviation
SME	42.45	122	12.024
ASSE	37.46	205	11.699
EF	34.72	99	10.377

Using the posttest scores, Table 4 displays information which show that SME students had a mean of 42.45 with a standard deviation of 12.02, while ASSE had a mean of 37.46 with a standard deviation of 11.70, and EF had a mean of 34.72 with a standard deviation of 10.38. This indicates that students in SME had a higher mean score followed by students in ASSE with EF coming in third among the three disciplines, with standard deviations which depict homogeneity.

Table 5: ANOVA for Difference in the ICT Performance of Teacher Trainees Based on Discipline

ANOVA	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	3516.941	2	1758.471	13.291	.000
Within Groups	55967.183	423	132.310		
Total	59484.124	425			

Table 5 reveal that there was a significant difference among the three departments where $F_{(2, 424)} = 13.29$, $p = 0.00 < 0.05$. This led to the rejection of the null hypothesis which states that There is no significant difference among the ICT performance of undergraduate teacher trainees exposed to blended learning based on discipline.

To determine where the significant difference lies among departments, Scheffe's post-hoc analysis was run and the summary of the result is presented in Table 6.

Table 6: Scheffe-Test: Pairwise Comparison of ICT Performance among Teacher Trainees Based on Department

(I)Department	(J) Department	$\bar{x}$ Diff (I-J)	Standard Error	P. value	Remark
SME	ASSE	4.992*	1.315	.000	Significant
	EF	7.734*	1.556	.000	Significant
ASSE	SME	-4.992*	1.315	.000	Significant
	EF	2.741	1.408	.127	Not Significant
EF	SME	-7.734*	1.556	.000	Significant
	ASSE	-2.741	1.408	.127	Not Significant

Significant at P ≤ α (0.05) level of Significance

In Table 6, Scheffe's post-hoc analysis showed a significant difference in the pairwise comparison of teacher trainees' ICT performance between SME versus ASSE; SME versus EF and vice versa since P-value (0.00) is less than α (0.05) level of significance. Meanwhile, the difference between ASSE versus EF teacher trainees and vice versa was not significant since P-value (0.127) is greater than α (0.05) level of significance.

Table 7: Mean and Standard Deviation of Teacher Trainees' ICT Performance Based on Gender

	Pretest		Posttest		
Gender	**Mean**	**S.D.**	**Mean**	**S.D.**	**Mean Gain**
Male	27.24	10.06	38.10	10.57	10.86
Female	27.72	9.03	38.04	11.02	10.32
				Mean Difference	**0.54**

Data in Table 7 show that male students had a mean of 27.24 and standard deviation of 10.06 in the pretest, also the male students had a mean of 38.10 and standard deviation of 10.86 in the posttest which gave a mean gain of 10.86. The female students had a mean gain of 10.32 from a mean of 27.72 and 38.04 in the pretest and posttest, while having a standard deviation of 9.03 and 11.02 in the tests respectively. The table further shows that there was a very small mean difference of 0.54 between the ICT performance of male and female teacher trainees.

Table 8: ANOVA for Difference Between Male and Female Teacher Trainees

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	67.318	1	67.318	0.458	0.499
Within Groups	104606.040	712	146.919		
Total	104673.357	713			

Table 7 displays results from ANOVA which shows that there is no significant difference between the performance of male and female students where $F_{(1,712)} = 0.458$, $P = 0.499 > 0.05$. This led to the non-rejection of hypothesis which states that There is no significant difference between the ICT performance of male and female undergraduate teacher trainees exposed to blended learning.

Discussion of Findings

The study found that the percentage level of teacher trainees' access to blended learning significantly improved at the post-test without gender and department difference. This led to significant increase in the ICT performance of teacher trainees across gender and disciplines as a result of integrating/applying ICT in the teaching and learning processes. These agrees with the findings of other researchers (Alsalhi *et al.*, 2021; Tong, Uyen & Ngan, 2022) whose findings indicated significant statistical differences among the mean scores on the students' post-test achievement in favor of the experimental group of undergraduate students, who were educated through blended learning. Also, Ndioho, Etokeren and Kingdom-Aaron (2021) averred that Science education undergraduates in the experimental group taught using blended learning performed significantly better with higher score in the ICT performance test than those in the control group taught with lecture method. Although among the three groups of disciplines (departments), a significant difference existed in the mean ICT performance between SME versus ASSE; SME versus EF and vice versa since. Nevertheless, the difference between ASSE versus EF teacher trainees and vice versa was not significant since. All the same, teacher trainees' ICT performance at post-test were significantly better than those at pre-test.

Also, on the ICT performance according to gender, this study found that male and female students performed at par to each other, which is corroborated by Igyu, Ada, Achor and Ada (2022), who found that

there was no significant difference in the ability levels of male and female teacher trainees in working online for the study of application of ICT in Education in the Faculty of Education, Benue State University, Makurdi and the findings of Ndioho, Etokeren and Kingdom-Aaron (2021) who stated that bended learning is not gender discriminatory as it enhances the ICT performance of both male and female science education undergraduates. But contradicts the findings of Alsalhi et al (2021) whse outcomes showed that the scores of the experimental group students were diverse based on the variable of gender in favor of females.

Conclusion

The study concluded that blended learning boost undergraduate teacher trainees' ICT performance, which is a significant factor in enhancing both male and female undergraduate teacher trainees' academic learning and achievement.

Recommendations

Based on the findings and conclusion, the study recommended as follows:

1. Blended learning as a component in ICT is to be employed more broadly to include various educational fields in order to improve learning outcomes.
2. University teachers should be encouraged give students feedback on assignments that involve both short and long-term projects and have the students assess the quality of their collaborative works using blended learning.
3. Ease of access is a key component in blended learning which may be factor that motivates university learners and endear higher ICT performance.
4. Nigerian university authorities should provide ICT/internet facilities that are blended learning compliant and suitable for sustainable development.

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PROSPECTS AND CHALLENGES OF INTEGRATING BLENDED LEARNING IN NIGERIA SCHOOLS

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Abstract
Science and technology education is vital to national growth and technological development. In Nigeria, science and technology education is modelled to ensure that the country has a population of trained and competent scientists to drive its technological advancement. Technological advancement has brought new opportunities, facilitating many innovative approaches in educational sector, enriching the teaching and learning experience. Technology has changed the way teaching is done and the way students learn stimulating students' interest, curiosity and motivation. The advent of digital technology has dramatically changed the routines and practices in most arenas of human exertion. Information and Communication Technology has paved the way for accelerating a paradigm shift in the teaching-learning processes. Several research findings support that online learning enhances learning as well as higher order thinking skills. However, all topics in science cannot be transacted completely online. Moreover, science as a discipline demands certain modes of transaction such as experimentation, demonstration and discussion. Therefore, blended learning as a pedagogical strategy for facilitating learning by skilfully blending online learning techniques such as delivery of materials through web pages, discussion boards and/or emails with the effectiveness and socialization opportunities of face-to-face instruction become significant. Though the blended learning strategy is gaining momentum all over the world, most of the researches on blended learning focus on higher education. In this context, the present study attempts to check the prospects and challenges of integrating blended learning in Nigeria schools.

Keywords: Technology, Science, Chemistry, Blended learning, Internet

Background to the Study

The world has revolutionized as a result of technology, climate change, covid-19 and globalization. Therefore, these challenges both the teacher and student in the acquisition of innovative methods and new skills for teaching and learning (Kalyani & Rajasekaran, 2018; Majherová & Králík, 2017). According to Numonjonov, (2020), the application of innovative methods in teaching through the use of technology is a new normal which have come to stay. Researchers have shown that innovative pedagogies are in the front line of discussion in academics (Olimov, 2021; Süer & Oral, 2021), while is yet to establish its effectiveness in developing country like Nigeria (Emelife, 2021). Researchers have argued that the use of modern technology in Nigeria is poor as a result of being non-compliant with innovative pedagogical tools (Obaroakpor, Dikenwosi & Obaroakpor, 2021; Aguboshim, Onwuka, Obiokafor, & Oboti, 2021). Innovative pedagogical tools are the instructional technological tool that aid students to participate actively in either virtual or real classrooms (Korucu-Kış, 2021).

Technology has changed the way teaching is done and the way students learn stimulating students' interest, curiosity and motivation. Presently, man is experiencing an era in scientific and technological development that affects his life in one way or the other. Virtually everything we use daily involves science.

The knowledge of science has been widely applied in solving basic human needs and improving living standards of the people.

Science may be regarded as the body of related courses concerned with knowledge. It consists among other component; Chemistry, Physics, Biology, Mathematics, Astronomy, Agriculture, among these, chemistry is vigorously described as the queen of science.

The field of chemistry has made major contributions in health care. For instance, chemical knowledge has helped in the preparation and use of materials for surgery. The sutures used in surgeries today do not have to be removed because they dissolve in the body after a period of time. Again, the global nations have been challenged and threatened by the COVID-19 pandemic. The field of chemistry is playing an undeniable, significant and indispensable role in the development of the vaccine and drugs for the prevention and treatment of the virus. The development of a new drug for any disease involves a complicated chemical analytical process. The chemistry of the disease as well as the chemistry of the human body must be studied to determine how the drug would affect the patients. The role of chemistry in scientific and technological development informs why it is a pre-requisite for studying many science-based courses in Nigeria Universities. Standard teaching which involves the inculcation of good knowledge with the purpose to enhance quality service delivery so as to meet man's requirement for food, health care facilities, and a host of other materials to advance the quality of life that humans live is termed chemistry education (Khanam, 2018).

Chemistry is the central in the drive of global sustainable economic development. It plays the major roles in food (fertilizers and insecticides), clothing (textile fibers), housing (cement, concrete, steel, bricks), Medicine (drugs), Transportation (fuel, alloy materials). Chemistry is a fundamental subject needed to combine with other lifelike science subjects such as physics, and biology to guarantee learners admission into higher institutions. Joint Admission and Matriculation Board (JAMB) (2020/2021UME) Brochure spelled out the guidelines for admission into first degree courses in Nigerian universities clearly stated that the mandatory subjects for all courses in medical/pharmaceutical and health science, five '0′ level credit passes in English Language, mathematics, physics, chemistry, and biology are necessary. For all courses in sciences, five '0′ level credits including English Language, chemistry, mathematics, physics, and biology. In engineering/environmental technology, education science, computer and agricultural science, chemistry is required (Jamb, 2021). Efforts to improve instructional delivery by chemistry teachers through the use of students-centered instructional strategies have been advocated by chemistry educators (Udofia & Edem, 2019). The teaching of chemistry needs the use of appropriate instructional strategy capable of creating an interactive learning environment for meaningful learning and understanding of concepts to enhance a better academic achievement and retention in the subject

The importance of this subject for students' future career aspirations in that academic and professional disciplines cannot be overemphasized. Review Reports Unfortunately, the performance and attitude of students in this important subject have not been encouraging (Abulude, 2016; Nja et al., 2017).

In spite of the significant role of chemistry in industrial and technological development of the society, chemistry students have continued to experience a decline in academic performance in external examination like NECO and WASSCE. In Nigeria. several factors have been identified such as infrastructural problem, poor study habits, poor retention, gender, teachers' attitude to work and application of ineffective teaching strategies among others. Of all these factors, instructional strategies employed by teachers appear overbearing because of its facilitating effect in understanding the concept taught. Efforts to improve instructional delivery by chemistry teachers through the use of students centred instructional strategies have been advocated by chemistry educators (Udofia & Edem, 2019).

The 21st century is characterized by a technology-infused environment with a budding generation of digitally conscious youths that are highly conversant with various forms of electronic gadgets and tools from the Information and Communication Technology (ICT) sector, such as personal computers (laptops, etc.), cellular or smart phones, digital (satellite) television channels and other emerging electronic media

that allow people and organizations to communicate and share information digitally. Therefore, it has become paramount to address the challenges and expectations of 21st-century learners and provide them with alternative and new learning opportunities capable of responding to their teachers, growing interest in technology-based learning experiences. For instance, the application of computer technology in a classroom environment has been shown to play a significant role in enhancing the teaching and learning of science subjects. These computer technologies could include e-learning, and blended learning, among others (Falode & Onasanya, 2015).

Karma et al., (2019) defined e-learning as a student-focused learning media that utilizes electronic equipment, such as computers and smartphones, to deliver instruction. It is basically an online version of face-to-face instruction, in that it only focuses on presenting instructional content via the Internet (Karma et al., 2019). it can also be used in conjunction with face-to-face teaching, in which case the term blended learning is commonly used.

Blended learning (BL), a term derived from the words "blend" and "learning," is an educational model that combines various learning strategies. Blending things together is what the term means, and learning is the act of acquiring useful information. It is also a combination of ideas, techniques, and technologies to establish optimum learning in a certain environment, Cronje (2020) proposed that a definition of BL must contain context, theory, method, and technology.

Blended learning also referring to the use of online platforms and applications to deliver a lesson while teacher facilitates instruction (Bazelais and Doleck, 2018).

Types of blended learning

Mishra and Devi (2022) expressed that to execute the mixed learning, six models ought to be hypothesized, specifically: supplemental model, face to face or replacement model, emporium model, flex or completely online model, buffet model, and linked workshop model.

Supplemental model

This is a mixed learning supplements of conventional course or educating growing experience by utilizing innovation based materials, items and talks or out-of-class exercises. By utilizing innovation based materials it changes over the latent learning climate of a class into dynamic learning climate and furthermore countless understudies can be benefited by embracing this model of mixed learning (Olatunde-Aiyedun, 2021). The fundamental qualities of Supplemental model are the quantity of class gatherings (eye to eye addresses) continues as before; the class gatherings (up close and personal) addresses are enhanced by the innovation based materials, items and talks or out-of-class exercises; the fundamental reason for involving supplements in up close and personal class gatherings is to make the understudies more drew in and dynamic in the class. The strategy expects understudies to audit the material containing intuitive exercises, re-enactments, narratives, recordings and so on.

Appraisal can be directed by online tests toward the finish of every week. The understudies might be approached to endeavour the tests on various occasions until they fulfil with their own advancement. The understudies might be told that main the last score or the most noteworthy score will be viewed as in their formative appraisal. This cycle can be utilized preceding up close and personal connections; for example, out-of-class. Be that as it may, carrying out supplemental model of mixed learning the test is in regards to responsibility on understudies (Viditi, 2022).

Replacement model

This model replaces some homeroom time (eye to eye collaboration time) with on the web, intuitive exercises. In this manner this model decreases the quantity of class gatherings by supplanting some class gatherings with on the web, intuitive or clobber exercises and by making a few changes in nature of

outstanding class gatherings. The fundamental attributes of replacement model are: it diminishes the genuine number of class gatherings for example up close and personal class time; it additionally thinks about which exercises can be performed better in web-based mode and can give improved outcomes, which exercises can be directed separately and which can be led in bunch; the leftover class gatherings might be altered by changing the exercises into open air, lab, or online exercises so understudies can take part and connect with themselves whenever, anyplace. During these exercises, understudies might work exclusively or in bunch. This model plans understudies by perusing the reading material, finishing tasks, and utilizing web-based assets (Chowdhury, 2020).

Emporium model

This model replaces the entire class gatherings with a learning resource center model. The principal component of this learning resource center is use of an intuitive program and customized help whenever required. This model depends on the learning resource center model having intuitive programming and customized help. A space like the learning resource center offers heaps of network and offices–PCs, remote associations, simple admittance to all web-based course materials, adaptable furnishings, and so on. It gives the potential to open doors to understudies to choose learning materials, for example, intelligent programming relying on their inclinations and requirements, and deal with the materials rapidly (Mozelius & Hettiarachchi, 2017). The ramification of this model is that it requires more framework and costly gear to advance the better utilization of shared space for example learning resource center.

Fully online model

This is a shift or dispose of eye-to-eye classes to internet growth opportunities, web-based exercises, reproductions, intuitive programming, and online appraisals alongside input and elective model human resource management. It might take on certain components of different models like components of supplemental, replacement, and emporium models including web-based exercises, recreations, intelligent programming, online appraisals along directed criticism, connections to extra assets and elective human resource management model. In this model educators are not liable for all cooperations, addressing each question exclusively, remark, or conversation (Ekpo & Aiyedun, 2020). Educators don't have to introduce content before understudies as Software presents the substance. All tasks evaluated up by the actual product thus the accomplishment of learning targets regarding every understudy can undoubtedly be investigated by the educators (Olatunde-Aiyedun et al., 2021).

Buffet model

The buffet model spotlights on customization of the learning climate for individual understudy in light of their experience, learning inclination, and scholarly/proficient objectives. This model offers understudies a progression of individualized ways to every understudy to accomplish similar learning results. This model redoes the learning climate for individual understudy according to their experience, learning inclination, and scholarly/proficient objectives. It requires a web-based appraisal to recognize the understudy's learning styles and study propensities. It incorporates a progression of learning open doors for understudies for example it incorporates addresses, individual disclosure by research center work (in-class and web-based), group/bunch revelation by lab work, individual and gathering audit (both live and remote), concentrate on in little gatherings, recordings, therapeutic/essential/strategy preparing modules, oral and composed introductions, critical thinking in huge gathering, schoolwork tasks, and individual and gathering projects (Bryan & Volchenkova, 2016). It presents the total course as modules.

Linked workshop model

This model gives medicinal/formative guidance. The medicinal directions are given by connecting studios. These studios offer understudies supplemental scholastic help on time. This model holds the fundamental design of the course, for example the quantity of class gatherings continues as before. The healing/formative course is given by studios, not in class gatherings. The motivation behind leading these studios is to eliminate lacks in course ideas understanding and abilities (Ayob et al., 2020). Studios are led in little

gatherings utilizing PC-based guidance. Programming modules are appointed to individual understudy according to their exhibition and test survey of symptomatic testing. Incredible understudies of the greater classes are prepared by the educator and afterward these understudies work with these connecting studios.

Instructional purposes and usage

By adopting blended learning as a strategy in Nigeria Schools, seeks to create a hybrid learning environment in which educational systems provide and present educational components such as content, learning activities, support services, teaching and evaluations, and quality evaluation system independently in face to face and online manner and then integrate them with each other. Universities like Indirah, Anadolu, and OUC usually emphasize on mixing e- learning with face to face learning mechanism. These attempts conceptually are close to hybrid learning and not to blended learning because at these universities, characteristics of blended learning such as developing live interactions, self-learning, cooperation and self-assessment does not take place.

Blended learning environment must focus on extending live interaction, collaboration, evaluation, self-learning, and function supports. And then, different components of learning, such as self-learning, printed and multimedia materials, individual and group learning activities, learning resources, technical and instructional support services for teachers and students, teaching and evaluating the learned materials, formulating the quality evaluation system, and especially, transactions and the effects between them should be put together to improve learning quality.

The Benefits of integrating blended learning:

(1) Encouraging hesitant teachers to try blended learning: teachers who could benefit from blended learning may be reluctant to try it because they think that blended learning is very complex and highly technical.

(2) A quick approach in which the teachers can directly add a new activity that appropriately meets the students need without consuming extra time and effort in rethinking and preplanning the whole course or investigating the many possible blended learning components and delivery methods.

(3) A low risk of failure: the three major risk factors identified by teachers who have taught blended courses are: fear of receiving lower student evaluations, fear of losing control over the course, and uncertainty about the impact of online learning on classroom relationships. Adding an activity while keeping the traditional course almost the same can minimize these risks.

(4) Minimal experience in teaching the traditional course is enough to design the blended course. With limited experience the instructor can spot the part of the course that could be enhanced by an extra online activity.

Prospects for integrating blended learning

It is important for teachers to understand basic pedagogy before attempting a new instructional strategy, such as how the model will impact the students' ability to think critically, collaborate in their learning and interact towards the success of their learning (Strohmyer, 2016)

The teaching of chemistry needs the use of appropriate instructional strategy capable of creating an interactive learning environment for meaningful learning and understanding of concepts to enhance a better academic achievement and retention in the subject. Chemistry teachers therefore need to be conversant with numerous and innovative teaching strategies that take recognition of the magnitude of complexity of the concepts to be taught.

The Internet is the basis for the use of technological tools in learning, and high-quality connections play a leading role in enabling pupils and students to take advantage of its potential in new learning environments which may be integrated into the formal dynamics of teaching and learning (Shaidullin, *et al.*,2014& Siew-Ling & Anak, 2015)

The Internet plays an important role in supporting remote work, online learning, online collaboration, and so on (Favale et al., 2020). Online learning and training make full use of the advantages brought by the innovation of Internet technology, breaking through the constraints of time and space, and constructing a new learning model which differs from face-to-face learning (Panigrahi et al., 2018). When students study via an online learning platform used as a virtual classroom, they can interact with teachers freely (Ganesh et al., 2015). However, scholars have pointed out that experimental courses which involve practical learning have often been implemented in face-to-face classrooms or laboratories, whereas the vast majority of online courses lack hands-on activities requiring experimental operations.

Online learning helps learners overcome the limitations of time and place. Behavioural engagement emphasizes the time and energy that learners devote to online learning courses in order to achieve the desired learning effectiveness (Hong et al., 2021). Many studies have focused on college students' online learning. For example, Kumari et al. (2020) proposed that the adoption of new technologies in online courses was able to boost graduate students' satisfaction with their competitive examinations, and encouraged participants to improve their inquiries in forums and with feedback on concepts and time management. In addition, Hong et al. (2016) found that using YouTube to learn guitar could facilitate college students' procedural knowledge learning. The recent decade has been witnessing dramatic growth and various benefits in the use of online learning in education (Allen & Seaman, 2017). Numerous studies reported that online learning could increase student participation, improve discussion quality, and foster online interactions. The discussion forum could support students and improve learning by solving difficult problems. Mobile technologies such as applications and computers could enable an easy access to an online learning platform and facilitate mobile learning effectiveness (Panigrahi et al., 2018). One of the factors that is crucial for functional science and technology education is that the learners must be ready to receive and retain what he or she has been taught.

Challenges in integrating Blended Learning in Nigeria

Adopting blended learning strategy by educators showed some difficulties and challenges which might have some consequences on the quality of the learning process and may hinder its expansion and application in various learning settings. five challenges were identified:

(1) Technological knowledge: to successfully integrate technology into the teaching experience, teachers need knowledge that can allow them to:
- identify which technological tool is needed to meet a specific pedagogical goal
- specify how the tool will be used to help student to achieve that goal
- enhance students' ability to use appropriate technological tools in the different phases of the learning process: exploration, analysis and production
- select and adopt technological tools that can allow them to identify need and resolve issues related to their own professional development.

(2) High risk of producing two separate courses: adding online work to a traditional course without reducing in-class time often leads to two separate courses, one online and one face-to-face.

(3) Adding an extra activity can be seen by students as a burden rather than a bonus. The added activity can be regarded by many students as just another task on top of an already content-heavy course.

(4) Adding a new activity without eliminating an existing one can excessively increase the instructor's workload. Teachers can face time constraints and overwhelming workloads as a result of adding additional online teaching resources.

(5) Extra activity in an existing course is often not recognized by administrators, and teachers are therefore not compensated for their efforts., inadequate compensation and incentives is one of the main factors negatively affecting teachers' e-learning use.

When chemistry is taught using practical activities through the use of instructional materials, especially with improvised instructional materials, students tend to remember what was taught. Tera (2018) claimed that instructional resources ensure that the learners see/ hear/ feel/ recognize and appreciate as they learn /

utilize almost all the five senses at the same time. The availability and use of teaching and learning materials, like textbooks in the sciences and laboratory equipment, affect the effectiveness of the lessons and the learners' motivation. It makes the teacher's lesson more concrete; and students learn more easily by doing. Thus, students' achievement is highly improved by the availability and good use of teaching and learning materials; and students enjoy an activity-based lesson; and they then participate actively in the course (Banyoko et al., 2016; Ejidike & Oyelana, 2015; Tolsdorf et al., 2018).

Chemistry students' academic achievement refers to their educational accomplishment at school, and it is characterized by score or percentage (Ajayi, 2017a). As an indicator, academic achievement is an important milestone for learners; it is the vital goal of learning Chemistry all over the world.

Anyanime and Abasifreke (2019) linked students' low achievement in chemistry to teachers' use of ineffective traditional methods of teaching which do not make room for active learning. Academic achievement relies hugely on teaching and learning, as well as on the fulfilment of the aims of education. Instruction dominated by lecturing does not inspire students to learn; and no single teaching method fits all (Tümay, 2016); whereas good teaching methods influence students' interest in the topic; since good teachers consider students' perspectives by managing and helping them to change their misconceptions about the subject. Karma and Tshering (2020) showed that an active learning approach enhanced the learning achievement of students in science.

Most studies on online learning have examined whether there are gender differences in psychological changes or learning outcomes (Pinto et al., 2018). Previous studies have found that students' performance in online learning has a strong relationship with their characteristics, especially in terms of gender (Rizvi et al., 2019). Gender is a concept used to describe the characteristics, behaviors or roles of men and women that are socially or culturally constructed. Whereas sex is biologically determined, that is, the state of being born a male or a female, gender is decided by the society. For example, Eze, Egbo and Omeje (2018) found a significant difference in favour of female students when taught kinetic theory and gas laws using programmed instruction. Olatunji and Mbanefo (2019) reported a non -significant difference in the achievement and retention of males and females exposed to peer instruction in Basic science.

Discussion and Findings

The blended learning approach requires least time and effort, and is the safest in terms of risk of failure. Driven by a specific pedagogical need, an instructor can directly add a new activity to his/her course with minimal rethinking and re-planning of the course. As an add-on to the course, no reworking of the course is usually required; however, successful application of this approach may require some technical knowledge. The instructor will need to investigate possible blended learning components, evaluate these in terms of the pedagogical goals of the course, implement the selected component and help students use during the learning process. The risk of the new blended course failing is low, as the traditional teaching modes of lectures and tutorials will remain almost the same and the learning objectives of the course can be covered regardless as to whether or not the new activity is used. The teacher can stay in his/her comfort zone: the additional activities are introduced for the benefit of the student, without the teacher having to change his/her teaching style. The potential enhancement that blended learning can bring to an existing teaching program and to the student learning experience is minimal, as only a small number of blended activities can be introduced to a traditional course without the course being received by students as overloaded. Adding components to the extent of overloading may then involve the replacement of existing components and would be, in effect, a medium-impact blended approach.

(1) An instructor should start by adding a simple online activity that they and their students can easily manage, for example, an online discussion board (Hofmann, 2006) or the Facebook activity that McCarthy (2010) added to his course. Later, if more online activities are needed, a medium-impact approach involving replacement could be considered.

(2) The addition of an activity must be driven by a specific pedagogical need, rather than, say, technology for technology's sake. Teachers therefore need to find out what is problematic or lacking in their courses and understand how to apply the technologies and teaching approaches to address these issues (Picciano, 2009).

(3) The added activity should be well integrated into the course. It is essential to consider the connection between what occurs in class and what happens online (Chen & Looi, 2007; Kaleta et al., 2007).

(4) The course should not be overloaded with tasks and activities. It is worthwhile investigating students' opinions about the course components. Sharpe et al. (2006) reported that consistent and transparent communication with students about their opinions and expectations is essential for the success of the blended learning experience.

(5) A low-impact blend is recommended for teachers with no experience in designing for blended learning. It is easy to implement and has a low risk of failure.

Conclusion

The application of BLMs has been regarded as the new normal. The application of these models in teaching, especially in Secondary Schools, improves learning outcomes. Based on the results and discussion, the study evidently indicated that the achievement and ability to retain by undergraduates in learning of sciences improved when exposed to BLMs.

Recommendations

The findings of this study encourages educationist to apply BLMs because it enhances the academic performance and retention of students. Based on the findings from this study, the followings can be recommended:

1. Future teachers should receive the necessary training to develop the necessary competencies to use BL techniques. Every member of the university staff should learn at least the fundamentals of ICT, including how to use word processing, spreadsheets, databases, the internet, basic hardware, software maintenance procedures, and applications relevant to their fields. The government can promote this by allocating funds for ICT training for academic staff.
2. Teachers or lecturers should be able to recognize the various BLMs and learn how to create and apply the models in their instruction.
3. Calls for proper funding of public and private schools should be supported by the federal and state governments, TETFUND, as well as regulatory organizations like the Nigerian Universities Commission, Association of African Universities, and others through the provision of contemporary ICT resources in Nigeria, including, but not limited to, computers (desktop and laptop), printers, scanners, projectors, full software licenses, and digital storage devices.
4. To make it convenient for teachers to access the internet, service providers like MTN, Airtel, 9Mobile, and GLO should make affordable technological infrastructure, such as contemporary ICT devices and high-end internet services, available.
5. The Federal Capital Territory electricity distribution company should ensure an improvement or consistency in the community's electrical power supply, particularly in Minna, Niger State, this will make it possible for teachers, students, and residents of the area to use BL and other ICT electronic devices for teaching and learning.
6. Each school's institution's administration should allocate funds from domestically produced revenue to buy ICT equipment specifically for using BL methods in the classroom.

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ATTITUDE OF SENIOR SECONDARY ECONOMIC STUDENTS TOWARDS EDUTAINMENT INSTRUCTIONAL PACKAGES IN NIGER STATE

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Abstract

This study investigated the attitude of senior secondary economic students towards edutainment instructional packages in Niger State. The study employed the use of descriptive survey research design. The sample size of this research consists of 361 students from six secondary schools in the three senatorial zones. The instrument used for the study is a researcher designed four point likert type questionnaire titled Questionnaire on Students' Attitude towards Edutainment Instructional Packages (ATEIP). It consists of students' bio data and two other sections of 8 items questions each in form of statements. The reliability of the questionnaire was ascertain using Cronbach Alpha formula and a coefficient of 0.94 was obtained. Data obtained was analyzed using t-test statistic in Statistical Package for Social Sciences (SPSS) Version 20. Findings revealed that there was significant difference in Mean attitude score of Economics students taught using Game-based Edutainment Instructional Package, Video-based Edutainment Instructional Package and Audio-based Edutainment Instructional Package. And that there was significant difference Mean attitude score of male and female Economics students taught using Game-based Edutainment Instructional Package, Video-based Edutainment Instructional Package and Audio-based Edutainment Instructional Package. Based on the findings, it was recommended that Edutainment Instructional Package should be encouraged for teachers use at secondary schools to teach Economics. Government should incorporate the use of instructional materials like Edutainment Instructional Packages for use at all level of education among others.

Keywords: Attitude, Edutainment Instructional Package, Economics

Introduction

Education is a process that involves teaching and learning which is the basis for development and empowerment of every nation, this is, because it builds people's character and plays a significant role in transmitting one's culture, belief and values in the society. Education helps in creating innovations and meeting the growing needs of every nation. The development of a nation is not measured through the number of buildings it has built, the roads it has constructed, bridges it has constructed but by the human resources, the nation has developed through a well-defined system of education. The physical facilities are usually important although they are perishable and valuable (Adamu et al., 2018). In the absence of good education, a nation can hardly develop. Education is therefore more crucial not only to equip the new generations with skills so essential for earning a livelihood but also to create among them an awareness to social and environmental realities and inculcate in them scientific temper, independence of mind and spirit which are of paramount importance for them to become responsible citizens. As a result of development that come with education, innovations on Information and Communication Technology were introduced, this includes entertainment.

Similarly, Entertainment is a form of activity that capture the attention and interest of an audience, or gives pleasure and delight. It can be an idea or a task, but is more likely to be one of the activities or events that have developed over thousands of years specifically for the purpose of keeping an audience's attention focused. It therefore means that entertainment can be used to achieve educational goals. Entertainment has influenced to a great extent the traditional educational environments with both negative and positive impact

on the performance of students at all levels of education. As noted by Kamo and Ekaterina (2020) infrequent exposure is not likely to produce lasting consequences, but parents, particularly need to be urged to protect their children against the kinds of repeated exposures that excessive play with violent video games or immersion in violent television programs is likely to produce a disarray behaviour.

Children spend more of their total time watching television and spend a significantly shorter amount of time for academic purposes as compared to those who do not (Nireti et al., 2017). Thus, viewing television causes poor academic performance, peer relationship and thereby increases the risk for social isolation, anxiety disorder, agoraphobia, and antisocial behaviour, including aggression and gang involvement. While entertainment may isolate children, the reverse causal direction is also plausible. Lonely children may turn to television for entertainment and companionship. At this junction, it is essential to note that whenever investigating the relationship between media use and behaviours, violent television viewing may influence younger children to become more antisocial, resulting in their becoming socially isolated which, in turn, attracts them to more violent media. Thus, to optimize children social development and long term mental health, parents, teachers and paediatricians should discourage the viewing of violent television programs (Aiyedun, 2020).

Studies also indicate that playing home video games and watching Television has a negative effect on children's academic performance. When children watch home video, they are typically not reinforcing school activities or doing homework. In a survey of conducted by Nkok (2020) frequency and times children play video games determine any negative effects, when compared with their academic progress. He stressed further that video game play during the week was harmful to a child's academic progress, but playing during the weekend did not adversely affect a student's performance. Buckingham and Vijayalakshmi and Janardhana (2020) sees edutainment as a hybrid genre that relies heavily on visual material, on narrative or game-like formats computer games-education-implication for game developers, and on more informal, less didactic styles of address. Alexander *et al.* (2017) stated that edutainment software is a type of software for educating students through entertainment.

The teaching strategies in education have evolved where edutainment has taken its place in the world of education. Edutainment allows students to learn by using various combination of multimedia elements (text, images, video, sound and animation) by simply using a computer mouse to point and click on a particular word, picture or button. This makes the stories as well as information come alive on a computer screen (Adedamola, 2018). It is also important to note that education and learning can be linked with lucid, playful and pleasurable experiences. Johnson et al. (2016) defined edutainment as education that has been placed within the framework of entertainment. The introduction of computers and the Internet has affected traditional educational environments, enabled implementation of a large variety of edutainment types in the learning process thus radically transforming educational paradigm by strengthening the relationship between learning, new media and play. Although, elements of edutainment were already implemented in the educational process sporadically with the advancement of ICT it has become immensely popular and commercially successful with students, teachers, parents and children. In the past, however, edutainment existed but it was not highly utilized as today while today we are facing a growing number of adults that have grown up with technology, entertainment and computer games. We could say that digital natives (Awodun and Oyeniyi, 2020) who recently were discussed as students and learners are now grownups entering educational process. Edutainment has been known to enhance learning as a result of the learner-centred approach which is a shift from the teacher-centred approach (Guidance of adult and teachers).

The learner-centered approach has greatly influenced the usage of edutainment and the popularity of the Web 2.0 tool such as mind maps, infographics, cartoon/video development, pins, and YouTube videos has brought a variety of options and teaching method in order to increase students' interest and understanding. The principles of edutainment focus on the utilization of entertainment as a learning motivator. Media and activities are hence supporting tools. According to Johnson, et al. (2016) students naturally learn well

through games which contribute to a more effective learning and build their cognitive domains. The building of cognitive domain enhances mental development of a child up to secondary school level where subjects like Economics are offered, therefore there is need to use edutainment in the teaching and learning process of the students so as to make learning interesting and understandable for the students.

The study of Economics plays an important role throughout our life. Today, economic issues are drawing the attention of every citizen directly or indirectly. It is therefore; appropriate to include Economics as a distinct area of study in the system of open school learning particularly because for most of the students it will be a terminal stage. At the same time, it fits within the frame of open schooling wherein it is advocated that education should be relevant to the needs of students. Economics, in comparison to other social science subjects has an edge in providing certain job opportunities to the learners and open the gates for various occupations, if they pursue the study of the subject further. Another reason why economics teaching is necessary is that there are many changes occurring in our economy like privatization, liberalization and the outside forces are influencing it like globalization. This makes a strong case for imparting economic education to all students in order to understand these new concepts and issues that are related to the economy. The learning of Economics further helps students to participate effectively in economic and social affairs and make intelligent decisions in day-to-day life. At the same time, the democratic system which is adopted in Nigeria will succeed only when Nigerians win the race on economic fronts. Academic achievement is the performance in a school subject as designated by a score obtained in an achievement test. An achievement test is an instrument administered to an individual as stimuli to elicit certain desired and expected responses, as demanded in the instrument, performance on which the individual is assigned a score representing his achievement. It is concerned with measuring what a candidate has learned (Kadir et al., 2018). They added that other unforeseen circumstances notwithstanding, the score measures his possession of the characteristics. In other words, academic achievement is always denoted by a score which represent the amount of learning acquired, knowledge gained or skills and competencies developed, learner's mental ability and learner's level of intelligence. Also, could be termed as the score obtained by a test measured against an expected score

Attitude then can be described as settled behavior or manner of acting, as representation of feeling or opinion. It refers to certain predisposition to act or react in a positive or negative way towards certain situations and ideas (Al-khafaji et al., 2017). Attitudes in teaching and learning process are enduring systems of positive or negative assessments, enthusiastic feeling and tendencies with respect to social objects. Students' attitude towards Economics is neglected when examining the knowledge gained with a few exceptions. As part of an ongoing effort to expand knowledge gained in Economics and the measurement of attitudes of students before and after taking Economics subjects, there was a quantitative analysis carried out on some students and it was observed that the performance of the students was largely as a result of different levels of attitudes exhibited by the students. Students' attitude towards Economics is very poor irrespective of gender.

Gender has been acknowledged as one of the attribute that affects student's attitude towards practical-based subjects at senior secondary school level. Adamu et al. (2018) carried out a study to investigate the extent to which Use of audio-visual materials in teaching and learning of classification of living things among secondary school students in Sabon Gari LGA of Kaduna State affect student learning based on gender. and it was found that gender had no effects on students' academic achievement in physics and there was no relationship between gender and achievement. Also, Adedamola (2014) reported that gender had no significant effect on students' achievement in Biology Studies. Meanwhile the study of Pratiwi et al. (2019) revealed that male students perform better than female students while Kamo and Ekaterina (2020) reported that female students perform better than male students as such the study on gender is inconclusive. Therefore, this study focuses on development and evaluation of Edutainment Instructional Package for teaching Economics among secondary school students in Niger State.

Aim and Objectives of the Study

The aim of this study is to ascertain the attitude of senior secondary economics students towards edutainment instructional packages in Niger State. Specifically, the study achieved the following objectives:

Research Questions

The following research questions were answered in this study.

1. What is the attitude of male and female SS2 Economics students in Niger State after being taught using Edutainment Instructional Packages (Game-based)?
2. What is the attitude of male and female SS2 Economics students in Niger State after being taught using Edutainment Instructional Packages (Video-based)?
3. What is the attitude of male and female SS2 Economics students in Niger State after being taught using Edutainment Instructional Packages (Audio-based)?

Research Hypotheses

HO_1: There is no significant difference in the mean attitude scores of SS2 male and female Economics students taught using Edutainment Instructional Packages (Game-based).

HO_2: There is no significant difference in the mean attitude scores of SS2 male and female Economics students taught using Edutainment Instructional Packages (Video-based).

HO_3: There is no significant difference in the mean attitude scores of SS2 male and female Economics students taught using Edutainment Instructional Packages (Audio-based).

Methodology

The study adopted a descriptive survey research design. The study entails ascertaining the attitude of students towards economics after exposure to edutainment instructional package. Edutainment instructional package was categorized into Audio - based Edutainment Instructional Package, Video – based Edutainment Instructional Package, and Game – based Edutainment Instructional Package. The target population was all Senior Secondary School II Economics students in Niger state which has the total population of 44,317 (25,104 males and 19,313 females) in the 2018 / 2019 academic session Source ministry of education Niger State.

The instrument used for the study is a researcher designed four point likert type questionnaire titled Questionnaire on Students' Attitude towards Edutainment Instructional Packages (ATEIP). It consists of students' bio data and two other sections of 8 items questions each in form of statements. The reliability of the questionnaire was ascertain using an intact class of 30 economics students from Maikunkele Day Secondary School and a reliability coefficient index of 0.94 using Cronbach Alpha. Data obtained was analyzed using t-test statistic in Statistical Package for Social Sciences (SPSS) Version 20.

Results

Research Question One

Will there be any change in attitude of male and female SS2 Economics students in Niger State after being taught using Edutainment Instructional Packages (Game-based)?

Table 1: Mean and Standard Deviation of Attitude Score of Male and Female Students in Game-based Edutainment Instructional Package

	Variable	N	Mean ($\bar{X}$)	SD
Game-based	Male	70	54.24	2.18
	Female	42	54.74	2.03

Table 1 shows Mean attitude score and Standard Deviation of male and female students taught Economics using Game-based Edutainment Instructional Package. From Table 1, it was observed that the Mean score of the two groups were different where Game-based Edutainment Instructional Package female students had Mean attitude score of 54.74 with Standard Deviation of 2.03 and Game-based Edutainment Instructional Package male students had Mean attitude score of 54.24 with Standard Deviation of 2.18.

Research Question Two: Will there be any change in attitude of male and female SS2 Economics students in Niger State after being taught using Edutainment Instructional Packages (Video-based)?

Table 2: Mean and Standard Deviation of Attitude Score of Male and Female Students in Video-based Edutainment Instructional Package

	Variable	N	Mean ($\bar{X}$)	SD
Video-based	Male	75	53.41	2.22
	Female	50	53.68	1.60

Table 2 shows Mean attitude score and Standard Deviation of male and female students taught Economics using Video-based Edutainment Instructional Package. From Table 4.11, it was observed that the Mean score of the two groups were different where Video-based Edutainment Instructional Package female students had Mean attitude score of 53.41 with Standard Deviation of 2.22 and Video-based Edutainment Instructional Package male students had Mean attitude score of 53.68 with Standard Deviation of 1.60.

Research Question Three: Will there be any change in attitude of male and female SS2 Economics students in Niger State after being taught using Edutainment Instructional Packages (Audio-based)?

Table 3: Mean and Standard Deviation of Attitude Score of Male and Female Students in Audio based Edutainment Instructional Package

	Variable	N	Mean ($\bar{X}$)	SD
Audio-based	Male	85	53.37	2.14
	Female	39	53.38	1.48

Table 3 shows Mean attitude score and Standard Deviation of male and female students taught Economics using Video-based Edutainment Instructional Package. From Table 3, it was observed that the Mean score of the two groups were different where Video-based Edutainment Instructional Package female students had Mean attitude score of 53.37 with Standard Deviation of 2.14 and Video-based Edutainment Instructional Package male students had Mean attitude score of 53.38 with Standard Deviation of 1.48.

Hypothesis One: There is no significant difference in the mean attitude scores of SS2 male and female Economics students taught using Edutainment Instructional Packages (Game-based).

Table 4: Summary of t-test Analysis of Mean Attitude Score of Game-based, Edutainment Instructional Package on Gender

Group	Variable	N	df	$\bar{X}$	SD	t-value	P-value
	Male	70		54.24	2.18		
Game-based			110			0.17	0.22^{NS}
	Female	42		54.74	2.03		

NS-Not Significance at 0.05.

Table 4 shows the t-value was 0.17 and the P-value was 0.22, this means it was not significant as such the hypothesis was accepted. The mean score of the male group was 54.24 and standard deviation was 2.18 while the mean score of female was 54.74 and the standard deviation was 2.03. This implies that using Game-based Edutainment Instructional Package in Economics have the same effects on both gender. There was no significant difference in the mean attitude scores of SS2 male and female Economics students taught using Edutainment Instructional Packages (Game-based).

Research Hypothesis Two: There is no significant difference in the mean attitude scores of SS2 male and female Economics students taught using Edutainment Instructional Packages (Video-based).

Table 5: Summary of t-test Analysis of Mean Attitude Score of Video-based, Edutainment Instructional Package on Gender

Group	Variable	N	df	$\bar{X}$	SD	t-value	P-value
	Male	75		53.41	2.22		
Video-based			123			0.00	0.47^{NS}
	Female	50		53.68	1.60		

Table 5 shows the t-value was 0.00 and the P-value was 0.47, this means it was not significant as such the hypothesis was accepted. The mean score of the male group was 53.41 and standard deviation was 2.22 while the mean score of female was 53.68 and the standard deviation was 1.60. This implies that using Video-based Edutainment Instructional Package in Economics have the same effects on both gender. There was no significant difference in the mean attitude scores of SS2 male and female Economics students taught using Edutainment Instructional Packages (Video-based).

Research Hypothesis Three: There is no significant difference in the mean attitude scores of SS2 male and female Economics students taught using Edutainment Instructional Packages (Audio-based).

Table 6: Summary of t-test Analysis of Mean Attitude Score of Audio-based, Edutainment Instructional Package on Gender

Group	Variable	N	df	$\bar{X}$	SD	t-value	P-value
	Male	85		53.37	2.15		
Audio-based			122			0.13	0.98^{NS}
	Female	39		53.38	1.48		

NS - Not Significance at 0.05.

Table 6 shows the t-value was 0.13 and the P-value was 0.98, this means it was not significant as such the hypothesis was accepted. The mean score of the male group was 53.37 and standard deviation was 2.15 while the mean score of female was 53.38 and the standard deviation was 1.48. This implies that using Audio-based Edutainment Instructional Package in Economics have the same effects on both gender. There was no significant difference in the mean attitude scores of SS2 male and female Economics students taught using Edutainment Instructional Packages (Audio-based).

Discussion of Result

It was revealed that there was significant difference Mean attitude score of Economics students taught using Game-based Edutainment Instructional Package, Video-based Edutainment Instructional Package and Audio-based Edutainment Instructional Package. And that there was significant difference Mean attitude score of male and female Economics students taught using Game-based Edutainment Instructional Package, Video-based Edutainment Instructional Package and Audio-based Edutainment Instructional Package. This could be attributed to the fact that attitude as internal beliefs that influence personal actions which are learned through one's experience. This has to do with a disposition to act or react in a particular way as the individual responds to a situation. Thus, the students' perceptions of the teachers' disposition could influence their attitude and thinking toward Economics or any other school subject.

The finding agrees with the finding of Eze et al. (2020) who investigated the effect of Edutainment Instructional Approach on Students' Academic Achievement and Retention in Building Technology in Technical Colleges, significantly changed students' attitudes towards biology. It also agrees with the finding of Nireti et al. (2017) who carried out a study on students' attitude towards biology as well as their knowledge of biology before and after taking a college introductory biology class which was examined using standardized multiple choice biology knowledge and attitude questions and discovered that prior experience in or outside of high school appear to have little impact on knowledge gain or attitude though the beginning of the semester knowledge of biology is important. Results are mixed but show a clear need to improve attitudinal change of students and the pedagogical knowledge of prospective teachers.

Recommendations

Based on the findings of this study the following recommendations are as follows:

1. . Economics students should be exposed to edutainment instructional packages such as game-based, video-based and audio-based so as to enhance effective learning, motivation and also learning through sight hearing and doing.
2. Edutainment instructional package should be used to complement convectional method of teaching in the classroom situation so as to bring about effective learning among the students.
3. The government should see to it that she collaborates with the ministry of educations in various states so as to give a good training to economics teachers on how to use edutainment instructional package in their classrooms in Nigeria.
4. The curriculum planners should include edutainment instructional package in the Nigerian school curriculum in order to enhance effective teaching and learning situation in the classroom.

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ASSESSMENT OF PRE-SERVICE BIOLOGY TEACHERS' ACHIEVEMENT USING TECHNOLOGY-MEDIATED DYNAMIC AND STATIC VISUALS IN COLLEGES OF EDUCATION IN NORTH CENTRAL, NIGERIA.

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Abstract
The study assesses pre-service Biology teachers' learning outcomes using technology-mediated dynamic and static visuals in Colleges of Education in North Central, Nigeria. A pre test post test quasi experimental research design was adopted in which two research questions and two null hypotheses guided the study. The sample consists of 354 (154 males and 200 females) pre-service Biology teachers undertook as intact class of NCE II students of the four (4) selected Colleges of Education using simple random sampling technique. Two schools were assigned into experimental group I and two schools assigned as experimental group II. A total of 40 multiple choice objective questions were used for data collection at pre test and post test. The instruments were validated by experts and subjected to pilot testing. The reliability coefficient of .78 was obtained which shows that the instrument is reliable for the study. The data was analysed using mean and standard deviations for the research questions and Analysis of Covariance (ANCOVA), Sidak Post-hoc analysis, and partial eta squared were used for testing the null hypotheses at 0.05 level of significance. Findings revealed that there was a significant difference $F_{(2,352)} = 11.412$, P-value = 0.001 at $P < 0.05$, in the achievement scores taught Genetics using technology-mediated dynamic and static visuals with students exposed to technology-mediated dynamic visuals achieved higher than those taught with technology-mediated static visuals. The calculated effect size for achievement scores determined through partial eta squared was ($\eta_p^2 = .03$), which signified a "medium" effect at approximately 3% of the variability in the observed outcomes attributed to the independent variable. It was recommended among others that educators and instructional designers should prioritize the integration of technology-mediated dynamic visuals in Genetics instruction. The observed higher achievement scores associated with dynamic visuals indicate their effectiveness in conveying complex genetic concepts.

Introduction

Science and Technology hold the key to the progress and development of any nation and has a great influence on human in all aspects of life including feeding, clothing, healthcare, shelter as well as leisure. Science and technology plays an important role in the evolution of technologically driven society, thereby creating positive changes that help people to investigate the world around them. Kathleen *et al.* (2019) opined that apart from the acceleration of man's standard of living, science and technology have facilitated the development of third world nations and consequently leading to improvement upon the needs and desire to compete with the industrialized nations in all spheres of development. Science provide answers to unanswered questions, justifies the occurrence of a natural phenomenon, suggests ideas and solve human problems and technology operationalizes them. Science clarifies and justifies how an objective may be achieved. The "how" is translated into practical realization and from here, technology takes over and complements science (Alejandro *et al.*, 2019). Hence, for any nation to reach the status of self-reliance, science and technology must be an important component of the knowledge to be given to all citizens of that nation irrespective of race or gender (Mohammed, 2020).

The quest for a complete understanding of the natural phenomena and the environment and what they encompass to satisfy the inquiry mind follows the process of scientific investigation and is pursued by scientists in every part of the world. Thus, as science itself is universal, so the quest for improved methods

of teaching science and scientific disciplines becomes universal by using different technologies for instruction called Technology-mediated Instruction.

Technology-mediated instruction (TMI) is a "parasol" term, incorporating different methods of using computers in teaching and learning process. Matthias *et al*. (2017) established that technology-mediated learning (TML) is a major trend in education, since it allows the integration of traditional and information technology (IT)-based learning activities into the teaching of complex and abstract concept such as genetics. Technology need to have autonomy over the learning process. Technology-mediated learning includes both e-learning (which is viewed as courses delivered totally on the web) and computer-assisted learning using any technology such as clickers, Computer Aided Learning (CAL), Computer-Mediated Communication (CMC), technology-mediated dynamic and static visuals. Alternatively, Suyatna *et al.* (2017) opined that one promising way to support students' understanding of complex concepts like genetics may lie in the use of visuals through symbolic descriptions of images (motion and motionless) depicting instructional contents in a visualization scene.

Visualizations denote pictures, computer-generated displays, three-dimensional models, geometrical illustrations, diagrams, simulations, animations and videos which help teachers to effortlessly transfer information to students (Connolly, 2019). The purpose of any visuals to be used in an educational context is to facilitate the learning of some knowledge, idea, fact, concept and computer-based visuals (Shaffer *et al.*, 2017).

Recently, advances in computer-based visuals enabled the display of visual objects in a variety of media formats, including computer screens, interactive whiteboards and videos to help students create a pictorial connection between the contents they learnt through images and the power of recalling information (Ryoo and Linn, 2012). Furthermore, Mayer (2009) described instructional visuals as a visual-spatial representation intended to promote learning with variations along several dimensions to include; realism and dynamism. Realism; in which pictures vary from high realism (a photo or video) to low realism (a line drawing or an animated line drawing) while statism is where pictures are static (a drawing and photo) or dynamic (an animation or video) and delivery medium where pictures are presented on a page or screen.

Technology-mediated Dynamic Visuals (TDV) are animated graphics displayed on computer screen which gives students a mental ability to manage cognitive processing of the material more accurately while studying to avoid overloading in working memory. Ryoo and Bedell (2017) opined that dynamic visuals allow students to directly depict dynamic features of animated concepts in order to understand the complexities that existed among them. For instance, the genetic concepts such as phenotype, genotype, mutation, variation, dominant and recessive gene and chromosomes are difficult to understand with verbal explanation. However, the dynamic visuals have the capacity to describe the concepts live as they act in their natural environment in visual terms. Supporting this, Sung and Chen (2019) added that it also allows for segmenting the concepts in stages of sequence for students understanding. What is more enticing in dynamic visuals as applied to genetics is the display of characters in their minute form using colors, structures and graphics which are all made to act like a living creature. Moreover, how effective a dynamic visual is, also depends on the fact to what the dynamic visuals are compared with. For instance, within the dynamic display, static visuals of the same instructional contents are extracted to form an impression of moving frames called static visuals.

Accordingly, Technology-mediated Static Visuals (TSV) are illustrations, drawings, photos, diagrams, maps, graphs, charts, figures, tables displayed on screen. The mode of presentation of static visuals includes displaying content all at once or in sequence on the screen. Stromme and Mork (2020) remarked that multiple static pictures may be presented either sequentially, that is, one after another at the same position on the screen so that earlier pictures can be replaced by later ones, or simultaneously, that is, all together on one page. This can be required in teaching science related disciplines.

Science related disciplines like Biology, Chemistry and Physics require that students understand the complex nature of their interrelations and changes that occur over time in order to inform future practices. However, the content in these subjects seems to be challenging and abstract especially in specific content areas like genetics of which students often fail to understand their complexity. Biology is one of the science subjects that is more inclined to human life in which science students cannot do without it. Chu and Reid (2018) opined that it is practically impossible to verbally explain the complex interrelationship that exist between parents and their children; dominants and recessive genes; chromosomes and alleles in the body of human. That is why Ryoo and Bedell (2017) stated that it is better to teach concepts that are difficult and abstract to illustrate with pictures rather than words. Therefore, learning Biology often requires the use of models to help pre-service Biology teachers who are undergoing studies to be potential tutors-visualize micro-processes in order to simplify its teaching and learning. The effectiveness of this independent variable (dynamic and static visuals) can be comparatively established on pre-service Biology teachers' achievement in genetics concepts.

Achievement is the product of students results in a subject measured at a particular time and learning condition. Academic achievement has long been recognized by stakeholders (students, teachers, parents and employers) as one of the important goals of education in the world at large. For teachers, measuring students' achievement through diagnostic, formative and summative assessment is the norm. Teachers do this in order to categorize students in to low, medium and high achievers. Though, in this study, achievement is centred on students' cognitive processing of biological concepts and how learning of these concepts can be enhanced through visuals approaches.

Statement of the Problem

Despite the potentials of visuals to bridge the gap between pictorial mental models to practical visualization of concepts and ideas by ensuring that students have clear understanding of genetic concepts, yet this concept not popularized, hence, pre-service teachers continue to have difficulties in understanding genetic concepts in Biology. The use of these Dynamic and Static visualization eliminates long passive teaching that are associated with traditional method of teaching and clear pre-service teachers' misconceptions of what seems to be, to what it is. Specifically, semester examination reports on performance of students in Genetics 2017 to 2021 of Niger State College of Education Minna (2022) were explicit about the weaknesses of pre-service teachers' regarding poor grasp of genetic concepts. These might be attributed to the passive lectures with laying more emphasis on texts rather than pictures. However, many strategies have been adopted or adapted by researchers such as the use of CAI, Animations, Charts, Models, Concept Maps and Analogy among others to salvage the problem, but the poor achievement have persisted among pre-service Biology teachers in genetic concepts and if the trend continues, it may rub on the future careers that demands Biology related expertise (NCCE, 2012). Hence, the need to free learners from experiencing passive lectures and explaining the associative structures of genetics in non-representational form. Therefore, the strategies considered by the researcher to salvage the persistent poor achievement in Genetics might be the use of technology-mediated visuals; Dynamic and static visuals. Therefore, the study intends to assess pre-service Biology teachers' achievement using technology-mediated dynamic and static visuals in Colleges of Education in North Central, Nigeria.

Aim and Objectives of the Study

The aim of this study is to assess pre-service Biology teachers' achievement using technology-mediated dynamic and static visuals in Colleges of Education in North Central, Nigeria.

The specific objectives of this study are to asses:

1. technology-mediated dynamic and static visual on pre-service Biology teachers' achievement in genetics in colleges of education in North Central, Nigeria.
2. the influence of gender on the achievement of pre-service Biology teachers' taught genetics using technology-mediated dynamic and static visuals.

Research Questions

The following research questions are raised to guide the study

1. What is the difference in the mean achievement scores of pre-service Biology teachers taught Genetics using technology-mediated dynamic and static visuals?
2. What is the difference in the mean achievement scores of male and female pre-service Biology teachers taught Genetics using technology-mediated dynamic and static visuals?

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 achievement scores of pre-service Biology teachers taught Genetics using technology-mediated dynamic and static visuals.

$HO_{2:}$ There is no significant difference in the achievement scores of male and female pre-service Biology teachers taught Genetics using technology-mediated dynamic and static visuals.

Methodology

The research design adopted for this study is quasi-experimental design using the pre test, post test non-equivalent control group design. According to Shadish and William (2002), quasi-experimental design also known as nonrandomized design is used when it is not feasible to conduct randomization in a sampled population. This study engaged students in two groups: Experimental Group I (students were taught using Technology-mediated Dynamic Visuals); Experimental Group II (students were taught using Technology-mediated Static Visuals). The design layout of the study is presented in Table 1;

Table 1: Research Design Layout

Groupings	Pre test	Treatment	Post test
EXP 1(TDV)	O_1	X_1	O_2
EXP 2 (SV)	O_3	X_2	O_4

Where:

O_1, and O_3 = Represent pre test Scores for experimental groups

O_2, and O_4 = Represent Post test Scores for experimental groups

X_1 = Represent Technology-mediated Dynamic Visuals (Treatment)

$X_{2=}$ Represent Technology-mediated Static Visuals (Treatment)

Population of the Study

The population of the study comprised of 5935 pre-service teachers offering Biology in Colleges of Education in North Central, Nigeria. The target population focused on NCE II (200 level) students of 2022/2023 academic session. The choice of 200 Level students was premised on the Biology course synopsis derived from Nigeria Certificate in Education Minimum Standards for General Education. The population characteristics considered involves the same curriculum, study duration, course combination, environmental condition and co-educational nature. A sample size of 354 pre-service Biology teachers was

captured in the intact class of NCE II students of the four (4) selected Colleges of Education using simple random sampling technique.

Results

Research Question One: What is the mean difference in the achievement scores of pre-service Biology teachers' taught Genetics using technology-mediated dynamic and static visuals? To answer this question, mean and standard deviation was used and the results presented in table 2

Table 2: Mean and Standard Deviation of Pre test and Post test Achievement Scores of Experimental Group I and II exposed to Genetics concepts using Technology-Mediated Dynamic and Static Visuals

Group	N	Pre test		Post test		Mean Gain/Loss
Descriptions	**No. in Samples**	$\bar{X}$	**SD**	$\bar{X}$	**SD**	**Gains**
Experimental Group 1	158	54.80	24.166	78.75	14.170	23.95
Experimental Group 2	196	57.30	23.693	72.38	20.295	15.08

Key: $\bar{X}$ = Mean, SD= Standard Deviations, N= Number in samples

Table 2 displays the means and standard deviation of experimental group one treated with technology-mediated dynamic visuals and experimental group two treated with technology-mediated static visuals at pre test and post test. The mean achievement scores of experimental group one at post test were higher (*M* = 78.8, *SD* = 14.2) than the pre test mean scores (*M* = 54.8, *SD* = 24.2), indicating a major change in their achievement. For experimental group two, the mean achievement scores on the post test were higher (*M* = 72.4, *SD* = 20.3) than the pre test scores (*M* = 57.3, *SD* = 23.7), indicating a major change. This implies that the changes that occur at pre test and post test are attributed to the intervention given to the experimental group I and II. Thus, there is a difference in the achievement scores of pre-service Biology teachers' taught Genetics using technology-mediated dynamic and static visuals with students exposed to technology-mediated dynamic visuals achieving higher than those taught with technology-mediated static visuals.

Research Question Two: What is the mean difference in the achievement scores of male and female pre-service Biology teachers' taught Genetics using technology-mediated dynamic and static visuals? To answer this question, mean and standard deviation was used and the results presented in table 3

Table 3: Mean and Standard Deviation of Pre test and Post test Achievement Scores of Male and Female Students Taught Genetics using Technology-Mediated Dynamic and Static Visuals

Groups	N	Pretest Gender		Achievement	
Descriptions	**No. in Samples**	$\bar{X}$	**SD**	$\bar{X}$	**SD**
Technology Mediated Dynamic Males	73	51.52	23.409	82.92	8.535
Technology Mediated Dynamic Females	85	57.62	24.585	75.16	16.873
Technology Mediated Static Males	81	56.51	23.756	65.65	23.265
Technology Mediated Static Females	115	57.85	23.736	77.11	16.430

Key: $\bar{X}$ = Mean, SD= Standard Deviations, N= Number in samples.

Table 3 displays the means and standard deviation of male and female students in experimental group one treated with technology-mediated dynamic visuals at pre test and post test. The mean achievement scores of the post test for male group was higher (*M* = 82.9, *SD* = 8.53) than the pre test scores (*M* = 51.2, *SD* =

23.4). The mean gain was 31.4 indicating a major difference in their achievement. For the female group, the mean achievement scores of the post test were also higher (*M* = 75.2, *SD* = 16.9) than the pre test scores (*M* = 57.2, *SD* = 24.6). The mean gain was 18.0 indicating a substantial difference in their achievement. This implies that there is a difference in the mean achievement scores of male and female pre-service Biology teachers' taught Genetics using technology-mediated dynamic visuals. Similarly, the means and standard deviation of male and female students in experimental group two treated with technology-mediated static visuals at pre test and post test were displayed. The mean achievement scores of the post test for male group was higher (*M* = 65.7, *SD* = 23.3) than the pre test scores (*M* = 56.5, *SD* = 23.8). The mean gain was 9.2 indicating a minimum difference in their achievement. For the female group, the mean achievement scores of the post test were also higher (*M* = 77.1, *SD* = 16.4) than the pre test scores (*M* = 56.5, *SD* = 23.7). The mean gain was 20.6 indicating a substantial difference in their achievement. This implies that there is a difference in the mean achievement scores of male and female pre-service Biology teachers' taught Genetics using technology-mediated static visuals favouring females.

Hypothesis One: There is no significant difference in the achievement scores of pre-service Biology teachers' taught Genetics using technology-mediated dynamic and static visuals.
To answer hypothesis one, ANCOVA analysis was used as shown in table 4.

Table 4: Summary of ANCOVA Result of Mean Achievement Scores of Pre-Service Biology Teachers' Taught Genetics Using Technology-Mediated Dynamic and Static Visuals

Source	Sum of Squares	df	Mean Square	F-value	P-value	Partial Eta Squared
Corrected Model	3759.520a	2	1879.760	5.911	.003	.033
Intercept	294373.576	1	294373.576	925.609	.000	.725
Covariate (Pretest)	210.641	1	210.641	.662	.416	.002
*Achievement	3629.514	1	3629.514	11.412	.001	.031
Error	111629.294	351	318.032			
Total	2118356.000	354				
Corrected Total	115388.814	353				

S = Significant at 0.05 level

Table 4: ANCOVA statistic was computed to examine the difference in the achievement scores of pre-service Biology teachers taught Genetics using technology-mediated dynamic and static visuals in experimental group I and II at posttest. The table revealed that $F_{(2,352)} = 11.412$, *P*-value = 0.001 at $P < 0.05$, indicating a significant difference in the mean achievement scores of pre-service Biology teachers taught Genetics using technology-mediated dynamic and static visuals. Consequently, hypothesis one was rejected. The calculated effect size, determined through partial eta squared was ($\eta_p^2 = .03$), which signified a "medium" effect. This indicates that approximately 3% of the variability in the observed outcomes can be attributed to the factor under investigation, which signified the utilization of technology-mediated dynamic and static visuals in teaching Genetics to pre-service Biology teachers. While the effect size may be considered medium, it is important to note that even seemingly medium variations hold meaningful implications, especially in educational contexts where multiple factors contribute to the learning process. The finding implies that students taught Genetics using technology-mediated dynamic and static visuals differ significantly in their mean achievements.

Hypothesis Two: There is no significant difference in the achievement scores of male and female pre-service Biology teachers' taught Genetics using technology-mediated dynamic and static visuals.

To answer hypothesis two, ANCOVA analysis was used as shown in table 5

Table 5: Summary of ANCOVA Result of Mean Achievement Scores of Male and Female Pre-Service Biology Teachers' Taught Genetics Using Technology-Mediated Dynamic and Static Visuals

Source	Sum of Squares	df	Mean Square	F-value	P-value	Partial Eta Squared
Corrected Model	12441.771a	4	3110.443	10.545	.000	.108
Intercept	287898.954	1	287898.954	976.004	.000	.737
Covariate (Pretest)	292.010	1	292.010	.990	.320	.003
*Gender (Posttest)	12311.765	3	4103.922	13.913	.000	.107
Error	102947.043	349	294.977			
Total	2118356.000	354				
Corrected Total	115388.814	353				

S = Significant at 0.05 level

Table 5: ANCOVA statistic was computed to examine the difference in the achievement scores of male and female pre-service Biology teachers' taught Genetics using technology-mediated dynamic and static visuals for experimental groups I and II. The table revealed that $F_{(4,349)} = 13.913$, P-value = 0.000 at $P < 0.05$, indicating a significant difference in the achievement scores of male and female pre-service Biology teachers' taught Genetics using technology-mediated dynamic and static visuals. Therefore, hypothesis four was rejected.

Thus, the effect size analysis was conducted using partial eta squared; ($\eta_p^2 = .10$). It was observed that a large effect size was evident. This indicates that approximately 10% of the variability in the outcomes can be attributed to the variable being examined. In practical terms, this signifies a modest influence of the analysed factor on the observed results. The large effect size suggests that the variable, while contributing to the observed differences, might also have a substantial practical impact within the context of the study. The finding implies that both male and female pre-service Biology teachers' taught Genetics using technology-mediated dynamic and static visuals differ significantly in their mean achievement. These differences were further examined using a pairwise comparison analysis as presented in table 6;

Table 6: Sidak Pairwise Comparison of the Post test Means Achievement Scores of Male and Female Pre-Service Biology Teachers' Taught Genetics Using Technology-Mediated Dynamic and Static Visuals

(I) GENDER	(J) GENDER	Mean Difference (I-J)	Std. Error	Sig.[b]
Dynamic Males	Dynamic Females	7.987*	2.751	.023
	Static Males	17.454*	2.778	.000
	Static Females	6.047	2.582	.113
Dynamic Females	Dynamic Males	-7.987*	2.751	.023
	Static Males	9.468*	2.667	.003
	Static Females	-1.940	2.457	.966
Static Males	Dynamic Males	-17.454*	2.778	.000

	Dynamic Females	-9.468*	2.667	.003
	Static Females	-11.407*	2.492	.000
Static Females	Dynamic Males	-6.047	2.582	.113
	Dynamic Females	1.940	2.457	.966
	Static Males	11.407*	2.492	.000

Table 6 displays the Sidak pairwise comparisons of dynamic males vs. dynamic females. The mean difference between dynamic males and dynamic females in experimental group I is 7.987, with a standard error of 2.751. This difference is statistically significant ($P = .023$), indicating that there is a notable disparity in mean scores between these two gender groups. The mean difference between dynamic males and static males is -17.454, with a standard error of 2.778. This difference is highly significant ($P < .001$), suggesting a substantial variation in mean scores between these two groups. Similarly, the mean difference between dynamic males and static females is 6.047, with a standard error of 2.582. This difference has a p-value of .113, which is not statistically significant ($P > .05$), indicating that the observed difference in mean scores between these groups may not be meaningful.

The mean difference between dynamic females and static males in experimental group II is 9.468, with a standard error of 2.667. This difference is statistically significant ($p = .003$), suggesting that there is a noteworthy distinction in mean scores between these two gender groups. The analysis of mean differences among the gender groups indicates that there are significant variations in mean scores between dynamic males and dynamic females, dynamic males and static males, dynamic females and static males, as well as static males and static females. These findings highlight the potential influence of gender on the observed achievement, particularly in cases where statistically significant differences were detected.

Discussion

The findings of research question one on the achievement scores of pre-service Biology teachers' taught Genetics using technology-mediated dynamic and static visuals revealed that there is a difference in the achievement scores of pre-service Biology teachers' taught Genetics using technology-mediated dynamic and static visuals. Students exposed to technology-mediated dynamic visuals achieved higher than those taught with technology-mediated static visuals. The finding of the null hypothesis one indicated a significant difference in the mean achievement scores of pre-service Biology teachers taught Genetics using technology-mediated dynamic and static visuals with a "medium" effect size accounting approximately 3% of the variability in the observed outcomes. The finding is in agreement with Stromme and Mork (2020) findings which demonstrate that students in the animated condition outperformed students in the static condition. The finding agrees with Chiu and Linn (2014) whose result showed that in comparison to the control condition, performance was best with dynamic visuals than static visuals. The self-explanation condition without visuals did not attain statistical significance in comparison to the control condition. The finding also agrees with Sudatha and Kamdi (2018) whose finding showed that there was a significant difference in learning achievement between the students who learned from dynamic visuals and static visuals. However, the finding is not in tandem with the earlier finding of Berney and Betrancourt (2018) whose study showed no main effect of the presentation formats on performances but revealed the predictive influence of spatial visuals and spatial relation abilities on performance.

The findings of research question two on the achievement scores of male and female pre-service Biology teachers' taught Genetics using technology-mediated dynamic and static visuals discovered that there is a difference in the mean achievement scores of male and female pre-service Biology teachers' taught Genetics using technology-mediated dynamic visuals. The finding of the null hypothesis indicated that a significant difference exists in the achievement scores of male and female pre-service Biology teachers' taught Genetics using technology-mediated dynamic and static visuals with a large effect size accounting for approximately 10% of the variability in the outcomes attributed to the variable being examined.

Furthermore, the analysis of mean differences among the gender groups indicates that there are significant variations in mean scores between dynamic males and dynamic females, dynamic males and static males, dynamic females and static males, as well as static males and static females. The finding is consistent with the finding of Victoria *et al.* (2020) who revealed that a significant sex difference was observed, wherein males outperformed females on spatial ability tasks. The finding was also consistent with Sudatha and Simamora (2021) who revealed that the mean of the comprehension test before the use of dynamic visuals differed significantly from that after the use of dynamic visuals and that dynamic visuals was attractive to be used in the instruction.

Conclusion

It was established that the choice between technology-mediated dynamic and static visuals significantly affects the achievement scores of pre-service Biology teachers in Genetics as students exposed to dynamic visuals consistently outperformed their counterparts instructed with static visuals. This finding emphasizes the educational importance of selecting appropriate visual aids, with dynamic visuals leading to higher achievement outcomes. Similarly, it was confirmed that technology-mediated dynamic visuals contribute to improved retention rates among pre-service Biology teachers compared to static visuals. The statistical significance of this difference, combined with the moderate effect size, emphasizes the benefits of dynamic visual elements for reinforcing and retaining genetic concepts, thereby enhancing the learning experience.

Recommendation

1. Educators and instructional designers should prioritize the integration of technology-mediated dynamic visuals in Genetics instruction. The observed higher achievement scores associated with dynamic visuals indicate their effectiveness in conveying complex genetic concepts.
2. While dynamic visuals demonstrated advantages in achievement, static visuals may still play a role in certain aspects of Genetics instruction. Instructors should consider a blended approach that combines dynamic and static visuals thoughtfully, optimizing the respective strengths to cater to diverse learning styles and preferences

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ECONOMIC DIVERSIFICATION FOR SUSTAINABLE DEVELOPMENT IN NIGERIA: STEM EDUCATION AS THE WAY FORWARD

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Abstract
This paper took a cursory look at the important role of education as a supporting agent in enhancing economic diversification for self-development in Nigeria. The necessity for Nigeria to promote education for economic diversification for her citizenry to engage in an entrepreneurship education as a way of sustaining self-development most especially with the current economic harsh realities were enumerated. The paper goes further to advocate that the country's educational system needs an urgent review in a more serious manner to take into account the present employment needs of the citizens. Emphasis on education should be placed on promoting entrepreneurship education from the basic up to the tertiary education level. It was also suggested that Public Private Partnership (PPP) should be the way forward in this with the necessary backing from financial houses in order to give entrepreneurship education the right attention it requires. Workshop trainings should be mounted for participants at an affordable cost. Entrepreneurship education is now a critical area of need that is to be given the necessary attention it deserves in order to create self-employment, create an enabling environment for jobs, self-development and sustainability of lives and businesses. This is one sure way of ending the unemployment challenges in Nigeria.

Keywords: Education, Economic, Diversification, Sustainable Development, Nigeria.

Introduction

Education is unarguably the key variable used as a tool in promoting teaching, learning and research and a means of providing manpower for the engineering of social, economic, political and cultural development of societies and nations across civilizations. The growth, development and advancement of nations depends on education. There is no country that can provide the needs of her citizens without education playing a major role. Education is a critical area that cut across all fabrics of a nation and has the ability to reorient and transform individuals and the nation's resources both human and natural to productive capacity to meet the country's overall interests. Education has transformed many countries to developed status and possess the ability to do so to others that can use it to excel in all fields of human endeavour. Little wonder that, it is in the realisation of the significant role education plays that every nation is investing hugely in it. In Nigeria, education is generally considered as a panacea for natural development and a means par excellence. Education has contributed immensely to the economic, social and cultural development of Nigeria in the past decades. There exist abundance economic resources in industry, agriculture, tourism, information, and education sectors among others which if adequately explode can be of great economic gain for the nation.

Nigeria like other up-coming counties is faced with lots of challenges. Principal among them is the unemployment rate with it's devastating consequences on the nation's economy and it's security. Many Nigerian youths are presently unemployed and so many more continue to remain unemployable. This is due to the type of the system and education received by our youths which is usually fit for white collar jobs that are no longer available. The population of graduates coming out of our tertiary institutions in Nigeria is quiet alarming without a commensurate opportunity for absorbing them. In addition to these myriad of problems is the ever increasing social unrest occasioned by frequent armed robbery activities, cultism, prostitution, communal clashes among others in and around most towns in Nigeria.

Although Several governments in the past have made many attempts in one policy form or the other with a view to resolving these unemployment issues, not much effort have been recorded due mostly to the uncontrollable population growth that results in an increase of tertiary institutions of learning and resulting further in an upsurge of students enrolments in schools and often resulting to more increase in the rate of graduating students, thereby making the unemployment challenges in Nigeria even more worse.

It is obvious from the above submission, that for any Nigerian government at all levels to envisage reviewing the country's educational policy, serious attention must be placed on areas that will increase initiatives for self-employment and self-development among the citizens that will recognize the essence of partnership in education as one key way of diversifying areas of emphasis from education for white collar job to creation towards education for self-employment opportunities and self-reliance for national development. Diversification of education to such areas that include entrepreneurship, science and technology, agriculture, and technical education will by extension create learning opportunities for skills acquisition, knowledge based competencies to students across various disciplines that offer opportunities for entrepreneurship education for self-employment, self-reliance and economic development. Economic diversification in this perspective means deemphasizing our system of education from the theoretical aspect, with the soul aim of producing productive and sustainable work force that can be self-engaged in any business opportunity, remain creative, innovative and productive and sustainable for future advancement. Self-development connotes depending on self for living and also means self-dependency for livelihood.

The major goal of this study is to determine the place of education as a strong pillar for the diversification of Nigerian economy for self-development.
But essentially, the study will determine the following:

- Define the concepts of education, economic diversification, and sustainable development
- Determine how Nigerian economy can be diversified for sustainable development
- Find out the rationale for economic diversification
- Determine the prospect for the diversification of the economy.

Defining the Concepts

Education

Education as a concept has been defined by many educationists in several ways but all focused on its impactful impression on man and his society. Education according to Cooke (1993) cited in Oboh and Ufuoma (2014) is the process of transferring knowledge from a teacher to a learner, allowing both people explore and come to full understanding of all that is in their domain. While Fafunwa (1989), an erudite scholar and author described education as the aggregate of all the processes by which a child or adult develops the abilities, attitudes and other forms of behaviour, which are of positive value to the society in which he/she lives.

But Oboh and Ufuoma (2014) observed education as that which facilitates realisation of self-potential and talent of an individual and can be generally seen from three dimensions; development of knowledge, training of mental abilities and development of character. Judging from the submissions above, education can be seen as a powerful element of influence on the learner to acquire knowledge by means of learning, developing mental abilities through training and the enhancement of good character through practice of lessons gained by way of experience and learning. Olayiwola (2010) opined that a critical function of education is to adapt to the ever changing values of most societies the world over. Current challenges in education, especially in the twenty first century include the system of education where much emphasis is placed on the production of graduates trained mainly for white collar jobs that are so scarse to ameliorate the employment challenges in our present day societies. There is therefore a great need to review our National Policies on Education to realign and reflect the needs of the citizenry. Such as the call to de-emphasize the present system of education and turn attention to other sectors that are mostly proactive such

as Entrepreneurship education, science and technology, agriculture, and tourism just to mention a few, have become so expedient and inevitable.

This study is of the opinion that one major area to be considered in the current circumstances where the nation's educational needs can be refocused is in the area of entrepreneurship education. This emphasis for redirecting attention of our educational need to other areas of present day needs that have some economic benefits to the country is the hallmark of the theme of this study of education and economic diversification for sustainable development.

Sustainable Development

The concept, Sustainable development conotes one taking a decision and be held responsible and accountable for such decision (Ogar and Atanda, 2019). In order words, it means a self-decision and accountability for the results of the decision taken. In the views of this study, sustainable development means the act of exploiting a business opportunity in existence and taking the initiative to undertake the business with the goal of making a profit, developing the business and maturing it to the level of using it for self-development and livelihood. The extant unemployment scenario where graduates of institutions of learning are found malangaring in the streets without job calls for self - engaged activities as a means of survival and sustainability.

Self-development as observed by Iwele and Ogoegbunam (2015) refers to being economically independent and self-satisfying. In a nutshell, it means the act of fending for oneself and not necessarily relying on someone else. Although no individual or nation can boast of being self-sufficient and self-sustaining, but the level of development is highly limited. Fonchingong and Fonjong (2003) posited that self-development may be defined as self-help, self-sustainability, self-sufficiency and self-support. The concept of self-development hinges more emphasis on the individual role as principal agent of development and self determination to be initiative, creative, innovative and productive by utilising any existing opportunity to make something anew. This therefore means that wealth creation is a product of imaginative and creative ability of individuals who utilise the available material resources to maximise gain and social life satisfaction which cannot be achieved without economic Sustainability (Iwele and Ogoegbunam 2015). Rightly postulated, is that, self-development and decreasing of the unemployment rate in the society are closely inter-related, that is, self-development is a key factor in reducing unemployment in a society and a significant means of lessoning the financial and social burdens on the government administration.

Economic Diversification

Economic diversification is the process of refocusing attention on several areas of economic interest that could create socio-economic development. According to Webster Universal Dictionary and Thesaurus (2010), diversification is defined as a noun which denotes an engagement in a variety of commercial operations to bring down risk. The main emphasis of this definition is to the practice of an individual or organization engaging in different activities or performing various operations with the social aim of achieving a goal with minimum risk. While Economic is an adjective relating to economics or business venture that is capable of producing profit. Economic diversification in this perspective can be defined conceptually as a business undertaking with some economic benefits engaged on at various stages with the soul aim of achieving an individual, collective or organizational objective. Nigeria as a nation state at the moment is in a dier need of redirecting her educational policies towards diversifying the economy in all sectors by adopting a workable education system in such areas as agriculture, commerce, manufacturing, industries, tourism, mining, transportation, and health among a few. Many opportunities exist in the areas mentioned hitherto where entrepreneurship education, science education, agricultural education, mathematics education and Information and Communication Technology education can be used.

Entrepreneurship has been adduced to be one major area that opportunities in education can be used in diversifying the Nigerian economy.

Nigerian Education System: An Overview

Nigeria, been a British colonial creation was introduced to western education before independence in 1960. This came through Christian Missionaries. To achieve their Missionary activities, the colonial missionaries engaged the services of locals and trained them in the art of reading and writing in English language mainly to become catechists, interpreters and messengers to the colonial Missionaries. Over the years, Churches and Schools began to spring up where local inhabitants were taught how to acquire Christian religious knowledge and western education geared alongside the western culture and civilization and the knowledge received therefrom usually often times used for literacy purpose mainly for white collar jobs and acquiring the believe in God (Fafunwa, 1989). This was the foundation that bereft the Nigerian education system of a self-sustainable development pattern. This was due majorly for its lack of a skills acquisition, creative, and innovative system.

Furthermore, by Independence In 1960, some drastic and overwhelming majors were introduced by government to redirect the education system that the British bequeted to the country to meet up with the social, economic, cultural and political interests of her citizenry (Fafunwa, 1989). The philosophy and idea underlining this action was that the educational philosophy of the colonial masters was not in tandem with the culture of colonized Nigeria and therefore could not meet up and satisfy the aspirations of Nigerians. This is because the system of education did not provide room for skills acquisition, creativity, and innovations. Another reason is that the colonial education system placed much emphasis on the ability of graduates to have comfortability in the acquisition of white collar jobs. These factors contributed immensely in the foundation for the emergence of a large number of school graduates without a commensurate opportunity in the job market which consequently brought about an avalanche of unemployed graduates in their torrents.

In order to resolve this issue, successive governments have put up and implemented one policy or another right from independence till date with the aim of managing the Nigerian economy and socio-economic development to no meaningful success (Ogar and Atanda, 2019). Some of these include the establishment of technical schools in Nigeria for skills acquisition at the school level, the establishment of National Directorate of Employment (NDE) to oversee the handling of concerns bothering on youth employment through apprenticeship programmes, the various N- power programmes and the National Poverty Eradication programmes such as Trader monie, Conditional cash transfer and Market woman monie by the Buhari administration. As rightly observed by Okpachu and Ojonugwa (2011) that in order for Nigeria to redirect her education to meet the needs of her citizens, it has implemented as many macro-economic policies and strategies like the:

Development planning, Import Substitution Industrialization Strategies (ISIS), Indigenisation policy, Export Led Development Strategy, Public Sector Led Development Strategy, Economic Stabilization Act of 1982, An IMF/World Bank Imposed Structural Adjustment Programme (SAP), National Poverty Eradication Programme (NAPEP), National Economic Empowerment and Development Strategy (NEEDS) and Yar'adua 7-point Agenda under which various agricultural policies and programmes such as agricultural financial policies, agricultural research and training programmes, water resources development pricing and Marketing policy were introduced, but all these proved ineffective in dealing with the fundamental problems confronting Nigerian economy.

Many countries like the Asian Tigers as they came to be known in Latin America and South East Asia that were at par in terms of development with Nigeria in 1960s have since overtaken the country and achieved respectable levels of development (Obadam 1998, NPE 2014) as cited in Okpachu and Ojonugwa (2011).

In the years preceding 1980s, agriculture was the significant force driving the Nigerian economy (Orohu, 2011). With the discovery of oil in the 1970s, its contribution to national economy steadily rose. With this

development, agriculture was no longer recognised both as an occupation and as the farmer's principal earner of revenue for the country; consequent upon which, the production of cash crops and staple food fell to the lowest ebb. The grave consequence of this is the present economic woes in the country as agriculture was relegated to the background and the advent of the oil glut era necessated an urgent revival of the agricultural sub sector of the Nigerian economy as observed by Egbule (2004). Also Adah (2004), submitted that through agricultural education, youth and farmers stand alot to benefit from advanced scientific and technological knowledge and some improved techniques from the works of local scientists in the universities and government research institutes. Apart from agriculture and oil, Nigeria is blessed with a lot of other resources such as manufacturing sector, tourism and hospitality, transport and communication potentials. The emergence of Information and Communication Technologies in the 21st century has also brought a new dimension of possibility and opportunity to areas where the Nigerian economy can be gainfully utilised for national development.

In exploring and exploiting the opportunities and possibilities of both human and natural resources aboundant in Nigeria, education has been recognised as the significant element that can be used in bringing about a positive and sustainable change to it's socio-economic development. In socio-economic environment, people live in society and engaged in activities that would advance there life style in relation to there environment, Iwele and Ogowgbunam (2015).This therefore implies that, there is a strong relationship between the social life of man and his activities in societies. This relationship is what is termed socio-economic. Gordon (1998) as cited in Iwele and Ogowgbunam (2015) defined socio-economic as a concept that explains "how limited productive resources and efforts of a society are located among the wide range of attendant users to which they might be put into use". Mark (2009) also defined socio-economic as "the reciprocal relationship between economic science on one hand; social philosophy, ethics, and human dignity on the other hand, toward social reconstruction and improvement of society and human life". From the above definitions, socio-economic can be understood as a concepts that involves the understanding of the relationship that is in-between social life of man, the economic activities and opportunities that determine the individual survival and contribution to the society.

Nigeria at the moment is in a dire need of socio-economic development and socio-economic diversification. Socio-economics as a concept relating to how the nation's limited resources are appropriated amongst various beneficiaries in an economy needs to be sustained; it is this sustenance of the socio-economics that is referred to socio-economic development. Socio-economic development can only be achieved in a society if most citizens are gainfully employed and contributing their quota to the development of the society. This can only be brought about by education, Majumdar (2013).

Education as Panacea to Diversifying the Nigerian Economy

Even as the Nigerian economy is majorly agrarian and also blessed with oil production, there are other production sectors of the economy that the nation's interest can be re directed, explored and exploited to boost the economy. These among other things include mining and manufacturing sector, transport and communication sector, tourism and hospitality sector, commerce and industry sector, education sector, information and communication sector. Education needs to be anchored along the several sectors of the economy, hence the concept of diversification of the economy. In this vain Majumdar (2013) observed that education should be refocusted to "Cheek the economic deficiency and the equity criteria of the different alternative investment packages ... likely to be available at different costs". The alternative investment packages gave impetus for entrepreneurship education.

Education has been adjudged as a tool for socio-economic development and stability of any nation state that invest hugely in it (Ogar and Atanda, 2019). Education has the ability through the production of scholars, researchers, scientists, entrepreneurs, teachers, students to explore and explain the various human and natural resources in the country for the nation's economic, social, cultural and political developments. The government at all levels have important roles to play in this process through strategic planning, good policy

development and implementation that gear education alongside the various subject disciplines, provision of financial support and providing peaceful and comfortable environment for teaching, learning and research in schools, especially institutions of higher learning among other variables. Few critical areas education can be diversified to serve as a spring board for the engineering of social, economic and cultural factors for national development include Science, Technology Education, Agricultural Education, Vocational and Technical Education, Business Education, and Educational technology to mention a few from the list.

The concept of economic development is usually enshrined in the idea of progress which is in tandem with the quantitative changes in a given society as posited by Okpachu and Ojonugwa (2011). The idea of progress -improvement or increase- is normally used in statistical terms of Gross National Production, Per capital income and such other indicators as reduction in poverty, improved standard of living from other positive impacts the economy has had on the people. The converse of the factors above may eventually lead to recession or even depression in the economy.

As posited by Todaro (1981) in Okpachu and Ojonugwa (2011), economic development is "a multi-dimensional growth which involves significant changes in social structures, people's attitude and national institutions as well as acceleration of economic growth, reduction of inequality and the reduction in poverty. It is further adduced that economic growth can be differentiated from economic development. Development economists have empirically and analytically proved that a certain society can witness economic growth without economic development. Economic growth stresses on the increase in size of the economy. For instance, it is often argued that it is likely for a society to witness an upsurge in it's aggregate wealth without a necessary commensurate benefit to almost all members of the society.

The development of any society is hinged on education. Government role in the process can be achieved through the following measures as observed by Egbule (2004):

- To review the school curricula to reflect the needs of the citizens.
- To review the National policies on education as to make education all-embracing to all the sectors of the economy.
- Government Policies should take cognizance of the several types of education required and needed for the diversification of the economy.
- It is in incumbent on Government to provide a conducive learning and teaching environment that could promote teaching, learning and research.
- Provision of favourable condition for training and retraining of teachers and
- Provision of system learning which are designed to equip the teachers and students with skills, competencies, knowledge and practical agriculture and other types of education.

This Study is of the opinion that using the instrumentation of entrepreneurship education and making it realistic for all students all subject areas will enrich them with the spirit of entrepreneurship which certainly assist them in becoming successful entrepreneurs after graduation. The Action Plan of African Education Minister's Summit at Adis Ababa 2006 as cited by Umoh and Udongwo (2014) described science and Technology (S&T) as the most important vehicle available for addressing the challenges to development and poverty eradication and participation in the global economy. The document further stated that to achieve the Sustainable Development Goals (SDGs), there is no alternative to knowledge, skills and human resources in science and technology. It is often said that the teaching and learning of science in Africa must be reformed at all levels of education sector if the continent is to possess a culture of science, technology, research and education. It can therefore be argued that science and technology education are the bedrock of archiving these goals and development.

Technical and vocational education is made up of different fields of human endeavours. Olanrewaju (2012) maintained that vocational education is a form of education and training that gives credence to the acquisition of skills for self-employment and self-reliance which include:, technical education, business

education, home economics, computer education, ICT education, agricultural education, entrepreneurship education. Simply put, it is education for skills acquisition in all forms of human undertakings.

Ways Education can be used to Diversify the Economy in Nigeria for Sustainable Development

Government has a fundamental role in the process of diversifying the economy using education as precursor for national development. As a critical player in the management of the education sector, government has several roles and responsibilities to undertake in the processes of policy formulation, creation of legal and ethical frameworks upon which policies and programmes are initiated, instituted, implemented and assessed (Otamba, 2013). In addition too, government is responsible for the establishment of institutions of learning, especially the tertiary institutions, their funding, provision of resources and services, provision of employment and training and retraining and the management and supervision of all activities in the institutions. The academic institution, specifically play a vital role in the process of economic diversification through education as a key driver alongside such areas and their components as Science education and Technology education as:

A. (i) Science Education: Biology, Chemistry, Physics and Mathematics
(ii) Technology Education: Technology Education and Educational Technology

B. Vocational and Technical Education (VTE)

A comprehensive team referring to those aspects of the education process involving in addition to general education, the study of technologies and related sciences, and the acquisition of practical skills, attitudes, understanding and knowledge relating to occupations in various sectors of the economic and social life (United Nation Educational, Scientific and Cultural Organization, UNESCO, 2001). UNESCO's document, "Revised Recommendation Concerning Technical and Vocational Education" Technical and Vocational Education committee defined the subject to be:

- An integral part of general education
- A means of preparing for occupational fields and for effective preparation in the world of work;
- An aspect of lifelong learning and preparation for a responsible citizenship;
- An instrument for promoting environmentally sound sustainable development;
- A means of mitigating poverty.

Vocational education is a type of education that prepare people for a trade at different stages from a trade, a craft, becoming a technician or having a professional position in Engineering, Medicine, Nursing, Agriculture, Pharmacy and Law, Bahar (2015). Vocational education may start at the basic, post -basic and tertiary levels spreading in different subject areas. Udu, Oguegbulu and Okoye (2016) observed that business education as part of vocational education comprise such subjects as computer education, moral education and entrepreneurship education while.

Okorie (2001) in Ekele and Mba (2014) identified and observed five major areas of VTE to include: Agricultural Education, Business Education, Home-economics Education, Industrial and Technical Education and Computer Education.

In fact, Science, Technology education and Vocational and Technical education forms part of all school subjects most especially, in the areas of skills acquisition and entrepreneurship experience, knowledge, competencies and skills acquisition (Popper, 2007).

It is in the knowledge of the above relevance of technical and vocational education and science and technology education that the federal government of Nigeria in it's National Policy on Education expressed the strong desire to place premium on science education with sixty percent (60) to forty percent (40) ratio on admission against the arts and social sciences.

Entrepreneurship education is now an important aspect of emphasis in all areas of disciplines due to its multi-dimensional disciplinary nature. Entrepreneurship skills acquisition is applied in like manner with business opportunities, potential talents, land, labour and capital in every type of education that when appropriately explored and exploited, individuals and organisations will be transformed into functional, productive, saleable, sustainable and self- developed entities. The need to place more emphasis on science and technology education as well as vocational and technical education has become even more expedient. This all inclusive form of education that cuts across every subject discipline do not only have the ability to create all aspects of skills among learners but can be instrumental for the diversification of the Nigerian economy . This behoves the fact that the education acquired by student learners and the quality of teachings/trainings from different departments in the school will make students fit in the world of jobs most appropriately. But those that cannot fit into public jobs can be successively self-employed for sustainable development, thereby bringing about the diversification of the country's economy and sustainable development.

Why Diversify the Economy?

Science, Technology and Technical and Vocational education have proven beyond any illusion that they have the basic and fundamental capacities that are necessary skills, knowledge and competencies to re-engineer Nigeria to a path-way of diversification of economic realism. Nigeria must develop a well thought out result oriented policy framework channeled along the possibility of accomplishing the necessary diversification. In view of this, there is need for a purposeful platform to ensure the real implementation of any policy and programme in tandem with the desired diversification. The establishment of an enabling environment for a political, economic, social and social atmosphere for the Nigerian economy to flourish must be taken as an utmost priority.

Diversification of the economy will necessitate the establishment and equiping of institutions of learning in all aspects of man power development particularly in the areas of skills acquisition and self-development. Science, technology and technical and vocational education will assist in actualising the Sustainable Development Goals (SDGs) agenda such as vision 2030 and 2050. Special interest on Science and Vocational education will lead to diversification of the economy as products from these sectors will engage in as many areas of professions that include Mechanical, Electrical, Electronics, Automobile, Building, Construction,

Fashion design, and soap making out of many different subject areas. Propotionate distribution of resources - both materials and human - within the constituent sectors of the economy will result to equity and fair share of resources of the country. With the diversification of the economy, the inhibiting states and local governments will receive the impact of government welfare.

Conclusion

Nigeria as a country can boast of the required manpower and capacity to turn around the fortunes of the nation towards economic development and prosperity. Education has an important role in the diversification of the Nigerian economy. Education planners needs to re - direct the country's national policies towards the diversification of the economy by way of emphasizing on science and technology education in consonance with other subject areas such as entrepreneurship education, agriculture, technical and vocational education to produce the needed manpower to ginger the processes of diversification of the economy. Education and training by way of workshops, seminars, in-service courses, learning on the job among others should be the focal point to accelerate the development of knowledge; skills, expertise or competences for enhanced job performance and increase productivity in Nigeria for sustainable development.

Recommendations

Nigeria should as a matter of urgency review her national education policy to encorporate the diversification of the economy. Education should be geared more on Science and Technology education - in addition to

entrepreneurship education, technical education, and vocational education. Furthermore, Government should provide adequate funds towards the funding of schools at all levels. Many forms of training and retraining should be encouraged to promote skills development and self-employment among educators and learners.

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SCIENCE TEACHERS' PERCEPTION AND ATTITUDE TOWARDS HIGHER ORDER THINKING SKILLS (HOTS) IN SENIOR SECONDARY SCHOOLS IN FEDERAL CAPITAL TERRITORY, ABUJA

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Abstract
This study aims at finding out science teachers' perception and attitude toward HOTS in senior secondary schools in Federal Capital Territory, Abuja. The study employed descriptive research design. The population of this study consisted of senior Secondary Schools in Federal Capital Territory, Abu. The total number of public and private Senior Secondary School are one hundred and seven (107) with one thousand, two hundred and thirty five science teachers as total population for the study. Seven hundred and seventeen are female science teachers and five hundred and eighteen are female science teachers. Multistage sampling technique was adopted. Firstly, cluster sampling techniques was used to group the schools into area councils. Secondly, is stratified random sampling techniques was used to select one hundred and eleven (111) science teachers from private senior secondary schools and one hundred and eighty science teachers from public senior secondary schools given a total of 291 science teachers. Thirty items were developed by the researcher and used for data collection. Construct and criterion validity of the instrument were established using z- test. The reliability was found to be 0.84 and 0.85 respectively. The data collected from the sample teachers were analysed using statistical package for social science (SPSS) version 21.0. The findings shows that there is no significant difference between science teachers' perception and attitude towards higher order thinking skills. The following recommendations were made; The curriculum should be revised to include more opportunities for students to develop HOTS. Schools should provide more resources, such as textbooks and manipulative, to help teachers implement HOTS

Key words: Higher Order Thinking Skills (HOTS), Perception. Attitudes and science teachers

Introduction
In the twenty-first century, Science and Technology have become the nexus for economic and national advancement. The application of Science and Technology has become a critical factor for sustainable development. Consequently, this has necessitated the need for the meaningful learning of science and technologies that will equip future generation with relevant skills refer to as Higher-Order Thinking Skills (HOTS). Therefore, curriculum issues are inextricably linked to current thinking and action on educational concerns and reforms around the world. Experience of educational reform almost all over the world have shown that curriculum is at the same time a policy and a technical issue, a process and a product, involving a wide range of institutions and actors.

Therefore, the process of constructing the curriculum is unique to each national setting. The problems related to curricula became noticeable soon after Nigeria's independence from colonial rule in 1960. By the mid-1960s, educators and educational planners were rethinking Nigeria's educational system and in particular, the curriculum being taught in the schools (FGN, 2014). Curriculum reform was intimately tied to changes in educational structure. Education was signaled to be a human right, and for the first six years of formal education, it would be accessible, free and mandatory for all children (Musbahu*et al.*, 2019).

The current science curriculum for senior secondary schools was revised and implemented in 2016/2017. The revision was mainly to improve the learning outcomes of students by promoting higher thinking skills. The textbooks consist of more hands-on activities that require student centered learning to be practiced. According to Rabgay (2018), to promote imaginative, critical and creative skills in students, teachers need to focus more on student-centered learning. Teachers need to practice their teaching based on everyday life

activities which develop higher order thinking skills. However, the teaching in Nigeria is still dominated by teacher and whether it helps to develop HOTs in students is a concern. Further, the students are required to carry out project work and homework that may require accessing web links that are provided in the textbooks. These web links are supposed to promotes HOTS. But how far these web links are accessed is another concern as students hardly have any access to internet facilities in schools (Utha, 2015). A study conducted by Karma and Karma (2021) stated that schools should strengthen and enhance Competency Based (CB) activities that require HOTS and assessment in the curriculum. As such, the CB questions which promote higher level thinking are introduced mostly in written examination in other to apply the new knowledge and use it in a new situation to solve real world problem.

In Nigeria system of education today, the need for higher order thinking skills is very paramount to science education teachers in enhancing teaching and learning of sciences. Higher order thinking skills (HOTS) is gaining tremendous recognition with the paradigmatic change in the light of 21st -century concerns faced by the teacher education institutions. Consequently, teachers' perception attitude and level of implementation of HOTS could yield important data that will have implication for policy changes.

Higher order thinking skills is a learning process that is more difficult to teach or learn. It requires more cognitive process in the creation of new knowledge with in depth application, analysis, evaluation, and synthesis. This requires different learning and teaching methods than the learning of facts and concepts. Meta cognitive experts agreed that that the main objective of learning is to develop higher order of thinking skills. This ability can be developed by providing students with problem solving exercise based on Meta cognitive knowledge. Higher order thinking skills will be effectively implemented when one is aware of its perceiving usefulness. Nurazilawati *et al.,* (2015) said higher order thinking skills is inclined to the theory of constructivism in which students construct their knowledge as well as associating the existing knowledge with the newly learnt knowledge.

Acharya (2021) perceived Higher Order Thinking Skills as a commonly known idea of analyzing and synthesizing skills together with logical thinking and decision making skills. That is, the concepts and understanding of higher order thinking skills are the skills of students' to solve daily problems creatively and critically. It is above the rote memorization with skills of higher level of Bloom's taxonomy. Based on the definition of HOTS, the skills of creative thinking, logical thinking, reflective thinking, problem-solving with understanding, connecting, categorizing, manipulating, and applying them to new problems are the HOTS. Given the fore going, therefore, teachers' perception and attitudes could promote or deter the implementation of HOTS in the science classroom in Nigeria. Hence, research focusing teachers' perception, attitudes could yield important data that could have implications for teacher practice and formulation.

Perception is one's view about the outcome of an experience or stance on using a particular idea or strategy that will enhance or improve his or her performance. This implies that perception has a positive relationship with behavioural intention. Perception is also influenced by the attitude of the user of a particular strategy of instruction. The importance of attitude has been emphasized in many studies (Howe &Krosncik, 2017; Vogel &Wanke, 2016). For example, Attitude impacts a person's intention and behavior and how a person processes information. Furthermore, attitude towards HOTS has been found to have a positive impact on teachers' teaching behavior in other contexts such as science education (Van &Walma 2015). Similarly, teachers' attitudes towards stimulating higher-order thinking impact teachers' teaching practices (Wijnen*et al.,* 2021). To support teachers' implementation of higher order thinking, it is important to gain insight into teachers' attitudes towards higher-order thinking.

However, a priori we do not assume a fixed relationship between these two attitudes. We expect that teachers may differ in their attitudes towards higher-order thinking. For example, a teacher may have a positive or negative attitude towards stimulating students' higher-order thinking. To explore which

'combinations of attitudes' exist, we aimed to identify teacher profiles. This means that we combined measurements of teachers' attitudes towards higher-order thinking and what extent participants scored similarly or differently on these measurements

Teachers as 21st-century educators should infuse HOTS elements into content instruction. So, to bring this to the course in class, the teacher should use non-routine questions which can help them to communicate and getting responses from students, teacher should plan classroom questioning and discussion time to tap into particular higher order thinking skills. This study therefore, investigates science teachers' perception and attitudes towards Higher Order Thinking Skills in senior secondary' schools in Federal Capital Territory, Abuja.

Statement of Research Problem

Higher order thinking skills (HOTS) is being emphasized in the development of students' cognitive skill as well as the aspiration that the country holds to achieve excellence in the education system in this 21st century. However, it was observed that large number of students lack the thinking skills required to prepare for the challenges of adult work and daily life. The reason could be the poor implementation of higher order thinking objectives in teaching processes in the classroom. Hence, teachers' implementation of HOTS in the science classroom could be influenced by their perception and attitude.

Perception could be seen as an individual view or idea on higher order thinking skills (HOTS) by using a particular idea, or strategy that will enhance or improve his or her performance. Sulaiman*et al.* (2017) explored the perceptions of science teachers in the implementation higher order thinking skills in teaching science. Attitude can be seen as positive or negative emotional disposition about HOTS which can therefore be described as either positive or negative emotional disposition. Positive attitude to HOTS lead to good application of HOTS which consequently lead to good performance but, if otherwise, it will lead to poor application. There have been several studies on student factors with fewer on teachers' factors hence the drive for this study is science teachers' perception and attitude towards Higher Order Thinking Skills in senior secondary schools in Federal Capital Territory, Abuja.

Objective of the study. Aim of this study is to:

i. Examine science teachers' perception of Higher Order Thinking Skills in Senior Secondary Schools in Federal Capital Territory, Abuja
ii Find out science teachers attitude towards higher order thinking skills in Federal Capital Territory, Abuja.

Research Questions.

The following research questions were raised to guide the study:

i. What is the science teachers' perception of higher order thinking skills in senior secondary schools in Federal Capital Territory, Abuja.
ii. What is the science teachers' attitude towards higher order thinking skills in senior secondary schools in Federal Capital Territory, Abuja

Null hypothesis.

The following null hypothesis were formulated and tested at 0,05 level of significance:

i. There is no significance difference between male and female science teachers' perception of higher order thinking skills in senior secondary schools in Federal Capital Territory, Abuja..
ii. There is no significance difference between male and female science teachers' attitude towards higher order thinking skills in Federal Capital Territory.

Reviewed Literature

Afandi*et al*. (2018) identifies pre-service science teacher perception about HOTs in 21st century. This study employed quantitative design using a survey research method involved 120 pre-service science teachers from Tanjungpura University Indonesia using randomized sampling. The instruments used for this study is a questionnaire. A total of 20 items of questions used in this study to identify pre-service science teacher perception about HOTs in 21st century, range from strongly disagree to strongly agree. The results of this study indicated that students are aware of the importance of HOTs and learning that emphasizes the aspects of HOTs to face the challenges of the 21st century. It is indicated by the mean score of pre-service science teacher perception about the important of HOTs to meet the challenges in the 21st century (M = 4.29, SD = 0.61) and the skills of HOT that there will be required to becomes a teacher in the 21st century (M = 4.31; SD = 0.47) in the high level. This also provides the reasons why we need cultivating a positive awareness of the importance of HOTs in order to fostering the need for teaching that emphasizes the aspects of HOTs during pre-service education. The similarity in the study is that both investigate teachers' perception about higher order thinking skills and both used survey research design. The difference between the study and the present study was that the present carried out the study on science teachers' in secondary schools while the later carried out the study in Universities.

Acharya (2021) explored mathematics teachers' perception on Higher Order Thinking Skills (HOTS). The explanatory sequential mixed method with Likert scale and interview guideline was used as research tools for data collection. 50 mathematics teachers who were teaching at Higher Education were conveniently selected for the survey and 5 of them were interviewed. The mean and standard deviation of different views on Likert scale were calculated and the results from quantitative data are presented in language with the help of qualitative data obtained from the interview. The teachers' perception was gathered about concept or understanding, needs, clarity, and practice about the HOTS. The study found that most of the teachers viewed HOTS as a commonly known idea of analyzing and synthesizing skills together with logical thinking and decision making skills. In depth, teachers were clear about the meanings, strategies and the use of HOTS but weak in implementation. Majority of the teachers viewed the practice of HOTS in mathematics classrooms as necessary but they were rarely used. Only a few of them were partially practicing them in classroom instruction. The teachers felt complexity in practicing HOTS due to students' basic knowledge, approach and access to different materials, teachers' training, curriculum and time of implementation in development of HOTS in students. The similarity in the study is that both investigate teachers' perception about higher order thinking skills and both used survey research design. The difference between the study and the present study was that the present carried out the study on science teachers' in secondary schools while the later carried out the study Mathematics teachers.

Omar and Awang (2021) determine the attitude of students in secondary schools towards science and the degree of Higher Order Thinking Skills (HOTS). The objective of the research is also to examine the connection between the dimensions of the student's attitude and HOTS. This study is a quantitative method which is a correlation study. The questionnaire was used for the collection of respondent's information. The questionnaire was divided into two sections, which are: (A) Students' attitude towards science and (B) Higher Order Thinking Skills (HOTS). The HOTS survey was consequently designed by the researchers centered on the 2001 Bloom's Taxonomy and based on the questions adapted and updated from Pentaksiran Tingkatan 3 (PT3) 2016 and 2017. A total of 89 secondary school students were randomly selected from the two secondary schools in Kuala Nerus, Terengganu. The study found that student's attitude towards science was moderate (mean = 3.08), while HOTS level was low (mean = 1.28). However, there was a substantial connection between the dimensions of the science importance in society of the student attitude variables and the dimensions of evaluating and creating HOTS variables. Therefore, The Ministry of Education Malaysia (MOE) must plan the programs and activities to increase the awareness and understanding of the students about the importance of science in society. The similarity in the study is that both studies uses descriptive research design, questionnaire were used as an instrument to collect data in

both studies. The difference in the study was that the present study investigates science teachers' perception, attitude and implementation of higher order thinking skills in senior secondary schools while the later determine the attitude of students in secondary schools towards science and the degree of Higher Order Thinking Skills (HOTS).

Research Methodology

This study employed descriptive survey design. The study obtained current information on the science teachers' perception and attitude towards higher order thinking skills in senior secondary schools in Federal Capital Territory (FCT), Abuja.

Population of the Study

The target population of secondary school science teachers within FCT Abuja to be used for this study is One thousand two hundred and thirty -five (1, 235) which comprises of 717 Male Science Teachers and 518 Female Science Teachers. The total numbers of senior secondary schools in FCT Abuja were One hundred and seven (107) senior secondary schools (both public and private senior secondary schools) in FCT Abuja.

Sample and Sampling Techniques

Multi stage sampling technique was employed for the sample and sampling techniques. Firstly, cluster sampling techniques was used to classify the schools into six groups, namely Abuja Municipal Area Council, Bwari Area council, Kuje Area council, Abaji Area council, Gwagwalada Area council, Kwali Area council. Secondly, stratified random sampling techniques was used to classify the schools into strata namely, public and private secondary schools. Thirdly, simple random sampling techniques was used to select 111 science teachers from the private schools and 180 science teachers from the public schools. Given 291 science teachers as the sample size for the study using (Krejcie and Morgan, 1970).

Research Instrument

The research instrument was adapted from Karm and Karma (2021) which was used to collect data from science teachers of senior secondary schools (Private and Public) in FCT, Abuja. The instrument was a questionnaire titled Science Teachers perception and attitude towards Higher Order Thinking skills (STPAHOTS).

Validity of Research Instrument

The validity of the instrument, science teachers perception and attitude towards HOTS Questionnaire was validated by two experts in the Department of Science Education, (FUT), Minna and one expert in Department of Physics FCT College of Education Zuba, Abuja.

Reliability of the Instrument

The reliability of a test instrument refers to the degree to which an instrument yields the same or similar results over some time in the same condition or setting; this implies the consistency of test results or items. To test the reliability of the instrument the researcher administered the questionnaire to a sample of thirty (30) science teachers who are part of the population but not among the sample study. Cronbach alpha statistics was used to establish the reliability of the instrument. The instrument yields an average reliability coefficient of 0.85

Method of Data Analysis

Null hypothesis Testing

Table 1: Summary of Mann-Whitney U test on perception on Higher Order Thinking Skills based on gender

Test Variable	N	Mean Rank	Sum of Ranks	U-Test	P-Value
Male	190	118.04	45638.00	13225.00	0.867
Female	101	106.89	35495.00		

Null hypothesis one: There is no significant difference between male and female science teachers' perception of higher order thinking skills in senior secondary schools in Federal Capital Territory Abuja.

Null hypothesis Testing

Table 2: Summary of Mann-Whitney U test on attitude on Higher Order Thinking Skills

Test Variable	N	Mean Rank	Sum of Ranks	U-Test	P-Value
Male	189	68.05	44647.00	10234.00	0.807
Female	102	66.60	43485.00		

Null hypothesis two: There is o significant difference between male and female science teachers' attitude towards higher order thinking skills in senior secondary schools in Federal Capital Territory, Abuja.

Discussion of the results:

For null hypothesis one:

The result of a Mann-Whitney U-test that was conducted to test the null hypotheses that male and female science teachers perception of higher order thinking skills in FCT, Abuja. Male science teachers had an average rank of 118.04 with sum ranks of 45638.00, while female science teachers had an average rank of 106.89 with sum ranks 35495.00. The results of the analysis were in the expected direction, the p-value 0.867 and this is greater than significance value of 0.05, the null hypothesis which stated no significance difference was retained. Therefore, there is no significance difference between the mean rank of the ratings for male and female science teachers' perception of HOTS in F.C.T, Abuja.

The result of a Mann-Whitney U-test that was conducted to test the null hypotheses that male and female science teachers attitude of higher order thinking skills in FCT, Abuja. Male science teachers had an average rank of 68.05 with sum ranks of 44647.00, while female science teachers had an average rank of 66.60 with sum ranks 43485.00. The results of the analysis were in the expected direction, the p-value 0.807 and this is greater than significance value of 0.05, the null hypothesis which stated no significance difference was retained. Therefore, there is no significance difference between the mean rank of the ratings for male and female science teachers' attitude on HOTS in FCT, Abuja

Conclusions

The finding of the results revealed that the science teachers' (male and female) have positive perception and attitude towards higher order thinking skills in senior secondary school in FCT, Abuja. The p-value for perception is 0.86 while that of attitude is found to be 0.81 which are more than significant value 0.0.

Recommendations

Referring to the results described on the preceding section, it was suggested as follows:

- The government should provide more training and support for science teachers in order to help them implement HOTS effectively.
- The curriculum should be revised to include more opportunities for students to develop HOTS.
- Schools should provide more resources, such as textbooks and manipulative, to help teachers implement HOTS.

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FINANCIAL INCLUSION AND LIVESTOCK MARKET PERFORMANCE IN NIGER SOUTH SENATORIAL ZONE: BRIDGING THE GAP FOR AGRICULTURAL MSMES

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Abstract
Globally, the agricultural industry's performance is a matter of great concern due to its pivotal role in serving various sector economies. This industry, contributing over 25% of the GDP in some developing countries, plays a crucial role in providing food security, reducing poverty, and mitigating environmental risks. In Africa, where agriculture contributes significantly to GDP and employment, its potential remains underexplored, primarily due to traditional practices and lack of innovation. Nigeria, a sub-Saharan African nation, faced economic challenges exacerbated by the Naira redesign policy. This policy led to a cash shortage, affecting informal sectors like agriculture, particularly the livestock market. Low patronage and plummeting sales in the cattle market highlighted the reluctance to adopt innovative sales approaches and financial illiteracy. By considering the various important offerings of financial inclusion via its importance, characteristics and prospect for greater effect on the performance of several sector firms, a proposed study was advanced to assess the effect of financial inclusion on the performance of livestock markets in Niger South Senatorial Zone, Niger State. It seeks to bridge the research gap in this crucial sector and explore how financial inclusion, through dimensions such as access to financial services, can enhance business performance. Employing a quantitative survey approach, the study will engage various stakeholders, including producers, dealers, retailers, and brokers. The research's significance lies in contributing valuable insights into enhancing the performance of agricultural MSMEs, promoting financial inclusion, and informing policy decisions to support economic development. By understanding the nexus between financial inclusion and livestock market performance, this study strives to foster growth and resilience in the agricultural sector.

Keywords: Financial inclusion, performance, Niger, financial usage, financial access.

Introduction

Globally the performance of the agricultural industry as core primary market has been of great concern due to its important role in serving other sector economies (Montalbano and Nenci, 2022). The industry serves as the antecedent to modern civilization with huge employment capacity, revenue generation and a massive contribution to global Gross Domestic Product (GDP) which is above 25% in some developing countries (Mngumi *et al*., 2023). This industry plays an important role in providing food for the nation as well as curb other economic menaces like; poverty, unemployment, trade shortages, other products raw materials, reducing risk of flood, and blocking greenhouse gases. The industry drives innovation in technology been the site of some fascinating development in technology.

In Africa, performance of agricultural sector is statistically tagged to be contributing an average of about 25% to GDP. Africa produces basically all the principal crops essentially with new improving varieties that yield the best compared to other continents (Africa, 2023). It provides employment to about 67% of African working population. It remains the single most important reliance sector employing more than 50% of total workforce of most sub-Saharan economies (SSEs). The status quo of this sector has remained unchanged for a considerable period of time, despite this contribution, the agricultural businesses have not been given due regards as it is considered as a sector largely filled with peasant crop and animal farmers and crude systems. One of these countries in the sub-Saharan region is Nigeria.

Agricultural sector performance in Nigeria though with fluctuating trend, it contributes to about 24% of GDP and remain an important sector despite oil discovery in Oloibiri in 1970s. The sector remains the major segment of employment in the economy and providing employment opportunities to over 60% of employed workforce.it contributes to development of Nigerian economy through, provision for input products, provision of goods for foreign exchange, provision of goods in the market for consumption and factor contribution. It includes hunting, fishing, forestry and so also crops cultivation and production of livestock which is presently performing. One of the key aspects of this agricultural industry with lesser attention is the livestock market. Contribution of the livestock to Nigerian GDP increased in the first quarter of 2022 to 1.55% relative to previous year (Mohammed *et al., 2023*). Livestock production is very important in the economy of all nations by ensuring availability of food and animal protein need of human as well as help in generating income and providing job opportunities in both the rural and urban centers. In achieving the above-mentioned benefits which comes with a positive performance of this sector businesses, finance plays a critical role. This interplay of finances with agribusiness performance can be observed on both micro and macro levels, with every country having needs for a strong and responsive financial system to enable effective implementation of monetary policies, which are used to manage several macro and micro-economic factors to enhance commercial activities (Asongu, & De Moor, 2015). Therefore, one of the major responsibilities of financial institutions is to provide growth induced economic development, ease of business and improved economic activities for both urban and rural dwellers (Abiara and Arosanyin, 2014).

Financial institutions particularly banks, are the largest and most reliable source of financial services such as external financing to small and medium scale enterprises (Babu, 2016). Banks can offer financing facilities to agribusiness entrepreneurs if they are financially included. Financial inclusion as a concept was first introduced by India Reserve Bank in 2005 with objectives of providing access to quality and affordable financial services to some targeted population by meeting their financial requirements. Global percentage of financial inclusion rises to 76% as at 2021 with majority of the European countries clocking 100% of their total population, most of the countries in the world now developing a strategy that brings all the stakeholders together to achieve all population being financially included.

Nigerian being the largest economy in Africa has further experienced a more dipped economic crisis due to persistent scarcity in naira scarcity. The Naira redesign policy has further shrunken business activities and increased the suffering of the masses. This policy as excellent as it is intended shows the extent to which changes and innovative procedures has been neglected by a large economic classis of the populous. The policy which mopped over 70% of the cash in circulation without a corresponding ejection of the new note led to financial losses as well as poor performance of businesses (Moses-Ashike, 2023). The losses which are in a tune of 20 trillion Naira is tied to the stifling in informal sector activities, contraction in agricultural sector and the paralysis of the rural economy. The agricultural sector as important as it is, is a major recipient of this dipped crisis. Considering its nature, which is contemporary in nature, cash transaction is still very predominant. The livestock segment which is an important aspect of the agricultural SME is greatly affected as well. The sector which serves as means of livelihood to a large number of livestock farmers and sellers was greatly disrupted too. One of such profound case was narrated by Alhaji Piro Musa the leader of cattle market in which a cattle worth four hundred thousand naira was sold for forty thousand naira due to drop scarcity in cash and unwillingness of the cattle sellers to accept alternative payment mode (Kaigama, 2023). This case of low patronage and drastic fall in sales is experienced across board and the resultant effect is much felt by farmers in the northern areas of the country. Niger State being one of these states experienced such crisis in its cattle market across the state.

This low patronage and reduction in sales performance of this cattle market operatives can be tied to their unwillingness in the adoption of innovative approach in sales and lack of financial literacy advanced by financial inclusion. This emphasizes on the awareness, utilization and the effectiveness of financial technology and innovations. Despite the importance of this sector, they have received lesser research attention in the business space. Recent research attention has focused on Climate change in the livestock

sphere (Adesokan et al., 2015), Terrorism and land usage (Fadawe et al., 2022), Inventory management (Ufua et al., 2022), Livestock systems (Ogunniyi et al., 2014; Nwagwu, 2015; Girei and Onuk, 2016; Ajayi et al., 2019). Considering this important gab and the recent observed cash mop up by the Nigeria government through the central bank of Nigeria (CBN), this study seeks to investigate the effect of financial inclusion on the performance of Livestock market in Niger south senatorial zone.

Financial Inclusion

Financial inclusion means that individuals and businesses have access to useful and affordable financial products and services that meet their needs – transactions, payments, savings, credit, and insurance – delivered in a responsible and sustainable way. Financial inclusion refers to the provision of affordable, well-timed, and appropriately regulated access to financial services and products for all segments of the population, with the goal of enhancing overall wellbeing. The extent to which financial services are used, their sufficiency, convenience, knowledge about products, affordability, and accessibility are among the key factors influencing financial inclusion.

Financial inclusion has emerged as a significant force in providing financial services to underserved and disadvantaged communities, ensuring affordability and fair conditions. This has resulted in several benefits, such as increased access to credit, improved savings opportunities, and enhanced financial literacy. Additionally, financial inclusion contributes to reducing poverty and inequality, while fostering economic growth. by offering greater access to financial services to previously marginalized individuals and communities, financial inclusion creates opportunities for poverty alleviation. For instance, providing formal banking services to groups like farmers enables them to save, invest, and access credit, thereby improving their financial situations and contributing to overall economic growth. To facilitate financial inclusion, it is essential for both the government and financial sectors to create an enabling environment that supports the capacity of financial service providers. This involves designing affordable products and services that cater to market demands, thus promoting financial inclusion. As an example, Pakistan's agricultural sector benefits from advancing agricultural technology and innovative Fintech applications, which improve access to financial, utilization and quality of the financial services provided.

In the context of this study, financial inclusion is defined as the comprehensive accessibility and effective utilization of reliable financial services and facilities. This encompasses the availability of high-quality financial products and resources that contribute to the increased sales and overall performance of livestock market operators within the Niger South Senatorial Zone in Niger State.

Benefits of financial inclusion

In the context of Small and Medium Enterprises (SMEs) performance, access to financial services plays a pivotal role in driving their growth, sustainability, and overall success. SMEs, being the backbone of many economies, often face challenges related to limited financial resources and access to credit. These benefits emphasize the importance of financial inclusion in empowering businesses and fostering sustainable economic development. Particularly, access to formal financial services, addresses these challenges and offers various benefits to SMEs. It offers significant advantages to businesses, particularly Micro, Small, and Medium Enterprises (MSMEs), impacting various facets of their operations and overall economic progress (international Financial Corporation, 2017; World Bank Group, 2020). The key benefits of financial inclusion for businesses include:

i. Access to Formal Financial Services: Financial inclusion ensures businesses have access to formal financial services like bank accounts, credit facilities, insurance, and payment systems, enhancing financial management and security.
ii. Increased Access to Credit: By embracing financial inclusion, businesses, especially MSMEs, gain access to credit and capital crucial for growth, investment in new ventures, expansion, and procuring necessary resources.

iii. Improved Financial Management: Financial inclusion equips businesses with tools and knowledge for better financial management, enabling informed decisions, expense tracking, and strategic planning.
iv. Enhanced Savings and Investment: Formal financial services grant businesses opportunities to save and invest surplus funds in secure and regulated accounts, promoting financial stability and growth prospects.
v. Risk Mitigation: Financial inclusion provides access to insurance products safeguarding businesses from unforeseen risks like natural disasters, accidents, and disruptions.
vi. Facilitation of Business Transactions: Digital financial services offered through financial inclusion simplify and secure business transactions, including online payments and remittances, bolstering trade engagement and customer outreach.
vii. Promotion of Inclusive Growth: Financial inclusion plays a pivotal role in fostering inclusive economic growth, empowering businesses from diverse sectors, including marginalized and underserved communities, to partake in the formal economy and contribute to overall development.
viii. Convenience: Financial inclusion allows easy access to diverse financial services, including bank accounts, mobile banking, and online payment platforms, enabling seamless transactions anytime and anywhere, thereby reducing the reliance on physical visits to banking institutions.
ix. Reduced Transaction Costs: Formal financial services typically entail lower transaction costs compared to informal or cash-based methods, resulting in cost savings for individuals and businesses during payments and fund transfers.
x. Enhanced Security: Formal financial systems provide a secure environment for transactions, mitigating the risks associated with cash-based dealings and safeguarding against loss or theft.
xi. Speed and Efficiency: Financial inclusion facilitates faster and more efficient transactions through electronic transfers, digital wallets, and online banking, enabling instant money transfers and payments, eliminating the delays associated with traditional approaches.
xii. Access to Diverse Payment Options: Financial inclusion offers an array of payment options such as credit/debit cards, mobile money, and digital wallets, catering to the diverse preferences and needs of individuals and businesses alike.
xiii. Support for Business Expansion: For Micro, Small, and Medium Enterprises (MSMEs), ease of financial transactions underpins business expansion by facilitating seamless payment collections, enhancing access to credit, and streamlining inventory management.
xiv. Financial Inclusion in Remote Areas: Through digital and mobile banking, financial inclusion extends its reach to remote and underserved regions, enabling residents to partake in formal transactions without the need for extensive travel.
xv. Financial Empowerment: Ease of financial transactions empowers individuals to manage their finances effectively, make informed decisions, and enhance their overall financial well-being.
xvi. Job Creation and Employment: Access to financial services fosters business expansion and job creation, contributing to reduced unemployment and economic prosperity.

Dimensions of financial inclusion

The dimensions of financial inclusion encompass a comprehensive set of aspects or components that collectively determine the level to which individuals and businesses can access and utilize formal financial services (Koomson *et al.*, 2018). These dimensions provide a holistic view of financial inclusion, covering various elements that contribute to the inclusive involvement of all segments of the population in the formal financial system. The primary dimensions of financial inclusion include:

i. Access to Financial Services: This dimension focuses on the availability and accessibility of formal financial products and services, such as bank accounts, credit, savings, insurance, payment systems, and digital financial services.
ii. Usage and Utilization: It refer to the degree to which individuals and businesses actively use formal financial services for their financial needs, including the frequency and volume of transactions conducted through formal channels.

iii. Affordability: This dimension assesses whether financial services are affordable to different segments of the population, considering factors such as fees, interest rates, and transaction costs.
iv. Quality of Services: It evaluates the reliability, efficiency, and convenience of formal financial services, ensuring that customers have a positive experience and are satisfied with the services provided.
v. Financial Literacy and Capability: This dimension emphasizes the level of financial knowledge and understanding among individuals, enabling them to make informed financial decisions and effectively use financial products.
vi. Consumer Protection: It focuses on the existence of regulatory frameworks and measures to safeguard the interests of customers, ensuring fair treatment, transparency, and accountability in financial transactions.
vii. Digital and Technological Access: With the increasing role of technology in financial services, this dimension assesses the availability and use of digital financial services, mobile banking, and internet-based platforms.
viii. Inclusive Policy and Regulatory Environment: This dimension examines the presence of policies and regulations that promote financial inclusion, address barriers, and encourage the participation of all segments of society in formal finance.
ix. Gender Inclusion: It emphasizes the extent to which financial services are accessible and tailored to meet the specific needs of women, aiming to reduce gender disparities in financial access and usage.
x. Geographical Inclusion: This dimension takes into account the availability of financial services in rural and remote areas, ensuring that residents have access to formal financial products and services.
xi. Inclusion of Marginalized and Vulnerable Groups: It focuses on extending financial services to underserved populations, such as low-income individuals, ethnic minorities, and people with disabilities.

This study will adapt the conceptualization of Otiato (2016) in investing the effect of financial inclusion on performance of livestock market in Niger South Senatorial Zone in Niger State, this conceptualization was adapted due to its consideration for the access of financial services, usage and the quality of these various services which is fundamental in answering the research question and meeting its overall aim. These dimensions will give a clear view as to the accessibility of this services, the extent of use and the quality of these services in enhancing the performance of this study's population.

This is justified as firstly, Access to Financial Services" is a fundamental dimension of financial inclusion that assesses the availability and accessibility of formal financial products and services to individuals and businesses. It gauges the degree to which people have the opportunity to use formal financial channels to meet their financial needs, including banking services, credit facilities, savings accounts, insurance, and digital payment systems. Demirgüç-Kunt *et al.* (2015) drew data from the Global Findex Database and underscores the role of access to financial services in improving the economic well-being of individuals and enhancing financial stability. Arzubiaga *et al.* (2023) found that access to financial services impacts the success of family owned SMES in Spain by providing for their termed financial needs, Hossain *et al.* (2023) also found that access to financial services through financial literacy is a pivotal path to the enhancement of business performance in Bangladesh. It holds significant importance in facilitating economic growth, poverty alleviation, and empowerment of individuals and businesses. A wealth of research, including analyses utilizing data from the World Bank's Global Findex Database, consistently demonstrates that improving access to formal financial services is a key driver in advancing financial inclusion and fostering sustainable development in economies of both developed and developing nations.
Secondly, Usage and Utilization of financial services represents a vital aspect of financial inclusion, evaluating the active involvement of individuals and businesses in utilizing formal financial products and services to address their financial requirements. It extends beyond mere access and delves into the frequency, volume, and variety of financial transactions conducted through formal channels. This dimension

is indicative of the level of engagement and proactive participation of individuals within the formal financial system, playing a crucial role in unlocking the complete advantages of financial inclusion. Prodanova *et al.* (2023) found that the usage of mobile services on a positive of customers has positive effect on their satisfaction and business performance, Lee *et al.* (2023) found that digital financial inclusion contributes to various sectors of the Chinese sectors and influences poverty alleviation in the area. This dimension is of utmost importance in the context of financial inclusion as they mirror the degree of active involvement and utilization of formal financial products and services by individuals and businesses. Extensive research and data from the World Bank's Global Findex Database offer valuable insights into the significance of encouraging active participation in formal financial systems to attain comprehensive financial inclusion and foster sustainable economic development.

Lastly, Quality of Services stands as a pivotal dimension within financial inclusion, aiming to gauge the standard and efficacy of formal financial services extended to individuals and businesses. This dimension transcends mere accessibility and usage, delving into the degree of contentment and satisfaction experienced in meeting financial needs through these services. Kar *et al.* (2023) found in India that providing high-quality services is essential to attract and retain customers as measures of performance, also, the World Bank's Financial Inclusion Global Initiative in 2021 acknowledges the importance of Quality of Services as a critical factor in fostering greater financial inclusion and customer retention in the formal financial system (Mushtaq *et al.*, 2023). It encompasses various crucial aspects, such as the efficiency, reliability, convenience, and responsiveness demonstrated by financial institutions in delivering services to their customers. Quality of Services emerges as a crucial dimension in the realm of financial inclusion, focusing on the effectiveness and satisfaction derived from formal financial services offered to individuals and businesses. Extensive research and data from diverse sources highlight the importance of emphasizing service quality to foster customer engagement, enhance the utilization of formal financial services, and ultimately achieve comprehensive financial inclusion.

Business Performance

Business performance refers to the assessment of a company's financial health and success based on various financial metrics and indicators (Kotane, and Kuzmina-Merlino, 2017). It involves analyzing factors such as profitability, liquidity, solvency, and efficiency to gauge the company's ability to generate profits, manage resources, and meet financial obligations. It can also be defined as the operational efficiency and effectiveness of a company's day-to-day activities and processes. It entails the assessment of various aspects, including production output, delivery timelines, customer satisfaction, and resource utilization, to gauge how well the company manages its operations and meets the needs of its customers (Manavalan and Jayakrishna, 2019). It relates to the realization of strategic objectives and long-term goals established by the company. It encompasses the assessment of the company's advancement towards strategic milestones, growth in market share, competitive advantage, and overall success in the market (Mahdi *et al.*, 2016). This evaluation allows the company to gauge its strategic effectiveness and alignment with its long-term vision and mission.

Considering MSMEs sector, it involves assessing the company's overall achievements and effectiveness in meeting its objectives while acknowledging the unique challenges and opportunities faced by these smaller businesses. This assessment encompasses both financial metrics, such as profitability, revenue growth, and financial stability, as well as non-financial indicators like customer satisfaction, employee productivity, and market competitiveness, all tailored to the scale and scope of MSME operations. The performance of small businesses is the ability to contribute to job and wealth creation through business start-up, survival, and growth (Johnson, 2020). Within the context of MSMEs, the evaluation of business performance also considers the significant contributions of these enterprises to local economies in terms of generating employment, distributing income, and fostering innovation. Additionally, it acknowledges the challenges they encounter, including limited access to finance, resource constraints, and scalability issues, which may necessitate customized strategies to enhance their performance and ensure their long-term sustainability.

This study defines business performance as the attainment of higher sales level by livestock market persons due to the adoption of financial technology related competencies.

Financial performance

Financial measurement of performance pertains to the evaluation of a company's success and effectiveness in attaining its financial objectives and targets. It entails the scrutiny of various financial metrics and ratios to assess the company's financial well-being, profitability, liquidity, efficiency, solvency, and market performance (Kotane, and Kuzmina-Merlino, 2017). These financial indicators offer valuable insights into the company's fiscal position, its capacity to generate profits, manage expenses, fulfil short-term and long-term financial commitments, and create value for its shareholders (Gallant and Cadez, 2017). The process of financial measurement of performance is of utmost importance to stakeholders, including investors, creditors, and management, as it facilitates informed decision-making and enables the determination of the company's overall financial soundness and prosperity. Some of these measures are discussed in the succeeding paragraphs;

i. Profitability Ratios: These ratios gauge the company's capacity to generate profits from its operations. Common profitability ratios comprise Gross Profit Margin, Net Profit Margin, Return on Assets (ROA), and Return on Equity (ROE).
ii. Liquidity Ratios: These ratios evaluate the company's immediate financial solvency and its ability to meet short-term financial obligations. Examples of liquidity ratios include the Current Ratio and Quick Ratio.
iii. Efficiency Ratios: Efficiency ratios measure how effectively a company manages its assets and liabilities to generate sales or revenue. Examples encompass the Asset Turnover Ratio and Inventory Turnover Ratio.
iv. Solvency Ratios: Solvency ratios analyse the company's long-term financial stability and its ability to meet long-term debt obligations. Instances of solvency ratios include the Debt-to-Equity Ratio and Interest Coverage Ratio.
v. Market Performance Metrics: These metrics concentrate on how the market perceives the company's performance. Market-based measures encompass the Price-to-Earnings (P/E) Ratio, Market-to-Book Ratio, and Total Shareholder Return.
vi. Cash Flow Indicators: Cash flow indicators assess the company's competence in generating and managing cash inflows and outflows. Key cash flow metrics comprise Operating Cash Flow, Investing Cash Flow, and Financing Cash Flow.

Non-Financial Performance

Non-financial measurement of performance refers to the assessment of a company's success and effectiveness in achieving its strategic objectives and goals through non-monetary metrics (Ahmad and Zabri, 2016). Unlike financial measures, which focus on the company's financial outcomes, non-financial measures encompass various aspects of the company's operations, processes, and performance that are not directly related to financial figures. These measures provide insights into the company's overall performance, efficiency, and effectiveness in areas such as customer satisfaction, employee engagement, innovation, product quality, environmental sustainability, and social impact.

Non-financial measures are essential for a comprehensive evaluation of a company's performance because they capture important intangible assets and factors that contribute to the company's long-term success and sustainability (Panno, 2020). They help management and stakeholders gain a deeper understanding of the company's strengths and weaknesses beyond financial numbers, allowing them to make informed decisions and develop strategies to improve overall performance and achieve strategic objectives. Examples of non-financial performance measures include customer retention rate, employee turnover rate, product defect rate, employee satisfaction surveys, environmental impact assessments, community engagement initiatives, and innovation and research and development metrics. These measures complement financial metrics and provide a more holistic view of the company's performance and its impact on various stakeholders and the

broader society. It's a subjective approach to performance which can rely upon the perception of respondents which is contrast to the financial performance that is objective in nature.

For this study, sales as a measure of non-financial measure will be adopted in measuring the performance of the players in the livestock markets identified by the study. The rationale being that the unorganized characteristics of MSMEs depict that they do not keep due records of sales, and a disclosure of their financial ground is mostly not disclosed due to security reasons. Their perception of sales will give a subjective overview into how their sales as either increased or decreased overtime with giving actual financial figures.

Financial inclusion and Performance

Financial inclusion plays a vital role in influencing the performance of Micro, Small, and Medium-sized Enterprises (MSMEs). Multiple empirical studies have demonstrated a positive relationship between financial inclusion and MSMEs performance. For example, Wibowo and Widayat (2023) conducted a study in India and found that MSMEs with greater access to formal financial services and credit facilities exhibited higher levels of productivity and revenue growth. Similarly, Ratnawati (2020) conducted research in Uganda, revealing that improved financial inclusion positively impacted the profitability and expansion of MSMEs in the country. These findings underscore the significant contribution of financial inclusion in enhancing the overall performance of MSMEs by providing them with improved financial resources and opportunities. Financial inclusion also promotes the resilience and sustainability of MSMEs, as evidenced by various studies. For instance, Rajamani and Rekha (2023) conducted, revealing that MSMEs with access to formal financial services were better equipped to withstand economic shocks and adverse business conditions. Additionally, research by Okafor *et al.* (2018) in Nigeria demonstrated that increased financial inclusion led to reduced vulnerability to external risks and increased chances of business survival among MSMEs. These findings indicate that financial inclusion provides MSMEs with the necessary financial tools and support to navigate through challenges and maintain their competitiveness, ultimately contributing to their long-term performance.

Furthermore, financial inclusion has been shown to enhance the growth and innovation capabilities of MSMEs. A study conducted by Onyeje *et al.* (2022) in Nigeria revealed that MSMEs with access to formal financial services were more likely to invest in research and development activities, leading to product innovation and diversification. Additionally, a study by Widyanata *et al.* (2023) demonstrated that financial inclusion facilitated greater access to working capital, enabling MSMEs to expand their operations and explore new market opportunities. These findings highlight the role of financial inclusion in fostering a conducive environment for MSMEs to grow, innovate, and remain competitive, ultimately contributing to their overall performance.

Overall, empirical evidence from various studies consistently establishes a positive and interconnected relationship between financial inclusion and MSMEs performance. Financial inclusion not only provides MSMEs with better access to financial resources and credit facilities but also enhances their resilience, sustainability, and growth prospects. As policymakers and financial institutions continue to prioritize and develop initiatives to promote financial inclusion, MSMEs stand to benefit from improved performance and increased contributions to economic development and prosperity**.**

Ratnawati (2020) assessed investigated how financial inclusion affects the performance of micro-, small-, and medium-sized enterprises (MSMEs) in Malang, Indonesia. The study also explores the role of financial intermediation and access to capital as potential mediators in this relationship. The research sample consists of 100 MSME actors from Malang City, selected using the Roscoes theory. Data is collected through a Simple Random Sampling method, utilizing questionnaires with Likert scales. The proposed hypotheses are tested using the Partial Least Square (PLS) model. The findings of the study indicate that financial inclusion has both direct and indirect impacts on the performance of MSMEs. The direct influence implies that enhancing access to financial services, particularly credit financing for MSMEs, can lead to increased

market share, workforce, sales, and profitability for these enterprises. Moreover, the study highlights that financial inclusion significantly improves MSMEs' performance through financial intermediation, as compared to access to capital. In other words, increasing financial access for MSMEs, coupled with a financial service approach, has a more substantial effect on enhancing the performance of MSMEs compared to the impact of access to capital alone.

Mujiatun *et al.* (2023) explored the relationship between marketing communication, Islamic financial literacy, Islamic financial inclusion, and the performance of micro, small, and medium-sized enterprises (MSMEs) operating in the halal-tourism sector. To achieve this, a covariance-based Structural Equation Modelling (SEM) technique using LISREL software was utilized for data analysis. The data was collected through nonprobability sampling, and the sample comprises 152 halal-tourism entrepreneurs. The study reveals a positive and significant relationship between Islamic financial inclusion and MSME performance in the halal-tourism sector. Additionally, it finds a positive and significant association between Islamic financial literacy and Islamic financial inclusion. However, the study identifies that the relationship between marketing communication and Islamic financial inclusion, though positive, is not statistically significant. The implications of this research suggest that building a sustainable halal-tourism ecosystem in Indonesia requires strong support from commercial actors. The study demonstrates that MSMEs within this ecosystem can flourish when backed by Islamic banking and Islamic rural banks. Consequently, a more accommodating approach from Islamic banking is necessary to provide adequate access to halal finance for business actors within Indonesia's halal-tourism ecosystem.

In Nigeria, Agbim (2020) investigated the effect of financial inclusion on the financial and non-financial performance of SMEs in South Eastern Nigeria. The study adopted a qualitative research design and employed interview in collecting data from the respondents. The study's data was collected from purposively selected one hundred and twenty respondents. The recorded interview data was transcribed and subjected to qualitative content analysis. The result revealed that financial inclusion has a positive and significant effect on the performance of SMES in the study area. Small and Medium-sized Enterprise (SME) owners can enhance both their financial and non-financial performance by synergizing government entrepreneurship incentives, support from friends and family, and implementing financial inclusion (FI) strategies and mechanisms.

Ibor *et al.* (2017) also in Nigeria study focused on examining how financial inclusion impacts the performance of micro, small, and medium enterprises (MSMEs) in Nigeria. The research employed a survey research design, utilizing questionnaires to gather data from respondents. The collected data underwent analysis using the Pearson Chi-square technique. The findings revealed that financial inclusion has a positive and significant effect on the operations and growth of MSMEs in Nigeria. However, challenges related to the distance of financial service access points and infrastructural deficiencies hindered the fast and effective access to financial services by MSMEs in the country. To address these issues, the study suggests implementing deliberate measures to expand access points to more rural areas and improve overall infrastructure to promote financial inclusion. This could be achieved through a policy roadmap that targets the expansion of financial services access points to unbanked and underserved regions, leveraging the financial services geospatial map. Additionally, prioritizing the digitization of payments nationwide is recommended, incorporating enhanced ICT/E-banking tools, and establishing a robust consumer protection framework to ensure the effective and secure usage of digital financial services.

Orange and Ondabu (2018) assessed the influence of various financial inclusion elements, such as financial literacy programs, usage of agents and representatives, proliferation of ATMs, and mobile banking services, on the financial performance of listed banks in Kenya. Additionally, the study sought to determine the impact of bank branch spread on the performance of these listed banks. The main theories reviewed in this study included the Grameen Model of Banking, Bank Led Theory, Financial Intermediation Theory, and Contemporary Banking Theory. To achieve these objectives, the study adopted a descriptive research design

and focused on the management and operational level employees of the 11 banks listed on the Nairobi Securities Exchange. A census study was conducted, and primary data was collected using questionnaires. Pilot testing with data from NIC Bank was conducted to ensure the reliability and validity of the research instruments. Data analysis was performed using SPSS software (version 2.3), and regression analysis results were presented through charts and tables. The findings of the study indicated that financial inclusion elements had a positive and strong impact on the financial performance of banks in terms of return on equity. Specifically, financial literacy programs showed a positive but weak effect on the financial performance of banks. On the other hand, the use of agents and representatives had a positive and strong effect on bank performance. The proliferation of ATMs and mobile banking services had a positive but weak effect on the financial performance of banks, while bank branch spread also exhibited a positive but weak effect on their performance. Based on the results, the study recommends that policymakers in financial institutions, particularly banks, should leverage financial inclusion elements to enhance the financial performance of banks. Additionally, the study suggests further research that incorporates moderating and intervening variables, such as the size and ownership of business entities, to gain deeper insights into the dynamics of financial performance in this context.

Shihadeh *et al.* (2018) assessed the relationship between financial inclusion (FI) and the performance of banks in the Jordanian economy, utilizing annual data from 13 commercial banks spanning the period from 2009 to 2014. The performance of these banks is assessed through two metrics: gross income and return on assets (ROA) in Jordan. To ensure the reliability of the findings, the study employs six distinct measures of FI. These measures encompass credits granted to small and medium enterprises (SMEs), deposits made by SMEs, the number of ATMs, the extent of ATM services, the quantity of credit cards issued, and the introduction of new services. The outcomes indicate a significant impact of FI on banks' performance, both in terms of gross income and ROA. However, the study reveals varying results when analyzing the effects of individual FI variables in isolation. Nevertheless, it concludes that overall, financial inclusion positively contributes to enhancing the banks' performance. Consequently, the study recommends that banks allocate more resources to bolster FI, recognizing its potential to bolster profitability and overall success.

Hidayat *et al.* (2022) explored the relationship between financial inclusion and MSME performance while examining the mediating role of intellectual capital and the moderating role of business age. The sample consists of members from three MSME clusters in Indonesia, with 134 respondents participating through survey questionnaires. The data analysis involves structural equation modelling with WarpPLS. The findings suggest that financial inclusion does not significantly affect MSME performance. However, intellectual capital has a positive impact on MSME performance, and financial inclusion positively influences intellectual capital. Furthermore, the study reveals that intellectual capital acts as a crucial mediator in the link between financial inclusion and MSME performance. Additionally, the age of the business can strengthen the relationship between financial inclusion and MSME performance. (F and N)

Thathsarani and Jianguo (2022) investigated the impact of financial inclusion on SME performances and explore the role of digital financing as a mediator in the association between financial inclusion and SME performance. Additionally, the study sought to examine how the Technology Acceptance Model (TAM) supports financial inclusion and SME performance. Data were collected from 366 owner-managers of Sri Lankan SMEs through a well-structured questionnaire using a quantitative research approach. The study's findings indicate that financial inclusion, digital financing, and TAM significantly influence SME performance. Specifically, digital financing and TAM were found to positively mediate the relationship between financial inclusion and SME performance. The results of this research highlight the importance of developing and promoting digital financing services that are cost-effective, secure, and low risk from a supply-side perspective. Moreover, improving financial literacy among SMEs is crucial from the demand-side perspective to effectively adopt and utilize digital financing methods.

Considering the discussions in the preceding subheadings that clearly establish the nexus between financial inclusion and performance, the review therefore proposed research aimed, question and hypothesis aimed at investigating the nexus as thus;

Aims of the study

The central aim of the study is to assess the effect of financial inclusion on the performance of livestock market in Niger South Senatorial Zone in Niger State

Based on the aim and objectives, the study has the research question; What is the impact of financial inclusion on the performance of livestock market in Niger South Senatorial Zone?

There is no statistical relationship between financial inclusion and performance of livestock market in Niger South Senatorial Zone.

Proposed Methodology

The proposed study will adopt quantitative design approach in surveying the various stakeholders of the livestock market in the three livestock markets in the Niger South senatorial area, namely; Karra Market Jebba, Mokwa LGA, Wuya Market Lavun LGA, and Tunga Market Lapai LGA. The population of the is made up of the various livestock producers, dealers, retailers and livestock brokers registered with the various local markets in the study area. These stakeholders sum to 17260 and considered as the population for the study. Taro Yamane formula will be employed to statistically determine the appropriate sample size from the population. A structured questionnaire will be employed to collect data from the respondents in the study area. All items utilized in the study will be adapted from prior research and assessed using a 5-point Likert scale. The collected data will be analyzed using Structural Equation Modeling- Partial Least Square (SEM PLS).

$$\text{Sample of livestock farmers } (n) = \frac{17260}{1 + \ 17260\ (0.05)^2}$$

$$n = \frac{17260}{44.15}$$

n = 391 Livestock market stakeholders in Niger South senatorial area

Conclusion

In conclusion, the concept of financial inclusion through its dimensions offers imperative contribution to MSMEs by ensuring the coverage of all regardless of educational, social, economic and geographical status, these capabilities has been observed to benefit businesses in various capabilities. Considering this and the lingering need to improve the performance of MSMEs, this study seek to explore the nexus between financial inclusion and performance among MSMEs, by the way of this, a proposed study was advanced with an aim to assess the effect of financial inclusion on the performance of livestock market in Niger South Senatorial Zone in Niger State, therefore to bridge existing gaps within the literature and contribute valuable insights towards the performance of Agricultural MSMEs in the proposed study area. The study will categorically will upon completion contribute to knowledge; literature on financial inclusion and performance, practice; providing financial inclusion practical knowledge and how this can enhance sales performance and finally, policies; providing policy insight as to upgrade on financial technological options to be enhanced, implemented and aided holistically be policy makers in ensuring that the important sector of agriculture thrive and contribute significantly to economic development.

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EFFECT OF COGNITIVE CONFLICT INSTRUCTIONAL STRATEGY ON GEOMETRY ACHIEVEMENT AND RETENTION AMONG SECONDARY SCHOOL STUDENTS IN MINNA, NIGER STATE.

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Abstract
The study determined the Effect of Cognitive Conflict Instructional Strategies on Student's Achievement and Retention in Geometry among Secondary School Students in Minna, Niger State. The study employed quasi-experimental research design (pretest and posttest experimental and Control groups) Two (2) research questions were raised and two (2) research hypotheses were formulated and tested at 0.05 significant level. The population of the study comprised 8,251 mathematics students (2020/2021) academic session in senior secondary schools in Minna, Niger State.The researcher used an intact class of 71 students (46 male and 25 female). The students were taught using cognitive conflict instructional strategy. Geometry Achievement Test (GAT) was used as research instrument for collecting data for the study. The instrument was validated by three experts and the reliability of the instrument was determined through test and retest method, the data collected were analyzed using Pearson's Product Moment Correlation Coefficient and reliability coefficient of 0.72 was obtained. After teaching, an achievement test (posttest) was administered on the students and retention test was given after the period of two weeks. The data collected were analyzed using descriptive statistics of mean and standard deviation and independent sampled t-test. The findings revealed no Gender influence on the achievement and retention of students taught Geometry concept using cognitive conflict instructional strategy. The study recommends that: Geometry is about identification, description of shapes and there properties, so teachers' should teach most of the concepts through cognitive conflict instructional strategy to improve students' achievement and retention in geometry.

Keywords: Achievement, Retention, Cognitive, Conflict, Collaborative, Geometry

Introduction

The school mathematics resulted from the confluence of two traditions. The first rooted in Babylonia astronomy, Egyptian earth measurement and ancient commerce, is mathematics as a reckoning, as a tool required for everyday life. The second tradition is rooted in Greek geometry and medieval algebra, is mathematics as reasoning, as one of liberal art whose mastery marks an educated person. In this tradition, mathematics offers aesthetics satisfaction as well as a means of developing the mind capacity for abstract thought. Every society attempts to pass to its children the language and skills it has acquired or developed for dealing with numerical and spatial problems. When schools are organized to give children grounding in their culture or to achieve their desires, this practical sort of mathematics is what appears in the curriculum (Farhat, 2016).

Among the branches of mathematics is geometry. According to Farhat (2016) geometry is the branch of mathematics that deals with the properties of spaces. He maintained that, geometry in its most elementary form is concerned with metrical problems of determining the areas and diameters of two dimensional figures and surface areas and volumes of solids. He further added that other fields of geometry include descriptive geometry, analysis situs or topology, the geometry of spaces having four or more dimensions and non-Euclidean geometry.

According to Ahmad (2016) Mathematics is one of the science subjects taught in Nigeria's primary, secondary, and tertiary institutions. It logically consists of thinking, formulating and testing conjectures, making sense of things, forming and justifying judgment, inferences and conclusions. He further added that, geometry is one of the seven major areas in mathematics in content in curriculum and taught at all secondary schools in Nigeria, and it is an aspect of mathematics that deals with the study of different shapes and their properties. Furthermore, Geometry is often taught to students separated from their real life experiences. As a result, they often cannot apply the concepts they have been taught to solve real life problems and in some circumstances, gain no benefits from learning mathematics.

Teaching and learning mathematics is essential to students and important to teachers to impart knowledge more appropriately to students. Therefore, teachers need to use an instructional strategy that can facilitate teaching and learning mathematics more meaningful to ensure that the students pay attention to them so that they should not get lost in mathematics. It is essential to capture students' attention with appropriate methods to motivate students. Every geometry course taught calls on logical and cognitive reasoning and visualization ability. Cognitive conflict is related to the content of mathematics, such as geometry. Because of geometry's cognitive nature, the cognitive conflict has been linked with geometry achievement Mitchemore (2015).

Cognitive Conflict Instructional Strategy is one of the major independent variables to be used in this study. Cognitive Conflict occurs when students are presented with examples which cause them to question their incomplete understanding of geometry shapes (for example rectangle among others), in this strategy the teacher promote Cognitive Conflict in the classroom by having students predict which of the shapes drawn by the teacher matches their expectation. When a teacher causes discrepancy among students in the class or the teacher tried using an approach that will cause uncertainty/conflict on the students' previous ideas on how to solve geometry problems in order to encourage conceptual change, he/she will use model process cognitive conflict to anticipate how students may experience cognitive conflict. This model process helps a teacher not to let students have conflict by guiding the student out of dissonance or confusion. Mufit *et al*. (2018) defined Cognitive Conflict as a conflict between structure Cognitive (that is, a structural Organized knowledge in the brain) with the environment (For example, an experiment, demonstration, opinions of peers, books, or other), or conflict between concepts in the cognitive structure.

This instructional strategy has recently been receiving much attention in teaching and learning, particularly in the area of mathematics education. There is evidence in the mathematics education literature that significant number of students are often confronted with contradictions between their way of describing and explaining concepts and how such concepts are explained by their peers, teachers, or textbooks. As a result, mathematics educators have a great interest in conceptual change through the use of cognitive conflict, as it is instrumental in promoting deeper learning and conceptual understanding in mathematics (Adnyani, 2020). capture students' attention with appropriate methods to motivate students. Every geometry courses taught calls on logical and cognitive reasoning and visualization ability. Cognitive conflict is related to the content of mathematics, such as geometry. Because of geometry's cognitive nature, the cognitive conflict has been linked with geometry achievement Mitchemore (2015).

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Cognitive conflict refers to a situation where a student is confronted with a discrepancy between their existing cognitive elements (attitudes, perceptions, knowledge, and behaviors) to form new information or ideas (Zazkis & Chernoff, 2016). During mathematics learning, cognitive conflict occurs when students have a preconceived idea about how a mathematical problem should be solved, which differs from how it is being solved (Maumee & Mathews, 2017) Utilizing Cognitive Conflict during Mathematics lessons can help promote the idea of Cognitively Guided Instruction (CGI) which underscores the need for teachers to pay more attention to students during mathematics learning to improve students' thinking and teacher skills in explaining concepts (Jacobs *et al*., 2017). Furthermore, teachers need to appreciate and understand students' existing ideas and understandings and present students with situations that provoke cognitive conflict to reveal the inadequacy of the students' ideas and encourage the formation of new knowledge. Mathematics teaching based on cognitive conflict can improve students' ability to solve Mathematical problems, develop critical thinking and improve their communication skills (Widada *et al*, 2018 Gal., 2019).

This instructional strategy has recently been receiving much attention in teaching and learning, particularly in the area of mathematics education. There is evidence in the mathematics education literature that significant number of students is often confronted with contradictions between their way of describing and explaining concepts and how such concepts are explained by their peers, teachers, or textbooks. As a result, mathematics educators have a great interest in conceptual change through the use of cognitive conflict, as it is instrumental in promoting deeper learning and conceptual understanding in mathematics (Adnyani, 2020). A counterexample is an important way to create cognitive conflict that can support the development of specific knowledge on the students, is widely recognized as an important teaching strategy in conceptual change and can be utilized effectively as instructional approach to promote students' conceptual development (Mufit *et al*., 2018).

Cognitive conflict refers to a situation where a student is confronted with a discrepancy between their existing cognitive elements (attitudes, perceptions, knowledge, and behaviours) to form new information or ideas (Zazkis & Chernoff, 2016). During mathematics learning, cognitive conflict occurs when students have a preconceived idea about how a mathematical problem should be solved, which differs from how it is being solved (Maumee& Mathews, 2017). Cognitive conflict can be viewed as an instructional strategy that is interactive, inspiring, fun, and challenging to students (Lee *et al.*, 2017). In mathematics education, several researchers have observed cognitive conflict as a situation that can play an important role in students' acquisition of mathematical concepts that can also act as evidence of mathematics learning (Susilawati *et al*., 2017; Subanji & Maharani, 2018).

This above strategies can be used to improve students' achievement and retention in geometry aspect of mathematics.

Achievement is one of the dependent variable in this study. According to Abdullahi (2015) achievement is a positive and optimal output as a result of successive solving of mathematics problem through effort, as a result of hard work. Despite the importance of geometry in specific and mathematics in general, the problem of students' poor achievement and retention capacity in the subject is undoubtedly worrisome and has been a major concern to the educationalist. Unfortunately, teachers and educators in different parts of the world are disappointed about the poor state of geometric skills in our mathematics classroom Royal Society / Joint Mathematical Council (JMC, 2020).

Another important variable in this study is gender. Food and Agriculture Organization of the United Nations (FAO), 2013define Gender in relation to man and woman, both perceptual and material. Gender is not determined biologically due to the sexual characteristics of either women or men but is constructed socially. Gender is a person's self-representation as male or female or how that person is responded to by social institutions based on the individual gender presentation. Yang and Chen (2013) state that among various human factors, spatial ability and gender differences are critical to geometric learning and gender

differences play an important role in geometric learning because boys and girls show different outcomes in different learning environments when they learn geometry. Thus, the present study will examine the effect of Cognitive Conflict Instructional Strategy on Achievement and Retention in the Geometry aspect of Mathematics among Senior Secondary School Students (SSII) in Niger State.

Statement of the Research Problem

Research studies have revealed that, many students in Nigeria secondary schools are not adequately prepared for geometry concepts and contents (Etsu & Ahmad, 2018). Ahmad and Idris (2017) opined that too much emphasis is often placed on formal symbolism and naming in the curriculum while relational understanding is underestimated. This therefore makes students in senior secondary schools to lack experience in reasoning about geometry. They further stressed that, students would perform well and developed good reasoning about geometry situations if they had substantial experience in geometry during their junior secondary school classes. Therefore, they report that, the above problem is one of the reasons that made most of the secondary school students and the general public at large to erroneously believe and developed the idea that, geometry is difficult to study. No doubt, there is evidence of discontentment in the achievement of students in mathematics at the senior school certificate examination despite the positive roles played by science educators specially Mathematics educators.

It has been reported that teaching and learning of Mathematics, geometry in particular, has been unsatisfactory (Odetola & Salama, 2014). This was compounded by the conventional method of instructions adopted by most mathematics teachers, which led to poor students' comprehension of relevant mathematics concepts, especially in geometry (Abakpa & Iji, 2013). Instructional methods of teaching mathematics have been identified to be one of the reasons why students perform poorly in mathematics, this should be a great reason for mathematics educators to explore more in other modern instructional strategy since, conventional methods of teaching and have relative limitations on students' academic achievement and retention (Ahmad, 2016).

Thus, it has become necessary to search for an innovative pedagogy capable of improving the students' achievement and retention. Based on this, the study will investigate the effect of cognitive conflict instructional strategy and collaborative instructional strategy on achievement and retention in geometry aspect of Mathematics among secondary school students in Niger State.

Aims and objectives of the study

The aim of the study is, to investigate the effect of cognitive conflict instructional strategy on achievement and retention in geometry aspect of mathematics among secondary school students in Minna, Niger State. Specifically, the objectives of the study are:

1. Determine the influence of gender on the achievement of students taught geometry concepts using cognitive conflict instructional strategy;
2. Determine the influence of gender on the retention of students taught geometry concepts using Cognitive Conflict Instructional Strategy;

Research Questions

The following research questions were raised to guide the study:

1. What is the difference in the mean achievement scores of male and female students taught geometry concepts using cognitive conflict instructional strategies?
2. What is the difference in the mean retention scores of male and female students taught geometry concepts using cognitive conflict instructional strategies?

Research Hypotheses

The following null hypotheses were formulated and testedat P= 0.05 level of significance:

HO_1: There is no significant difference in the mean achievement scores of male and female students taught geometry concepts using cognitive conflict instructional strategies;

HO_2: There is no significant difference in the mean retention scores of male and female students taught geometry concepts using cognitive conflict instructional Strategy

Research design

The study used quasi-experimental research design (Non-equivalent, Non-randomized and Experimental-Control group design). A quasi-experimental design is a type of design that aims to establish a cause and effect relationship between an independent and dependent variable.

Table 1: Research design layout

Groups	Pretest	Treatment	Post-test	Retention
Cognitive Conflict (Exp I)	O_1	X_1	O_2	O_3
Conventional (Control Group)	O_1	X_0	O_2	O_3

Where.

O_1= Pretest Scores

O_2 = Post-test Scores

O_3 = Retention Scores

X_1= Experimental Treatment (Cognitive Conflict Instructional Strategy)

X_2 = Experimental Treatment (Collaborative Instructional Strategy)

X_0 = No Treatment (Lecture method)

Population of the study

The population for the study consist all SSII mathematics students in senior secondary schools of 2020/2021 academic session in Minna. The target population is 8,251 (3,923 male and 4,328 female) senior secondary schools Mathematics students in SSII of 22 public secondary schools in Minna, Niger State. (Niger State Ministry of Education, 2020). The choice of SSII is based on the fact that the aspect of mathematics concepts to be taught, in terms of concept and content fall under SSII syllabus and scheme of work. In addition, the state public schools will be considered, mainly due to their common socio-economical background, admission and promotion policy, staffing and availability of instructional materials.

Sample and sampling techniques

A simple random sampling techniques was used to select three senior secondary schools in Minna, Niger state. The researcher used three intact class which give a sample of 226 senior secondary mathematics students (123 male and 103 female) from the three selected senior secondary schools in Minna, Niger State. The three intact classes were designated as experimental 1 and 2 and control groups. An intact class is an already formed classroom of students that no further selection procedure is used, but the entire classroom is used to represent and serve as a sample of the population

Research instruments

The research instruments were used. They are:

(A) Treatment Instrument and (B) Test Instrument

i. **Treatment instruments:** Three treatment instruments were used for the study. Cognitive Conflict Instructional Strategy Lesson Plan (Exp Lesson Plan),
ii. Conventional Instructional Strategy as a control group. Also, the two Instructional Strategies that will be used as an experimental group are constructivist teaching approaches and conceptual change approach.

(A) Test instruments: Two Test Instruments were used for this study. They are:

i. Geometry Achievement Test (GAT)
ii. Geometry Retention Test (GRT)

(i) Geometry achievement test (GAT): Geometry Achievement Test (GAT) questions were drowned by the researcher through careful study of past examination questions of West Africa Examination Council and National Examination Council. This instrument consists of section A (Instructions and Bio-Data) and Section B (Multiple Choice Objectives Questions). Section A requires the students to read carefully the instructions on how to answer questions and fill in their details such as Gender, School Name, Class and Date, While Section B Contains forty (40) questions with four options (A-D) each. In addition, this instrument content geometry concepts of mathematics. Students were asked to choose the correct option from the four given options lettered (A-D) within the period of (30) minutes. GAT was used to measure Pre-test and Post-test scores of experimental and control groups.

(ii) Geometry retention test (GRT): Geometry Retention Test was developed through the randomization of Geometry Achievement Test (GAT) that is, the questions numbers and options were reshuffled. Just like GAT, GRT consist of two section A (Bio Data) and B (Multiple Choice Objectives Questions). Section A requires the students to fill in their details such as Gender, School Name, Class and Date, while section B consists of forty (40) questions with four options (A-D) each. Students were asked to choose the correct option from the four given options lettered (A-D) within the period of (30) minutes. In addition, this instrument content geometry concepts of mathematics. Geometry retention test (GRT)
was used to measure retention scores of both the experimental and control groups.

Validity of research instruments

Three experts validated the face and content validity of the research instrument used for this study, they are; two senior lecturers in the Science Education Department, Federal University of Technology, Minna and a senior lecturer in the Mathematics department, Federal University of Technology, Minna. The experts' observations, corrections and suggestions were used to produce the final copy of the instrument used for the study.

Reliability of research instrument

In order to determine the reliability of the Geometry Achievement Test (GAT). Using test retest method, the GAT was subjected to pilot study on a sample of thirty (30) students (17 males and 13 females) in a school within the population of the study but not part of the schools to be used for the research study. The data obtained through test retest was used to assess the reliability of the research instrument using Pearson's product moment correlation coefficient (PPMCC). The reliability coefficient obtained was 0.72, this was considered an adequate reliable measure for the test instrument and was considered good enough for the research study.

Method of Data Analysis.

The data collected for the research study was analyzed using descriptive statistics of mean and standard deviation to answer research questions while inferential statistics of sample t-test was used to test hypotheses at 0.05 level of significance. This level of significance forms the basis for the acceptance or the rejection of each of the hypotheses raised; the Statistics Package of Social Sciences (SPSS), version 23.0, was used for the data analysis.

Results

Research question one (1): What is the difference in the mean achievement scores of male and female students taught geometry concepts using cognitive conflict instructional strategy? To answer this research question, Mean and Standard Deviation were used as presented in Table 2

Table 2: Shows Mean Achievement Score and Standard Deviation of Male and Female in Experimental Group

		Pretest		Posttest			
Gender	N	Main ($\bar{\chi}$)	S.D	Main ($\bar{\chi}$)	S.D	Main Gain	M.G.D
Male	46	16.11	3.49	25.85	5.29	9.74	4.62
Female	25	14.84	2.73	29.20	5.12	14.36	

Table 2 presented the Mean ($\bar{\chi}$) Achievement Scores and Standard Deviation of Male and Female for experimental group (cognitive conflict instructional strategy). It is observed that male had a mean ($\bar{\chi}$) gain 9.74 with standard deviation of 5.29 while the female had a mean ($\bar{\chi}$) gain of 14.36 with standard deviation of 5.12. The male and female students had achievement Mean gain difference of 4.62 in favor of female students.

Research question two (2): What is the difference in the mean retention scores of male and female students taught geometry concepts using cognitive conflict instructional strategy?
To answer this research question, Mean and Standard Deviation were used as presented in Table 3

Table 3: Shows Mean Retention Scores and Standard Deviation of Male and Female for Experimental Group

		Posttest		Retention test			
Gender	N	Main ($\bar{\chi}$)	S.D	Main ($\bar{\chi}$)	S.D	Main Gain	M.G.D
Male	46	25.85	5.29	26.20	5.23	0.35	0.11
Female	25	29.20	5.12	29.44	4.87	0.24	

Table 3 presented the Mean ($\bar{\chi}$) Retention Scores and Standard Deviation of Male and Female for experimental group (cognitive conflict instructional strategy). It is observed that male had a mean ($\bar{\chi}$) gain 0.35 with standard deviation of 5.23 while the female had a mean ($\bar{\chi}$) gain of 0.24 with standard deviation of 4.87. The male and female students had a retention Mean gain difference of 0.11 in favor of male students.

Testing of Null hypotheses
Hypothesis one (HO_1). There is no significant difference in the mean achievement scores of male and female students taught geometry concepts using cognitive conflict instructional strategies.

Table 4: Shows Summary of Independent Sample t-test for Mean Achievement Score of Male and Female for Experimental Group.

Gender	**N**	**DF**	**Mean($\bar{\chi}$)**	**SD**	**t- cal**	**P- Value**	**Remark**
Male	46		25.85	5.29			
		69			2.58	0.875	Ns
Female	25		29.20	5.12			

Ns = Not significant at 0.05 level

Table 4 presented the Independent sample t-test result of mean ($\bar{\chi}$) achievement scores of Male and Female students taught geometry concept using cognitive conflict instructional strategy. The result indicate that there

is no significant difference in the mean ($\bar{\chi}$) achievement scores of male and female student taught geometry concepts using cognitive conflict instructional strategy, t-cal (2.58) = p-value (0.875) is greater than 0.05 alpha-level (p = 0.996 > 0.05). Hence Hypothesis three **(HO_1)** is not rejected.

Hypothesis two (HO_2): There is no significant difference in the mean retention scores of male and female students taught geometry concepts using cognitive conflict instructional Strategy.

Table 5: Shows Summary of Independent Sample t-test for Mean Retention Score of Male and Female in Experimental Group

Gender	N	Df	Mean($\bar{\chi}$)	SD	t-cal	P- Value	Remark
Male	46		26.20	5.23			
		69			-2.56	0.931	Ns
Female	25		29.44	4.87			

Ns = Not significant at 0.05 level

Table 5 presented the Independent sample t-test result of mean ($\bar{\chi}$) retention scores ofMale and Female students taught geometry concept using cognitive conflict instructional strategy. The result indicate that there is no significant difference in the mean ($\bar{\chi}$) retention scores of male and female student taught geometry concepts using cognitive conflict instructional strategy, t-cal (-2.56) = p-value (0.931) is greater than 0.05 alpha-level (p = 0.996 > 0.05). Hence Hypothesis Five **(HO_2)** is not rejected.

Summary of findings

Based on the analysis of the data collected, the following major findings were made;

1. There is no difference in mean achievement between male and female students taught geometry using cognitive conflict instructional strategies.
2. There is no difference in mean retention between male and female students taught geometry using cognitive conflict instructional strategies.

Discussion of findings

Finding also shows that there is no significant difference in the mean achievement of male and female students taught geometry using cognitive conflict instructional strategy. This finding agreed with the finding of Susilawati *et al*. (2017) who reported that there was no significant difference in the performance of male and female students using collaborative instructional strategy in learning geometry. Tatiane and Edmilson (2020) and Madu and Emma (2015) also confirm that, there was not difference in the mean scores between male and female students exposed to cognitive conflict instructional strategy. This study disagree with Zetriuslita *et al*. (2018) who reported that, there is a significant difference between male and female students in mathematics curiosity attitude as the effect of applying problem based learning and cognitive conflict.

It was revealed from the study that, there is no significant difference in the retention scores of male and female students taught geometry using cognitive conflict instructional strategies. The result shows that both male and female Mean ($\bar{\chi}$) retention score has no significant difference. This agreed with the findings of Abdullahi (2015) which pointed out that, strategies that encourages self-learning just like cognitive conflict strategy leads to better retention of information and the development of a favorable attitude toward science and technology and there is no gender influence. Tatiane and Edmilson (2020) and Madu and Emma (2015) also confirm that, there was not difference in the mean retention scores between male and female students exposed to cognitive conflict instructional strategy.

Conclusion

The following conclusions are made based on the finding of the study. The results of this study provide empirical evidence that the use of cognitive conflict and collaborative instructional strategies enhanced students' academic achievement and retention in geometry more than the use of conventional lecture method of teaching. There was no mean difference between male and female students taught geometry using cognitive conflict and collaborative instructional strategies. There was no significant difference in the retention scores of male and female students taught geometry using cognitive conflict and collaborative instructional Strategies. In addition, the used of conventional lecture method for teaching appear to be inferior to the use of cognitive conflict strategies most especially in teaching geometry concepts.

Recommendations

From the results of this study, the following recommendations are made for the improvement of teaching and learning of geometry concepts.

1. Geometry teacher's awareness of cognitive conflict and collaborative strategies of teaching should be created through workshops, seminars and conferences on teaching strategies.
2. Geometry is about identification, description of shapes and there properties, so teachers should teach most of the concepts through cognitive conflict and collaborative strategies to capture and sustain student's retention of geometry concepts, this will improve their achievement and retentionin geometry.
3. Curriculum developers should incorporate cognitive conflict and collaborative instructional strategies into mathematics curriculum, this might supportmathematics teachers in teaching mathematics.

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EFFECTS OF COOPERATIVE AND MASTERY LEARNING METHODS ON MECHANICAL STUDENTS IN TECHNICAL COLLEGES IN NIGER AND KWARA STATE

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Abstract
Quasi experimental was used for this study. The population for the study consisted of 151 Technical College II (TCII) students offering auto-mechanic in technical colleges in Niger and Kwara State. The entire population of 151 students was used for the study. The instruments used for data collection were Mechanical Psychomotor Achievement Test (MPAT) and Mechanical Interest Inventory (MII). The MPAT and MII were developed by the researcher. To ensure content validity of the MPAT and MII, a test blue print or table of specification was built. The MPAT and MII were subjected to face validation by three experts. There liability of the MPAT and MII were trial tested on 30 Auto-mechanic students from Government Technical College, Lafiagi and found to be reliable at 82 and 79 respectively. Data collected were analyzed using the mean of the test scores for research questions while analysis of covariance (ANCOVA) was used to test the hypotheses at. 05 level of significance. The study found out among others that, Cooperative and mastery learning are effective in improving students' psychomotor achievement in auto-mechanic, but the effect of Mastery learning in improving students' psychomotor achievement in auto-mechanic is higher than Cooperative also Cooperative and mastery learning are effective in improving students' interest in auto-mechanic, but the effect of Mastery learning in improving students' interest in auto-mechanic is higher than Cooperative and finding also revealed that there is significant difference between the mean scores of male and female students' psychomotor achievement in auto-mechanic in favour of male students. The study recommended among others that workshops, seminars and conferences should be organized by State Science and Technical Schools Board to enlighten and train auto-mechanic teachers on the application of Mastery learning for improving students' achievement and interest in studying auto-mechanic and National Board for Technical Education (NBTE) should consider review of curriculum for auto-mechanic with a view to incorporating Cooperative and Mastery learning methods into the teaching of furniture craft.

Keywords: Cooperative, mastery learning, auto-mechanic, interest, students

Introduction
Technical colleges are a specialized institutions of learning where trades and modular courses are offered in addition to general education and science subjects. Umunadi (2013) emphasized that the main objectives of technical college education is to make students familiar with most important branches of production in industry, commerce, imparting of skills and practical competencies in the handling of tools, materials and generally equipping the students with both theoretical knowledge and work habits. Technical colleges provide the youth with vocational competencies needed in various disciplines required in the world of work. It also provides technical and vocational training for quite a number of occupations including Wood work, plumbing, computer craft, mechanical trades, radio, television (RTV), electronics development and auto-mechanics (Ede*etal.*,2010).

Auto-mechanics is one of the mechanical trade subjects offered under motor vehicle mechanic works in Nigerian Technical Colleges (Federal Republic of Nigeria, FRN, 2013). Auto-mechanics trade programme in technical colleges involves the application of scientific knowledge in the design, selection of materials, construction, operation, maintenance and repair of automobiles (Audu *et al.*, 2014). This trade involves the application of scientific knowledge in the design, selection of materials, construction, operation and

maintenance of automobile devices (Nigerian Educational Research and Development Council (NERDC, 2007).

So it is right fully expected that Auto-mechanic programme at technical college should equip recipients with those skills that would make them productive in industries which includes: stress grading, and computer aided drafting (CAD) to ease and fasten up the work of auto-mechanic for students psycho-motor achievement and interest in auto-mechanic in technical colleges.

Interest is an important factor in learning, it is viewed as the feeling that an individual has when he or she wants to know or learn more about something such as auto-mechanic. The conventional teaching methods (such as lecture and demonstration methods) adopted by most auto-mechanic teachers in technical colleges seem in adequate for equipping the craftsmen with the workplace skills such as flexibility, adaptability and creativity. These teaching/learning methods are teacher-centred, hence, do not give students enough opportunities to think for themselves and actively participate in the learning process.

There is no doubt that students' psychomotor achievement and interest should be improved so as to generate desirable changes in the achievement of students of auto-mechanic in Technical colleges. To improve students psychomotor achievement and interest of auto-mechanic, there is need to adopt cooperative and mastery learning method of teaching.

Cooperative is a teaching method in which learners are responsible for learning, the material and teaching it to other learners, activity has been at each in activity that can be used by teachers of all grades in their classrooms. Many educators have adapted and employed the Cooperative technique in their classes (Zhan & Georgia, 2011). Cooperative learning technique encourages student participation in a classroom where learners have a critical role for success sand this success depends on active cooperation and participation. Using Cooperative technique increases the variety of learning experiences, and teaches learners course content and cooperative social skills (Perkins*etal.* ,2011).

Mastery learning has been one of the more recently developed instructional model sand interventions used by teachers to foster academic enhancement among students. Mastery Learning is one teaching model under the behavioural systems family of models (Filgona *et al*., 2017). It is an instructional strategy proposed by Benjamin in 1968 which up holds that students must attain a level of mastery in requirement knowledge before stirring to learn the succeeding information. If students do not succeed mastery in the test, they would be given extra support by reviewing the lesson and undergo retest.

However, it is also observed that students' method of learning and psychomotor achievement may also be influenced by gender of the student. Gender refers to the characteristics, whether biological or socially influenced, by which people define male and female (Myers, 2012). Gender may also be explained as the socially constructed roles, behaviours, activities and attributes that a given society considers appropriate for men and women.

This study will therefore, ascertain if cooperative and mastery learning methods on students' psychomotor achievement and interest in studying auto-mechanic in technical colleges in Niger and Kwara states.

Statement of the Problem

Auto-mechanic is one of the trades offered in technical colleges where individuals learn skills for either paid or self-employment. Practical skills in Auto-mechanic areas such as construction of scaffolding, form work, partitioning, roofing and ceiling construction, when taught properly are expected to equip students with skills for employment after graduation. Unfortunately, Auto-mechanic graduates from technical colleges in Niger and Kwara State lack adequate skills to be employable. The graduates are weak in the practice of Auto-mechanic trade. The Teaching method is a crucial factor that may affect students'

motivation and consequently achievement. However, what is not known is how cooperative and mastery learning methods affects motivation to learn auto-mechanic by Learner. The decision to research on cooperative and mastery learning strategies in technical colleges in Niger State is based on reality that most of schools embrace traditional learning strategy.

It has also been observed that the teacher-centered method is the main teaching method employed by the technical teachers for implementing the curriculum (Filgona *et al*., 2017). Obviously, the adoption of teacher centered methods of teaching by the teachers results into in effective use of varieties of instructional method and instructional techniques and in ability of teachers to effectively implement the curriculum to naturally increase students' interest, involvement and commitment in learning (Ive, 2017). There is no doubt that students' psychomotor achievement and interest should be improved so as to generate desirable changes in the achievement of students of auto-mechanic in Technical colleges. To improve students psychomotor achievement and interest of auto-mechanic, there is need to adopt cooperative and mastery learning method of teaching.

Purpose of the Study

The purpose of this study is to determine;

d. The effect of cooperative and mastery learning on students' psychomotor achievement in auto-mechanic.
e. The effect of gender on students' psychomotor achievement when taught auto-mechanic using cooperative and mastery learning
f. The effect of cooperative and mastery learning on students interest in studying auto-mechanic.
g. The effect of gender on the interest of students (male and female) taught auto-mechanic using cooperative and mastery learning as was measured by auto-mechanic interest inventory.

Research Questions

The following research questions were formulated to guide the study:

1. What is the effect of cooperative and mastery learning on students' psychomotor achievement in auto-mechanic?
2. What is the effect of gender on students' psychomotor achievement when taught auto-mechanic using cooperative and mastery learning?
3. What is the effect of cooperative and mastery learning on students interest in studying auto-mechanic?
4. What is the effect of gender on the interest of students (male and female) taught auto-mechanic using cooperative and mastery learning as was measured by auto-mechanic interest inventory?

Hypotheses

The following null hypotheses were tested at. 05 level of significance:

H_{O1}:
There is no significant mean difference between the effect of cooperative and mastery learning on students' psychomotor achievement in auto-mechanic.

H_{O2}:
There is no significant mean difference between the effect of gender (male and female) on students' psychomotor achievement in auto-mechanic

Ho_3: There is no significant interaction effect of treatments given to students taught with cooperative and mastery learning and their gender with respect to their means cores in auto-mechanic psychomotor achievement test

Ho_4: There is no significant mean difference between the effect of cooperative and mastery learning on students' interest in auto-mechanic

Ho_5: There is no significant mean difference between the effect of gender (male and female) on students' interest in auto-mechanic

H_{O6}: There is no significant interaction effect of treatments given to students taught with cooperative and mastery learning and their gender (male and female) with respect to their means core son auto-mechanic interest inventory.

Methodology

Aquasi-experimental design was adopted in this study. Specifically, the pre-test, post test, non-equivalent control group design was adopted for the study. The study was carried out in technical colleges in Niger and Kwara States. The population forth is study consist of all 151 students of auto-mechanic in Government Technical College, Bida, Government Technical College, Minna, Government Technical College, Kontagura, Government Technical College New Bussa and Federal science and Technical College Kuta Shiroro in Niger State and Government Technical College, Ilorin, Government Technical College Patigi and Government Technical College, Erin-Ile in Kwara State. The data was obtained from the Ministry of Education in Niger and Kwara State. Since the population is manageable, a sample size of 151 students was drawn using purposive random sampling technique, representing 100% of the population. Each school had one single class for TCII auto-mechanic students hence, three classes each were randomly assigned to each group. The instruments that were used for data collection in this study were the Auto-mechanic Psychomotor Achievement Test (MPAT) and the Auto-mechanic Interest Inventory (MII). The instruments were validated by three experts from the faculty of Educational Technology, Department of Industrial and Technology Education, \University of Ilorin, The instruments were also pilot tested on 30 sampled TCII auto-mechanic students from Government Technical College, Pandogari|. There liability of the MPAT and MII were trial tested on 30 Auto-mechanic students from Government Technical College, Pandogari and found to be reliable at 82 and 79 respectively. Data collected were analyzed using the mean of the test scores for research questions while analysis of covariance (ANCOVA) was used to test the hypotheses at 05 level of significance.

Results

Research Question1

What is the effect of cooperative and mastery learning on students' psychomotor achievement in auto-mechanic?

Table1: Mean and Standard Deviation of Pre-test and Post test Scores of cooperative and mastery learning Groups in the Psychomotor Achievement Test

Group	N	Pretest scores		Post test scores		Mean Gain
		X	SD	X	SD	X
Cooperative	71	23.12	5.25	51.51	23.03	28.39
Mastery learning	80	24.92	6.26	57.05	17.84	32.13

Table 1 shows that Cooperative learning group had a Mean score of 23. 12 and Standard Deviation of 5.25 in the pre-test and a Mean score of 51.51 and Standard Deviation of 23.03 in the post-test making apre-test, post-test Mean gain of 28.39. Mastery learning group had a Mean score of 24.92 and Standard Deviation of 6.26 in the pre-test and a post-test Mean of 57.05 and Standard Deviation of 17.84, with a pre-test, post-test Mean gain of 32.13. With these results, both Cooperative and mastery learning are effective in improving students' psychomotor achievement in auto-mechanic but the effect of Mastery learning in improving students' psychomotor achievement in auto-mechanic is higher than the effect of Cooperative learning.

Research Question2

What is the effect of gender on students' psychomotor achievement when taught auto-mechanic using cooperative and mastery learning?

Table2: Mean and Standard Deviation of Pre-test and Post test Gender (male and female) Psychomotor Achievement Scores of students taught using Cooperative and mastery learning

Group		N	Pretest scores		Post test scores		Mean Gain
			X	S D	X	S D	X
Cooperative	M	52	24.52	5.13	53.58	23.82	29.06
		19	20.08	5.65	32.75	21.61	12 . 6
Masterylearning	M	57	26.33	6.27	58.83	14.59	32.50
		23	19.50	6.29	32.70	25.48	13.20

The data in table 2 shows that male students taught auto-mechanic with Cooperative learning had a Mean score of 24.52 and Standard Deviation of 5.13 in the pre-test and a Mean score of 53.58 and Standard Deviation of 23.82 in the post-test making a pre-test, post-test mean gain in the male students of 29.06. Female students taught auto-mechanic with Cooperative learning had a mean score of 20.08 and Standard Deviation of 5.65 in the pre-test and a post-test Mean of 32.75 and standard deviation of 21.61, with a pre-test, post-test mean gain of 12;.67. Also, male students taught with Mastery learning had a Mean score of 26.33 and Standard Deviation of 6.27 in the pre-test and a Mean score of 58.83 and Standard Deviation of 14.59 in the post-test making a pre-test, post-test Mean gain in the male students of 32.50. At the same time, female students taught auto-mechanic with Mastery learning had a mean score of 19.50 and Standard Deviation of 6.29 in the pre-test and a Mean score of 32.70 and Standard Deviation of 25.48 in the post-test making a pre-test, post-test Mean gain in the female students of 13.20. With these results male students taught auto-mechanic with Cooperative and mastery learning had higher post test mean scores than female students in the psychomotor achievement test. Therefore, there is an effect attributed to gender on students' psychomotor achievement in auto-mechanic.

Research Question 3

What is the effect of cooperative and mastery learning on students interest in studying auto-mechanic?

Table 3: Mean and Standard Deviation of Pre-test and Post test Interest Scores of students taught using Cooperative and mastery learning group

Group	N	Pretest scores		Post tests cores		Mean Gain
		X	S D	X	S D	X
Cooperative	71	32.04	5.21	74.84	7.38	42.80
Mastery learning	80	33.57	4.22	79.73	10.58	46.16

The data presented in Table 3 show that Cooperative learning group had an Mean interest score of 32.04 and Standard Deviation of 5.21 in the pre-test and a Mean score of 74.84 and Standard Deviation of 7.38 in the post-test making a pre-test, post-test Mean gain of 42.80. Mastery learning group had an interest Mean score of 33.57 and Standard Deviation of 4.22 in the pre-test and a post-test Mean of 79.73 and Standard Deviation of 10.58, with a pre-test, post-test Mean gain of 46.16. With these results, both Cooperative and mastery learning are effective in stimulating students' interest in auto-mechanic but the effect of Mastery learning in stimulating students' interest in auto-mechanic is higher than the effect of Cooperative learning.

Research Question 4

What is the effect of gender on the interest of students (male and female) taught auto-mechanic using cooperative and mastery learning as was measured by auto-mechanic interest inventory?

Table 3: Mean and Standard Deviation of Pretest and Post test Gender (male and female) Interest Scores of students Taught Using Cooperative and mastery learning

Group		N	Pretest scores		Post test scores		Mean Gain
			X	S D	X	S D	X
Cooperative	M	52	24.67	5.91	55.08	7.40	30.41
	F	19	21.97	4.70	50.74	7.49	28.77
Mastery learning	M	57	25.40	4.03	59.50	11.97	34.10
	F	23	22.63	4.36	54.48	8.04	31.85

Table 4 shows that male students taught auto-mechanic with Cooperative learning had an interest Mean score of 24.67 and Standard Deviation of 5.91 in the pre-test and a Mean score of 55.08 and Standard Deviation of 7.40 in the post-test making a pre-test, post-test mean gain in the male students of 30.41. Female students taught auto-mechanic with Cooperative learning had a mean score of 21.97 and Standard Deviation of 4.70 in the pre-test and a post-test Mean of 50.74 and Standard Deviation of 7.49, with a pre-test, post test mean gain of 28.77. Also, male students taught with Mastery learning had a Mean score of 25.40 and Standard Deviation of 4.03 in the pre-test and a Mean score of 59.50 and Standard Deviation of 11.97 in the post-test making a pre-test, post test Mean gain in the male students of 34.10. At the same time, female students taught auto-mechanic with Mastery learning had a mean score of 22.63 and Standard Deviation of 4.36 in the pre-test and a Mean score of 54.48 and Standard Deviation of 8.04 in the post-test making a pre-test, post-test Mean gain in the female students of 31.85. With these results male students taught auto-mechanic with Cooperative and mastery learning had higher post test interest mean scrod than female students in the auto-mechanic interest inventory. Thus, gender has influence on students' interest in studying auto-mechanic.

Hypothesis Testing

H_{O1}: There is no significant mean difference between the effect of cooperative and mastery learning on students' psychomotor achievement in auto-mechanic.

H_{O2}: There is no significant mean difference between the effect of gender (male and female) on students' psychomotor achievement in auto-mechanic

H_{O3}: There is no significant interaction effect of treatments given to students taught with cooperative and mastery learning and their gender with respect to their mean scores in auto-mechanic psychomotor achievement test

Summary of Analysis of Covariance (ANCOVA) test for hypotheses 1,2 & 3 are presented in table 5 below.

Table 5: Summary of Analysis of Covariance (ANCOVA) for Test of Significance of Effect of Treatments (cooperative and mastery learning), their Gender and Interaction Effect with Respect to their Mean Scores on Auto-mechanic Psychomotor Achievement Test

Source of Variation	Sum of Squares	D F	Mean Square	F	Sig
Covariate	401.082*'	5	80.216	1.895	.101
Intercept	243694.797	1	243694.797	763.390	.000
Method	24204.582	2	12102.291	13.911	19.001
Gender	292.357	1	292.357	.041	.196
Method*Gender	1.468	2	.734	.002	.398
Error	35753,440	145	319.227		
Total	384944.000	151			
Corrected Total	65872.000	150			

*Significant at sig of F <.05

Table 5 shows F-calculated values for three effects: treatment (Cooperative and mastery learning), gender and interaction of treatment and gender on students' psychomotor achievement in auto-mechanic. The F-calculated value for treatment is 13.911 with a significance of Fat 19.001 Since the F-calculated value is less than the significant F value, the null-hypothesis of no significant difference between the effect of treatments (Cooperative and mastery learning on students' psychomotor achievement in auto-mechanic is, therefore, accepted at. 05 level of significance. This means that there is no significant mean difference between the effect of Cooperative and mastery learning on students' psychomotor achievement in auto-mechanic. The F-calculated value for gender is 041 with a significance of Fat. 196. Since the F-calculated value is higher than the Significant F-value, the null hypothesis is, therefore, rejected at. 05 level of

significance. This result means that there is significant effect of gender in favour of males on students' psychomotor achievement in auto-mechanic. The interaction effect of treatment and gender has F-calculated value of 002 with significance of F of. 998. Since the F-value is higher than the F-calculated value, the null hypothesis of no significant interaction effect of treatments given to students taught with Cooperative and mastery learning and their gender with respect to their mean scores on auto-mechanic psychomotor achievement test is accepted at. 05 level of significance.

This, therefore, means that there is no significant interaction effect of treatments given to students taught with Cooperative and mastery learning and their gender with respect to their mean scores on auto-mechanic psychomotor achievement test.

Ho_4: There is no significant mean difference between the effect of cooperative and mastery learning on students' interest in auto-mechanic

Ho_5: There is no significant mean difference between the effect of gender (male and female) on students' interest in auto-mechanic

H_{O6}: There is no significant interaction effect of treatments given to students taught with cooperative and mastery learning and their gender (male and female) with respect to their mean scores on auto-mechanic interest inventory.

Summary of Analysis of Covariance (ANCOVA) test for hypotheses 4,5 & 6 are presented in table 6 below.

Table6: Summary of Analysis of Covariance (ANCOVA) for Test of Significance of Effect of Treatments, Gender and Interaction Effect of Treatments Given to Students Taught with Cooperative and mastery learning and their Gender with Respect to their Mean Scores on Auto-mechanic Interest Inventory

Source of Variation	Sum of Squares	DF	Mean Square	F	Sig
Covariate	178.196a	5	35.639	1.571	.1741
Intercept	211538.421	1	211538.421	3.826E3	.000
Method	22788.920	2	11394.460	.088	.190
Gender	216.016	1	216.016	.088	.190
Method*Gender	962.467	2	481.234	.204	.400
Error	6192.396‘	145	55.289		
Total	290259.000	151			
Corrected Total	31567.263	150			

*Significant at sig of F<.05

The data presented in Table 6 shows F-calculated for three effects: treatment, gender and interaction of treatment and gender on students' interest in auto-mechanic. The F-calculated value for treatment is 880 with a significance of Fat. 190. This shows that the F-calculated value is less than the significant F value. Therefore, the null hypothesis of no significant mean difference between the effect of treatments (Cooperative and mastery learning) on students' interest in auto-mechanic is accepted at. 05 level of significance. There sultmeans that the mean difference between the effect of Cooperative and mastery learning on students' interest in auto-mechanic is not statistically significant. F-calculated value for gender as shown in Table 9 is 307 with a significance of Fat. 212. Since the F-calculated value is higher than the significant F, the null hypothesis of no significant mean difference between the effect of gender (male and female) on students' interest in auto-mechanic has been rejected at 05 level of significance. With this result

there is significant mean difference between the effect of gender (male and female) on students' interest in auto-mechanic in favour of males. The interaction effect of treatment and gender has F-calculated value of 204 with significance of F of 400. This result means that there is no significant interaction effect of treatments given to students taught with Cooperative and mastery learning and their gender with respect to their mean scores on auto-mechanic Interest Inventory.

Discussion of Findings

The data presented in Table 1 provided answer to research question one. It was revealed that Cooperative and mastery learning are effective in improving students' psychomotor achievement in auto-mechanic, but the effect of Mastery learning in improving students' psychomotor achievement in auto-mechanic is higher than Cooperative. The result indicates that Mastery learning is more effective in improving students 'psychomotor achievement in auto-mechanic. However, analysis of covariance was used to test the fourth hypothesis (Table 5) at the calculated F-value (37.911), significance of F (.000) and confidence level of 05. It was revealed that the mean difference between the effect of Cooperative and mastery learning on students' psychomotor achievement in auto-mechanic was not statistically significant. Hence, the null hypothesis of no significant mean difference was accepted. The result means that there was no significant mean difference between the effect of Cooperative and mastery learning on students' psychomotor achievement in auto-mechanic.

The result of this study regarding students' psychomotor achievement could be explained by the fact that teachers' adoption of authentic instructional technique in Mastery learning group, where visual aids (e.g. auto-mechanic wiring circuits/diagrams) were not only used to address students' visual-spatial intelligence but also used intracing and diagnoses of electrical components/faults, engaged the students in higher order thinking tasks such as analysis synthesis and evaluation. This improved the students problem solving abilities in auto-mechanic. This is in line with the study of Nekang (2011) who in his study found out that the adoption of Cooperative mode linthe teaching of trigonometry students improved the students achievement intrigonometry than the students taught with Mastery learning methods. A possible explanation for the effectiveness of Cooperative mode list he students' active involvement in learning process using cooperative and intensive way, clarifying, probing and questioning as the students manipulate the materials and tools given to them.

Findings from research question two revealed that gender has effect on students' psychomotor achievement in auto-mechanic in favour of male students. Analysis of covariance was used to test the fifth hypothesis (Table 5) at the calculated F-value (041), Significance of F(196) and confidence level of 05. The result revealed that the null hypothesis was rejected. This means that the difference between the mean scores of male and female, subjects of this study in auto-mechanic psychomotor achievement test was statistically significant.

The finding that there is significant difference between hemeanscores of male and female students' psychomotor achievement in auto-mechanic in favour of male students confirms the findings of Akor (2010) and Pekene (2012) who in their study revealed that students taught with Cooperative model performed significantly better than those taught with Mastery learning methods in physics.

Findings from research question three revealed that Cooperative and mastery learning are effective in improving students' interest in auto-mechanic, but the effect of Mastery learning in improving students' interest in auto-mechanic is higher than Cooperative. Analysis of covariance was employed to test hypothesis seven (Table 6) at the calculated F-value (.088) significance of F (.190) and confidence level of 05. The result revealed that the null hypothesis of no significant mean difference between the effect of Cooperative and mastery learning in the auto-mechanic interest inventory was accepted. This means that there was no significant mean difference between the effect of Cooperative and mastery learning on students' interest in auto-mechanic. This result, particularly that Mastery learning is effective in stimulating

students' interest in studying auto-mechanic, tends to support the writings of Van Dat (2016) studied the effects of Cooperative Learning on students' knowledge retention in Vietnamesehig her education. The result indicated that students in the Cooperative Cooperative Group appreciated most working with others as they got help, discussed and shared information, taught others, and enjoyed the Cooperative context. The findings of the study revealed that students in Cooperative Group had greater long-term achievement than those who got theirs through lecture group.

Findings from research question four revealed that gender has effect on students' interest in auto-mechanic in favour of male students. This means that there was influence of gender on students' interest in studying auto-mechanic in favour of males. However, analysis of covariance was used to test hypotheses eight (Table 6) at the calculated F-value (.307), Significance of F (.212) and confidence level of.05. The result revealed that the null hypothesis of no significant mean difference between the effect of gender on students' interest in auto-mechanic was rejected. This means that the mean difference between the effect of gender on students' interest was statistically significant in favour of male students.

The result disagrees with the findings of Jimoh (2010) who found out that there was no significant difference between the mean interest scores of male and female students in Engineering Graphics Interest Inventory.

Conclusions

Based on the results of this study, which shows that Mastery learning is more effective in improving students' psychomotor achievement and interest in auto-mechanic tihan Cooperative, there was an effect attribute able to gender on students' psychomotor achievement and interest in auto-mechanic. Also, the study found out no significant interaction effect of treatments given to students taught using Cooperative and mastery learning and gender on achievement and interest of Technical College students in auto-mechanic. This means that the effectiveness of Mastery learning on students' achievement and interest in auto-mechanic does not depend on the levels of gender. Hence, irrespective of nature of gender, learners will record improved performance in achievement and interest in auto-mechanic when Mastery learning is employed to teach auto-mechanic Technical Colleges. These results, therefore, show that Mastery learning is a viable teaching method for teaching/learning auto-mechanic in Technical Colleges.

Recommendations

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

1. Workshops seminars and conferences should be organized by State Science and Technical Schools Board to enlighten and train auto-mechanic teachers on the application of Mastery learning for improving students' achievement and interest in studying auto-mechanic.
2. National Board for Technical Education (NBTE) should consider review of curriculum for auto-mechanic with a view to in corporating Cooperative and Mastery learning methods into the teaching of furniture craft.
3. State Science and Technical Schools Board should equip workshops in technical colleges with relevant modem equipment, tools and machines. This will help improve students acquisition and mastery of psychomotor skills

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EFFECTS OF REFLECTIVE AND THEMATIC TEACHING METHODS ON SECONDARY SCHOOL STUDENTS' ACHIEVEMENT IN CHEMISTRY IN NIGER STATE, NIGERIA

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Abstract

This study investigated the effects of thematic teaching methods on secondary school students' achievement in Chemistry in Niger State, Nigeria. The study adopted a quasi-experimental design, non-equivalent pretest-posttest and control group design. The population of this study comprised of the entire population of SS II students in all the two hundred and ten (210) Senior Secondary Schools in Niger State. Population 68, 231 in (2015/2016) academic session. A multi stage sampling techniques was used to arrive at sample of students used for the study. Purposive sampling technique was used to sample schools with standard laboratory and manpower. These schools are believed to share in common, environmental conditions, manpower, gender composition and enrolment of students for SSCE Chemistry examinations for a minimum of ten years. Two schools each were assigned to experimental group one and control groups respectively. Lastly, the samples size for the study was 359 students (242 male and 117 female) and intact classes were selected from the participating schools for experimental and control group. The test instrument that was used for this study was Chemistry Achievement Test, comprised of 40 objective items. Chemistry Achievement Test (CAT) was validated by experts in Science Education Department and two lecturers in the Chemistry Department, Federal University of Technology, Minna and Test and Measurement experts from the National Examination Council (NECO) for face and content validity. A pilot study was carried out at Government Day Secondary School, NEPA, Shiroro, in order to test the reliability of the research instrument using test and retest method, and a reliability coefficient of 0.76 was obtained using Pearson product-moment correlation coefficient (PPMC). All the experimental and control groups were given Pretest before the treatment that lasted for two weeks on chemistry teaching using thematic and conventional method. After the treatment, posttest was administered immediately on the groups. Mean and standard deviation were used to analyze research questions while analysis of variance (ANOVA) was used to analyze research hypotheses. Results; shows that there was significantly higher achievement scores of students taught Chemistry using thematic teaching method than those taught using conventional lecture method. Also, there was no significant difference in the mean achievement scores of students taught using thematic teaching method. Conclusion it was concluded that; student concept of chemistry using thematic teaching methods performed better than those taught with conventional lecture method. This indicate that thematic teaching method had improved learners' achievement in Chemistry. It was also noted that both male and female chemistry students has no significant in their achievement. Recommendation; Thematic teaching method should be adopted by Chemistry teachers in the teaching and learning process in secondary schools.

Keyword: Thematic, Lecture Method and Chemistry Achievement Test

Introduction

The position of science in the modern period of technological development in the world is wide and profound. In accordance with this reasoning, Oguleye and Fasakin (2011) emphasized the importance of scientific knowledge in boasting national prestige, national income and international rating of a country like Nigeria. Safo *et al.* (2013) affirmed that science and technology influence the feeding, clothing, shelter and healthcare of a man. Jegede *et al.* (2013) stated that the development of any nation, which depends on

science and technology hinges on the nation science education. According to Ige and Olayode (2015) science education today is expected to produce scientifically literate citizenry that can operate in a scientific and technology changing society. Therefore, the technological development of our nation Nigeria today depends on the study of science. Science has been divided into branches notably the physical science such as Chemistry, Physics and Geology, and the Biological sciences such as Botany, Zoology and Physiology. According to National Policy on Education (FRN 2013) which state that the goal of secondary school education is to prepare an individual for useful living in the society and higher education irrespective of gender differential, social status, religious and ethnic background. Also among the objective of the national policies (FRN 2013) is the development of appropriate skills, mental physical and social abilities and competences to empower the individual to live in and contribute positively to the society.

Chemistry Education has been identified to be one of the major bedrocks for the transformation of our national economy and hence must be accorded adequate attention (Edomwoniyi-Otu and Avaa, 2011). Chemistry occupies a unique position among various subjects offered at the senior secondary school level. Its uniqueness is indispensable in the fact that a credit pass in Chemistry is required in most science programs at the secondary level of education (Omwirhirence, 2008). Ezechukwu (2005) defined Chemistry as a branch of science which deals with the study of the nature, composition and properties of matter and the changes that matter undergo under different conditions. From this definition of Chemistry it is observed that chemists are interested in the study of the composition of substances and what they are made of, how are they arranged in the substance? What holds the particles of the substance together? Chemistry also is the study of matter and how and why substances combine or separate to form other substances. Chemistry also studies the energy contents of substances as well as the changes in the energies of substances undergoing transformations to other things, or in the course of their interactions with other substances.

Chemistry is among the important science subjects taught at the senior secondary school level. Chemistry occupies a central position among other science subjects. It is one of the core science subjects required to pass at credit level in order to qualify for admission into higher institution to pursue science based program in Nigeria. Kolawole and Ilugbusi (2007) stated that Chemistry is the foundation of all science and environmental related professions. Science students must learn and pass Chemistry before they can advance to higher level of education. Despite the importance of Chemistry among other science subjects and related disciplines, also to the nation building, the achievement of students in Chemistry in external examinations has been on the decline (Omvrihiren, 2008). The poor achievement experienced by Chemistry students in external examinations such as West African Examination Council (WAEC) and National Examinations Council (NECO) were disturbing. This has become a big concern to parents, school administrators, Chemistry educators, experts and the entire society in Nigeria.

The analysis of results of previous external examinations conducted by West African Examination Council (WAEC) in Nigeria revealed that percentage of students that passed chemistry at distinction and credit levels was not encouraging in West African Examination Council (WAEC) from 2005 – 2009. It was observed that less than 50 % of students passed Chemistry at credit level over these years. This indicates that only small number of students had opportunity of securing admission into science related courses like Pharmacy, Nursing, Medicine, Engineering, and Agricultural Science in higher institutions in Nigeria. It is disheartening that despite the importance of Chemistry to man and society, the efforts of government and professional associations towards improving the achievement of Chemistry. Student's achievements level continues to declines in external examination Nigeria (West African Examination Council (WAEC) chief examiner's report, 2005 and 2009).

Consequently, the West African Examination Council (WAEC) chief examiner's report in 2005 and 2009 identified some areas of weakness which were reported as contributory factors to students' poor achievement in Chemistry such as lack of understanding of basic principles and concepts, poor quantitative skills incorrect use of units of measurement, inability to differentiate theoretical knowledge from practical

observation, inability to relate concept in Chemistry in everyday life. A number of factors have been identified by researchers for the massive decline of students' achievement particularly in Chemistry and science in general at the senior secondary school certificate examinations and these include inadequate laboratory equipment inadequate laboratory, poor science background, mathematical nature of Chemistry and poor teaching method (Baja*et al.,* 1995; Adesoji and Olatunbosun, 2008; Eniayeju, 2010). Olatunbosun (2008) pointed out that students' abstract nature of some Chemistry concepts and terminologies make understanding of the subject difficult. Research work has shown that teachers' mode of presentation of various Science concepts in the class affects methods and teaching techniques in Science (Bankole, 2010).Students need to be actively involved in the learning process in which they are continuously equipping, testing, speculating and building their own personal construct and knowledge. It is only by personalizing such knowledge that it becomes valid, meaningful and useful to them. Usman (2000) stated that in Chemistry, students need to actively construct their own personal awareness and meaning. Usman (2006) also remarked that the brain is not a passive consumer of information and to learn with understanding, a learner must actively construct meaning of what is to be learnt. According to Njoku (2007) revealed that teacher employ effective and flexible strategy to help the students understand, reason and solve problem.

Therefore, Chemistry teacher needs to develop appropriate teaching strategies that will help the students to understand the concept, applying them and solving science related problems. The teachers' method of teaching was consistently being identified as a major factor responsible for the massive failure of students in Science (Agoro and Babajide 2009). Adeoye and Alayande (2009) pointed out that the teacher teaching method particularly lecture method is a major reason why students perceive Science subject and Chemistry in particular as being difficult. Hence, the needs for effective instructional strategy such as reflective and thematic teaching strategy which involves manipulation of tools, materials and accurate measurement, accurate recording of observations, analyzing of result and drawing inferences is urgently needed. It also involves exchange of ideas and provides answers to questions asked by the students. Ibole (2007) identified some concepts in Chemistry syllabus that students find difficult to comprehend when they are taught. These include chemical equation, mass -volume relationship, primary standard solution, energy change, Faraday's law. Mass volume relationship which shows the Stoichiometric ratio of reacting species seems to be a persistent problem among each passing class of Chemistry students in secondary schools. In an attempt to find solution to the students' poor achievement in Chemistry, many studies have been conducted by researchers (Adesoji and Olatunbosun, 2008; Joseph *et al.,* 2009; Bankole *et al.,* 2010) to find lasting solution to students' poor achievement in Chemistry and also exploring different innovative approaches and instructional strategies of teaching to enhance teaching and learning of science in general and Chemistry in particular in secondary schools in Nigeria. These teaching strategies include the Guided discovery, Analogy, JIGSAW, Vee mapping, Concept mapping, Reflective, Thematic, Cooperative learning among others (Joseph *et al.,* 2009).

Thematic teaching is one of the teaching strategies that use themes toward creating an active, interesting and meaningful learning. Thematic teaching strategy allows the teacher to organize topics around macro themes that emphasize interrelatedness and multidisciplinary approach irrespective of subject boundaries (Amukushu-Niipare, 2007). In other words, thematic teaching Strategy refers to an integrated method of teaching that allows for multidisciplinary approach and organization of topics around theme without subject boundaries. It could make the teacher a facilitator, motivator and guide. Here the students are made to see school subjects as connected and interrelated. Thematic instruction provides an effective way to contextualized instruction. It incorporates a concrete learning by-doing orientation and has the potential to facilitate corporative and interactive learning opportunities in the classroom.

Thematic strategic method of teaching can be practiced in many forms, these includes: demonstration method, group work, out of classroom learning, use of presents students with examples of published studies (Clarke and Braun 2013).

Gender disparity is one of the issues that are receiving the attention of researchers towards academic achievement of students in Chemistry. It has been observed as a factor that influences students' achievement in sciences at secondary level. Several studies (Anogbogu and Ezeliora, 2007; Okeke, 2011) conducted in the area of gender-related differences in the academic achievement of students at various level of education. Some research findings revealed that male students perform significantly better than female students in science related subjects (Obomanu, 2011; Moss-Racusin *et al.,* 2012). A study conducted by Ifeako (2005) on gender effect on students achievement and interest in Chemistry when exposed to computer assisted instructional package shows that male students perform better than their female counterparts.

However, the students' achievement in Chemistry over the years did not give any significant improvement. In view of the above, this study therefore determines to investigate the comparative analysis of thematic teaching and conventional lecture method on secondary schools students learning achievement in Chemistry in Niger State, Nigeria.

Statement of the Research Problem

There is a nationwide anxiety over the decline in students' achievement in science subjects particularly Chemistry. It has also been observed that the achievement of students in Chemistry at secondary school level in Nigeria is not encouraging (WAEC, 2005-2009). For instance the analysis of the achievement of students in Chemistry as a subject in Secondary School Certificate Examination (SSCE May/June) in WAEC 2005 to 2009 revealed that the percentage of students that passed Chemistry at credit level and above (A1 – C6) was consistently less than 50 %. However, this poor achievement of students in Chemistry as a subject has serious implications on the admission of students into Nigeria higher institution particularly in courses like Medicine, Engineering, Pharmacy, and Computer Science and so on. Consequently, secondary schools no longer produce adequate number of qualified candidates in science based courses for university admission.

Also, WAEC Chief Examiner's report (WAEC, 2007), observed that students' poor communication skills, lack of good mathematical abilities, inability to correctly write chemical equations, inadequate practical exposure, inability to relate concept in Chemistry to everyday life and many others are some of the factors responsible for students' poor achievement in Chemistry. This indicates that traditional method of teaching employed by most teachers has not been very successful for effective teaching to take place. This problem has become worrisome issue to the government, school administrators, parents and teachers. However, many researchers have worked on different instructional strategies that have enhanced students' achievement than conventional method. These include concept mapping, vee mapping, analogy etc but the problem of poor achievement of students in Chemistry over the years has remained persistent.

Therefore, there is need to explore more suitable teaching method and instructional strategy that will enhance students achievement in Chemistry. The strategies considered by the researcher which may salvage the problem if use thematic teaching strategy. It is in light of this, that the study investigates the effect of thematic teaching methods on secondary school students' achievement in Chemistry in Niger State, Nigeria.

Aims and Objectives

The aim of the study is to compare the effects of thematic teaching methods on secondary school students' achievement in Chemistry in Niger State, Nigeria.

The specific objectives are as follows:

i. To investigates the difference in achievements of students taught chemistry using thematic teaching method and those taught using conventional lecture method.
ii. To determine the difference in achievement of male and female students taught chemistry using thematic teaching method.

Research Questions

In an attempt to address the problem, the following research questions were raised.

i. Is there difference in achievement between students taught chemistry using thematic teaching method and those taught using conventional lecture method?

ii. Are there differences in achievement between male and female students taught chemistry using thematic teaching method?

Research Hypotheses

The following null research hypotheses were formulated and tested at 0.05 level of significance in order to guide the study:

$H0_1$: There is no significant difference in achievement between students taught chemistry using thematic teaching method and those taught using conventional lecture method,

$H0_2$: There is no significant difference in achievement between male and female students taught chemistry using thematic teaching method.

Methodology

The research adopted a quasi-experimental design, non-equivalent pretest-posttest and control group design was used. The population of this study comprised of the entire population of SS II students in all the two hundred and ten (210) Senior Secondary Schools in Niger State. The total population of the students in all the schools is sixty-eight thousand two hundred and thirty one (68, 231) in 2015/2016 session. A multi stage sampling techniques was used for the study. The study was carried out in nine selected co-educational senior secondary schools in Niger State drawn through purposive sampling. Purposive sampling technique was used to sample schools with standard laboratory and manpower. These schools are believed to share in common, environmental conditions, manpower, gender composition and enrolment of students for SSCE Chemistry examinations for a minimum of ten years. Two schools each were assigned to experimental group one and control groups respectively. Lastly, the samples size for the study was three hundred and fifty nine (359) students (242 male and 117 female) and intact classes were selected from the participating schools for experimental and control group. The test instrument that was used for this study was Chemistry Achievement Test. The CAT Consisted of forty (40) objective items developed from the concepts of Mass Volume Relationship in Chemical Reaction that were taught, it was made up of four options (A-D) with one correct answer while treatment material were thematic and conventional lecture method that comprised of lessons on Mass Volume Relationship in Chemical Reaction. Chemistry Achievement Test (CAT) was validated by experts in Science Education Department and two lecturers in the Chemistry Department, Federal University of Technology, Minna and Test and Measurement experts from the National Examination Council (NECO) for face and content validity. A pilot study was carried out at Government Day Secondary School, NEPA, Shiroro, in order to test the reliability of the research instrument, test- retest method was used and a reliability coefficient of 0.76 was obtained using Pearson product-moment correlation coefficient (PPMC). All the experimental and control groups were given Pretest before the treatment that lasted for two weeks on chemistry teaching using thematic and conventional method. After the treatment, posttest was administered immediately on the groups. Mean and standard deviation were used to analyze research questions while analysis of variance (ANOVA) was used to analyze research hypotheses.

Results

Research Question One: What is the mean difference in achievement of student's taught Chemistry using thematic teaching method and those taught using conventional lecture method?

Table 1: Mean and Standard Deviation of Pre-test and Post-test Scores of Experimental Group Two and Control Groups

Group	N	Pre-test		Post-test		Mean Difference
		$\bar{X}$	SD	$\bar{X}$	SD	
Thematic	119	23.45	3.29	32.34	2.87	8.89
Lecture	123	23.48	3.66	27.33	2.72	3.85

Table 1 shows the mean and standard deviation of scores of students taught Chemistry using thematic teaching strategy in Experimental Group two and those taught with lecture method in the Control Group at pre-test and post-test. From the Table, it was observed that the mean scores of the two groups at post-test differ, where students taught through thematic teaching strategy had higher mean scores of 32.34 with standard deviation of 2.87 while those taught through lecture method had mean scores of 27.33 with standard deviation of 2.72.

Research Question Two: Are there differences in achievement of male and female students taught Chemistry using thematic teaching method?

Table 2: Mean and Standard Deviation of Pre-test and Post-test Scores of Male and Female Students in Experimental Group Two

Group	N	Pre-test		Post-test		Mean Difference
		$\bar{X}$	SD	$\bar{X}$	SD	
Male	83	23.45	3.74	32.33	3.05	8.88
Female	36	23.44	1.90	32.39	2.44	8.95

Table 2 shows the mean and standard deviation of scores of male and female students taught Chemistry using thematic teaching strategy in Experimental Group two at pre-test and post-test. From the Table, it was observed that the mean scores of the two groups at post-test differ, where female students had higher mean scores of 32.39 with standard deviation of 2.44 while their male counterparts had mean scores of 32.33 with standard deviation of 3.05.

Hypothesis One: There is no significant difference in achievement of students taught Chemistry using thematic teaching method and those taught using conventional lecture method.

Table 3: Summary of Analysis of Variance (ANOVA) of Post-test Mean Scores of Experimental Group Two and Control Groups

	Sum of Squares	df	Mean Square	F-cal	Sig.
Between Groups	1523.804	1	1523.804	195.582	.000*
Within Groups	1869.866	240	7.791		
Total	3393.669	241			

*: Significant at $p < 0.05$ level

Table 3 shows the ANOVA result of post-test scores of students in Experimental Group two and the Control Group. An examination of the table shows ($df (1, 241) = 195.58$ $p = 0.000$ significant at $p < 0.05$). On the basis of this, hypothesis two was rejected. This implies that there was significant difference in the mean scores of students taught Chemistry using thematic teaching strategy and those taught with lecture method.

Hypothesis Two: There is no significant difference in achievement of male and female students taught Chemistry using thematic teaching method.

Table 4: Summary of Analysis of Variance (ANOVA) of Post-test Scores of Male and Female Students in Experimental Group Two

	Sum of Squares	df	Mean Square	F-cal	Sig.
Between Groups	.102	1	.102	.012	.912^{ns}
Within Groups	968.772	117	8.280		
Total	968.874	118			

^{ns}: Not Significant at p>0.05 level

Table 4 shows the ANOVA result of post-test scores of male and female students in Experimental Group two. An examination of the table shows (df (1, 118) = 0.012 p = 0.912 p > 0.05). On the basis of this, a hypothesis four was not rejected. This implies that there was no significant difference in the mean achievement scores of male and female students taught Chemistry using thematic teaching strategy.

Discussion of Results

The purpose of the study was to examine the effects thematic teaching methods on secondary school students' achievement in Chemistry in Niger State, Nigeria.

Findings of the analysis on the achievement of students taught Chemistry using thematic teaching method and those taught with conventional lecture method in the present study indicate that there was significantly higher achievement scores of students taught Chemistry using thematic teaching method than those taught using conventional lecture method. The result was rejected base on the null-hypothesis which state that there is no significant difference in the achievement of students taught Chemistry using thematic teaching method and those taught using conventional lecture method. The result is in agreement with the findings of Edomwonyi-Out and Avaa (2011) who revealed that the achievement of students taught Chemistry was better than those taught with lecture method. It was also supported by the finding of Ebele (2011) who observed that the use of thematic instructional strategy in teaching Chemistry improved students' achievement in science than lecture method.

The analysis of the achievement of male and female students taught Chemistry with thematic teaching method revealed that there was no significant difference in the mean achievement scores of students taught using thematic teaching method. As a result of the null hypothesis which states that there is no significant difference in achievement of male and female chemistry students taught using reflective teaching method was not rejected. The result was consistent with the report of McCarthy (2015) who noted that student's achievement is enhanced when taught with thematic method teaching. Also, Okoro and Okoro (2016) noted that thematic instruction gives guarded support for the current policy emphasis on teaching mathematics contextually and reveals some potential pitfalls associated with teaching mathematics thematically. This contradict the result of study by Ebele (2011), who revealed that there was significant difference in the achievement of both male and female students taught chemistry using the thematic teaching methods. It was also in agreement with the study of Sabiru (2014) and Ali (2013) who reveal that male students tend to achieve higher than female students when expose to instructional strategy. The disparity is based on an indication that male and female student have the same chance to achieve higher scores when taught in with similar learning condition because thematic teaching methods are friendly and interactive.

Conclusion

Base on the aforementioned findings of the research work, it was concluded that; student concept of chemistry using thematic teaching methods performed better than those taught with conventional lecture method. This indicate that thematic teaching method had improved learners' achievement in Chemistry.

The male and female student perform better when expose to thematic teaching strategies. Therefore has achieve equally well in chemistry. Also it is therefore the dues from this study that thematic teaching strategies are more effective in teaching and learning and had enhance student achievements in chemistry. Therefore the need for variety of teaching methods implies that not only must a teacher be aware of different teaching strategies available, but must have the wisdom to know which method to use under which condition and be prepare to adopt or change it. Consequently, the use thematic teaching methods could be regarded as one of the methods for enhancing learner's achievement in Chemistry.

Recommendations

Based on the findings of this study, the following recommendations are proffered:

1. Thematic teaching method should be adopted by Chemistry teachers in the teaching and learning process in secondary schools.
2. Government should encourage the use of thematic teaching method in the teaching and learning of Chemistry and other subjects in secondary schools by organizing workshops and seminars in training and retraining of teachers on the use of the aforementioned teaching methods.
3. Secondary school administrators should organize workshops, conferences and seminars to expose Chemistry teachers on the use of thematic mode of instruction to improve teaching and learning process in the classroom.

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DIGITAL TRANSFORMATION IN THE HEALTH SECTOR IN NIGERIA. A CASE STUDY OF GARKI HOSPITAL, ABUJA

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Abstract
The purpose of the study was to explore digital transformation in the health sector in Nigeria, with particular reference to Garki Hospital, Abuja. Specific objectives were; to examine how digital transformation affects worker satisfaction at Garki Hospital, Abuja, to evaluate how digital transformation affects patients experience at Garki Hospital, Abuja and to examine the effect of digital transformation on health service delivery at the Garki Hospital, Abuja. The exploratory research design was the adopted for this study. In this study, two instruments were used in data collection. First, qualitative data was collected from health administrator and information technology manager via interview schedule, whereas a questionnaire was used to gather quantitative data from patients. The SPSS was used to generate statistical tables and the thematic content analysis was used to analyze results from the interview. The ticketing system, electronic medical records, radiological tele-reporting, mobile health App, customer live chat platforms, serenity health and Garki Hospital virtual clinic were found to be digital tools/services introduced in Garki Hospital, Abuja. Digital technologies have greatly empowered the staff of the Garki Hospital, Abuja by improving their IT skills. The study concludes that the introduction of technology has shortened the time of health service delivery and accessibility of health services is now remote. Furthermore, feedback between patients and the hospital has increased tremendously.

Introduction

In this fast-changing world, there is an urgent need to capture and process patient data quickly and store it securely. Increasingly, the continents of the world have gradually shifted to more innovative digital health systems (Tambo et al., 2016). With emerging economies of the world, Africa has become an attractive destination point for innovation and opportunity that will drive improved performance and competitive advantage. The healthcare environment now owns a promise of technology and innovation to open new frontiers in revamping the weakness in the health systems in Africa. At a time when technology is on the ascendency, the use of digital platforms have promoted a real-time service for new healthcare (Visconti & Morea, 2020).

One of the biggest service sectors in most economies is healthcare. On that premise, service regulators have focused on service quality to drive high levels of satisfaction. In the same vein, patients have always willed to avail themselves of good healthcare service delivery. Indeed, policymakers, governments, industries, and regulators have put in measures to bridge the gap between technology and healthcare (Tambo et al., 2016).

The study by Herrmann et al., (2018) averred why the digital transformation of the healthcare sector is still yet to be seen by people. They revealed reasons as to the nature of regulation on safety, quality, and efficacy in the health sector. For many patients in Africa and even in Europe, the cost of healthcare is high and even sometimes inaccessible. This is where digital transformation plays a role in ensuring better and cheaper costs to access healthcare (Perakslis, 2017; Christensen
2013).

The healthcare industry has become a multi-sided phenomenon and more complex and this among other reasons is due to the emergence of digital transformation. Digital transformation allows for an increase in health care performance through quality care enhancement and cost reduction (Herrmann et al., 2018). New developments resulting from digital transformation include "self-tracking, big data, and predictive

analytics, e-health, mobile health, health apps, participative medical research, e-patient communities, electronic medical records, and shared decision-making" in health services (Belliger & Krieger, 2018).

Digital transformation has changed the expectations of many sectors with a specific aim to achieve high-worth digital services in real-time (European Commission 2017). In the context of this study, digital transformation in the health industry aims to increase transparency in health services, interoperability of health systems, and patient satisfaction. In all, new ways of building relationships and working with stakeholders, new frameworks of health service delivery become the priority of digital transformation (Gil-Garcia, Dawes & Pardo, 2018).

Beyond the traditional healthcare system, patients have become more knowledgeable, empowered, and electronically facilitated through ICT, mobile devices, and internet connectivity. Unlike before, healthcare is now open, flexible, participative, and networked with the advances in digital transformation (Belliger and Krieger, 2018). In this digital age, healthcare services are more distributed among human and non-human actors (databases, information systems, health records, etc). These new developments have guided the outcomes of healthcare services creating value in terms of efficiency and quality of healthcare (Barry & Edgman-Levitan, 2012).

Today, with the required digital tools, healthcare in Nigeria could address the challenges facing the sector (Lurent, 2018). These innovations easily connect patients, improve communication and processes, and reduction in variations in healthcare practices. In all, healthcare pathways are improved significantly while maintaining reduced health costs.

Overview of Garki Hospital, Abuja

Garki Hospital Abuja is owned by the Federal Capital Territory Administration (FCTA). It was closed in 2001 for full renovation. In March 2007, a concession agreement for the management and operation of the new Garki Hospital Abuja was signed between FCTA and Nisa Premier Hospital, after a competitive bidding process. Today Garki Hospital Abuja is a model 100plus bedded hospital in the FCT breaking barriers and setting the pace in both general and specialized services and also, one of the few hospitals in the country that carryout renal transplants. In 2013, surgeon Nadey Hakim and Elijah Miner performed the first kidney transplant at the hospital. Over the years Garki Hospital has built a reputation as a Hospital of choice in specialist healthcare. This model ultramodern hospital is a giant in quality healthcare delivery in Nigeria, known for its success rates and its provision of top-class medical and allied services using the best professionals available, empowered with appropriate level of technology and continuous training.

Aims and Objectives

The main aim of this study is to investigate digital transformation in the health sector in Nigeria with particular reference to Garki Hospital, Abuja. The specific objectives are as follows:

1. To examine how digital transformation affects worker satisfaction at Garki Hospital, Abuja.
2. To evaluate how digital transformation affects patients experience at Garki Hospital, Abuja.
3. To examine the effect of digital transformation on health service delivery at the Garki Hospital, Abuja.

Literature Review

Digitalization

Digitalization: This refers to the "use of digital technologies in the context of the production and delivery of a product or service" (Enzing, Knies, Boer, and Brouwer, 2018). The organization of healthcare services and mode of delivery of the service is made possible with digital technologies which differ from existing models. Digitalization is, therefore, less of a 'technical' process (like digitization), but rather an organizational and cultural process that focuses on the "potential changes in the processes beyond mere digitizing of existing processes and forms" (Enzing et al., 2018). Digitalization covers several tools such

as computers and electronic health records to monitor patients, electronic medical devices, and the application of computer-aided visualization
and decision support systems.

Digital transformation

The definition emphasizes improvements to services and processes in cultural, organizational, and relational terms. Competitiveness, responsiveness, speed, performance, consistency, simplicity, accessibility, and openness are not limited to these results. In all, it aims to contribute to the organization's better growth (Enzing et al.,2018). As digital instruments affect many facets of health care systems in terms of structure, culture, professions, treatments, and results and are anticipated to affect them, the definition now becomes "digital transformation." This means that health care facilities and systems are in a change in which more health services and processes are digitalized (Manta et al., 2016). This means that health care services and systems are in change.

As a developing country, this term encompasses an instrumental initiative to dramatically incorporate modern digital content, communication technology, and related new processes into the healthcare sector in Nigeria. Some of this digitalization is unique to healthcare, and another aspect is a result of society's wider trend of digitalization (Thirgood and Johal, 2015). Both can lead to changes in health technologies and health care delivery processes and innovations, thereby affecting health, health care, and health care. systems (Herrmann et al., 2018). Therefore, in some of its aspects, the digital transformation represents a fundamental change in the organizations' model and culture of care delivery.

Digital transformation in the health care sector appears to holistically revise government core processes and programs beyond conventional digitization strategies (Herrmann et al., 2018). Progressive change from analog to digital with reviewed policies tailored to customer needs, suggests digital transformation. Complete change of the existing processes and development of new digital services are geared towards customer satisfaction and it results in the expansion of the userbase (Cordella and Paletti, 2018).

Digital transformation and innovations in healthcare

One of the fastest global growing industries is the health sector, consuming less than 15% of the gross domestic product (GDP) of most developed nations. The healthcare industry can be strategically positioned to serve an enormous part of every economy. Vantara and Kalakota (2019) observed the healthcare industry to include several integrated multiple sectors (healthcare providers, physicians, payers, long-term care, pharmacies, diagnostic labs, life sciences, and government care), which treat patients with chronic, preventive, and rehabilitative. The digital revolution introduced in many industries, such as banking, telecommunication, etc., has become a strong force for quicker transformation, even as the healthcare sector seems to be lagging (Herrmann et al.,2018). Even though some challenges still exist, digital tools have demonstrated benefits and evidence of transformation (Lapão, 2018).

In recent times, the diffusion of digital tools has emerged as central in healthcare innovations. Digitalization appears to be a multifaceted concept in healthcare (Habran, Saulpic, and Zarlowski, 2018). Regularly, the World Health Organization (WHO) conducted studies on the diffusion of digital tools in healthcare services and concluded that the lack of innovation integration had thwarted the extension of healthcare digitalization.

From the above, digital tools have offered new opportunities in the identification, prevention, and promotion of health goals. As such, digital tools can transform healthcare services in many ways that can contribute to health system goals in the developing and developed world. The outcomes of the digital transformation of health services are significantly dependent on the two key factors, namely the associated stakeholders and the quality of the process (Ammenwerthe, 2017). Vantara and Kalakota (2019) acknowledged that the healthcare industry's future requires that all stakeholders within the ecosystem, especially from the perspective of patients, workforce, and policymakers, are engaged. For instance, patients can be engaged

using tools that drive new health care and revenue cycle models. By the approach of technology, coordination is promoted, and knowledge is shared among all stakeholders.

These stakeholders include end-users of digital health services (be it, professionals, care users, or citizens), digital health services, producers of health services, and governments. The success of digital transformations requires a sound understanding of the two essential interacting components, i.e., "the health service" and "the digital," at all these different levels. The full process of their development, production, funding, implementation, and evaluation requires careful consideration in this context. The innovative solutions that some digital health services represent can, if designed purposefully and implemented cost-effectively, provide better health outcomes, and contribute to health systems (Habran et al., 2018).

Though the term digital transformation is often claimed to originate from the private sector, it is mostly associated with the need to use new technologies to stay competitive in the Internet age, where services and products are delivered online and offline. Online service transformation is seen to improve the customizability and automation through standardization of services (Andal-Ancion, Cartwright, and Yip, 2003). Others define a digital transformation to rebuild business models following customers'needs by using new technologies (Berman, 2012). The emergence of digital transformation efforts has wholly changed the delivery mode of services, not limited to health. For example, customers are better able to share and interact directly with their needs using social media. With recent mobile and smart technologies, health institutions are better able to monitor and update in real-time. By this, health services are transformed, and relations with customers are improved (Porter and Heppelmann, 2015).

When existing ways of delivering health, services are entirely changed to new business models that become the ultimate digital transformation (Mergem,Edelmann, and Haug, 2019). It is inferred that new channels have replaced existing channels. Therefore, digital transformation means an opportunity to gain newmarket shares, enter new markets, and consider only profitable customers. In recent times, the medical and business advantages of powerful technology advances are attainably integrating digital innovations in mobility, data analytics, cloud computing, and IoTinto existing medical, business, and computing systems. Some of the benefits but unlimited to creation of efficient processes, provision of differentiated services, better care delivery, and cost reduction are derived from digital transformation (Anastasy, 2019).

However, as healthcare organizations embark on digital transformation, the underlying network infrastructure becomes the basic platform of digital transformation. In the past, network architectures were not equipped to support the patient's needs. Also, the implementation of new
technologies required in hospitals and clinics is essential to support digital transformation and remain competitive (Berman,2012).

Impact of digital transformation in the health sector in Nigeria

The patent impact of digitalization of health services has increased over the years and is expected to be even more profound in the future. Especially in the developed world, health services are evaluated for adopting, using, and investing in new digital health services at different healthcare system levels. In the light of meeting health goals, significant decisions must be implemented based on the available evidence.

The call for hospitals to be patient-centric seems obvious. In practice, patient experience, one of the critical domains of value-based purchasing, serves to measure quality and improvement in healthcare delivery (Mohammed et al., 2014). Increasingly, patient-centric care is being implemented in various settings to enhance the quality of healthcare. Thus, every hospital hopes to improve patient care (Nigeria Health Service, 2010). Thus, getting the view of patients on healthcare is the key to improving healthcare systems. According to Kleinman (2012), patient satisfaction is defined as “the patient’s view of services received and the results of the treatment” or the “level of contentment that patients experience having used a service” (Ministry of Heath, 2007). One way to measure the effectiveness of a system is the quality of patient care the better the patient care, the better the quality of health service. Ofosu-Kwarteng (2012) reported that

when customers are satisfied with health service, they can convince others to patronize the same service. Similarly, a dissatisfied patient desists from the service patronage at the sametime will convince others to do likewise, thereby damaging the health service brand. The section is imperative to discuss as patients play various roles in health care quality assessment and monitoring in health institutions. By expressing their preference, health institutions may consider refining health care it is much expected that patients give testimony to the hospital administration's efficiency, which a lot to do with the thought, feeling of the hospital's services. Eventhough it is difficult to measure patient satisfaction levels, the hospital must provide the necessary conditions to create comfort during and after health service (Wensing et al., 2012).

The emergence of technology has reshaped the relationships existing amongst patients, service providers, and the system infrastructure. Digitalization has become a cornerstone of patient experiences (The Deloitte Touche Tohmatsu Limited, 2018). According to OECD (2017), a significant transformation has occurred due to higher connectivity and real-time experiences.

For instance, until recently, real and immediate healthcare action is possible unlike before. As a result of the patients' use of digital tools, responsive healthcare has increased tremendously over the last decade. Consequently, improving the quality of life and preventing worsening conditions. In the healthcare services, Miorandi, Sicari, De Pellegrini and Chlamtac (2012) posit that digitalization continues to transform relationships as patients have become more self-reliant, independent, and more comfortable. Increasingly, Miorandi et al. (2012) contended that patients had been more connected via mobile technology as patients efficiently manage their health around the clock, inform themselves, and share experiences with health providers.

In Nigeria, Agbozo (2019) investigated the contributing factors supporting technology adoptions. Adopting Rogers' Theory of innovation diffusion, the authors used the quantitative methodology to select 1640 participants from 456 public and private healthcare centers in Nigeria. The authors found out that the institutional characteristics and healthcare manager characteristics significantly influence eHealth adoption in Nigeria. However, factors related to performance expectancy and effort expectancy had a common effect on adopting eHealth devices and systems.

Digital transformation in Garki Hospital

There are reported cases, that inability to support health services with digital tools affect value- based health transformation, patient dissatisfaction, continuous delay (long queue), difficulty in the retrieval of data/records, and among others.

Integrating digital innovation has become a strong force of health transformation in the hospital over the years. Most industries such as banking, telecommunication, and health in developed economies, etc. have evidence of faster transformation when digital tools are integrated to routine services such as records, queuing, consultation, dispensary, etc. (Crawford, 2021). Remaining relevant in this competitive environment requires health providers and managers to become technologically innovative to build an improved healthcare system. This imply the transformative impact of digital health technologies on healthcare must be understood. Also, health cost reduction and enhancing time efficiencies should be encouraged (Vantara, 2019).

However, inadequate integration of digital tools in hospitals pose a threat to positive health outcome. There is a need for health institutions to think digitally to cope with improved health service outcomes. The situation in Garki hospital, Abuja is not different from other health institutions in Nigeria and the developed world, as patients and health actors desire wish to see continuous improvement in the quality of care. In recent times, stakeholders have demanded investment in digital tools.

Summary
In developing countries like Nigeria, digital platforms in healthcare are a technology-enabled business model that facilitates exchanges between interacting agents within or outside the hospital. Applying digital platforms into healthcare is significant due to the inconsistencies and complexities of interactions existing in the health system. From literature, it is evidenced that technology becomes a central point to connect all stakeholders, where health information is shared and communicated (Visconti and Morea ,2020).

Patients have continued to demand high-quality healthcare in developing economies, making the healthcare industry's digital transformation a significant priority for health providers and policymakers. Overall, patients now seek specialized approaches not limited to transparency and more control in their healthcare experience. On that backdrop, investment in technologies has also increased to drive patient and workforce satisfaction. With the available innovations in technology, data deluge has been transformed meaningfully, thus making decisions to enhance improved patient care and experiences while reducing the cost of health service. Thus, strategically aligning technology to healthcare needs is critical in this era of connected healthcare.

To meet the rising expectations of both workforce and patient, health institutions must manage their data better. This means that much of the patient data can be more useful unless transformed into timely and actionable insights during and after healthcare via digitalization. It must be concluded that the long-term goal of digitalization is to achieve better outcomes for members, improved population health for communities, and decreased cost burdens for patients.

Methodology
Research Design
The exploratory research design was employed for the study. The exploratory research design is suitable because, it ensures that a phenomenon under study is not explored through a single lens, but rather a variety of angles which requires for multiple facts about digital transformation in the health sector can be revealed and understood. The exploratory design is also adopted because, it offers the researchers the opportunity to learn about issues that are very complex and perhaps needs abroad assessment of the issues which can be obtained through extensive explanation and analysis.

Target Population
The target population for this study are the patients, IT manager, and health administrator of Garki Hospital, Abuja. This is justifiable because of the lack of accessibility to all other potential respondents, inadequate time, and cost of reaching all respondents especially with the qualitative aspect of the study. Thus, the target population for the quantitative aspect of this study remains the patients, of the hospital.

Sample Size and Sampling Procedure
Two sampling techniques are used by the researchers to select the study respondents. First, the purposive sampling was used to select two key stakeholders; IT manager and health administrator in Garki Hospital, Abuja. The sampling technique relies on the judgment of the researchers when it comes to selecting the units (e.g., people, cases/organizations, events, pieces of data) that are to be studied (Alatinga and Williams, 2016).

Additionally, the convenience sampling technique was used to select the 50 patients in Garki Hospital, Abuja. For this technique, the sample was taken from patients that were easy to contact or to reach

Data collection methods
Two research instruments were used in this study. Firstly,a questionnaire was given to the patients to respond to the research questions of the study. The choice of questionnaires in this study includes it is less costly to use and the ability to collect more data from respondents over a wide geographical area within a

short time. Secondly, the interview guide was used to collect data from the IT manager and administrator of the Garki Hospital, Abuja. The semi-structured interview was used in responding to the research questions of the study. Specifically, the interview was conducted with the IT manager and health administrator who is knowledgeable on the digital transformation projectsin Garki Hospital, Abuja. The interview schedule directly addresses the objectives of the study.

Data analysis

On the backdrop of the qualitative approach, the researchers analyzed the interviews using thematic content analysis. Themes are formed based on the objectives of the study and also generated from the responses. Finally, the results from the qualitative data of the study were discussed in line with existing data or previous studies. However, the social package for social science (SPSS) was used to analyze the quantitative data collected from patients at the Garki Hospital, Abuja. For quantitative data, results arepresented in tables and charts.

Result

Demographic data

To understand the bio-data of respondents, data were collected regarding gender, marital status, and the familiarity with the use of ICT tools/resources. Table 4.1 - 4.3 shows the result obtained for demographic data.

Gender distribution

Table 4.1: Gender distribution

Gender	Frequency	Percent
Male	27	54.0
Female	23	46.0
Total	**50**	**100.0**

Source: Field data (2023)

From Table 4.1, the study gathered data with regards to the gender of the respondents. Out of 50 respondents, the females constituted (46.0%) while males constituted (54.0%), indicating that the males outnumbered the females in this study. The implication is that more male patients were surveyed in this study than females.

Marital status

The researcher gathered information about the marital status of the respondents. Table 4.2 captures the results obtained in the study.

Table 4.2: Marital status

Marital status	Frequency	Percent
Single	14	28.0
Married	35	70.0
Widowed	1	2.0
Total	**50**	**100.0**

Source: Field data (2023)

The majority of respondents 35 (70.0%) who were patients in Garki Hospital, Abuja were married. On the other hand, 14 (28.0%) of the marital status for respondents were singles. In conclusion, it can be said that more married respondents responded to the survey than single counterparts in Garki Hospital, Abuja.

Familiarity with ICT tools

The researcher inquired from the respondents about their familiarity with ICT tools.

Table 4.3: Familiar with the use of ICT tools/resources

Familiarity	Frequency	Percent
Novice	2	4.0
Intermediate	21	42.0
Expert	27	54.0
Total	**50**	**100.0**

Source: Field data (2023)

The survey revealed that 54.0% of respondents (27 out of 50) were experts with the use of ICT tools/resources. This was followed by 21 (42.0%) who expressed an intermediate level of familiarity with the use of ICT tools/resources. Only 4.0% of the respondents were of the view that they were novices in using ICT tools/resources.

Effect of digital transformation on customer experiences

The section evaluated how digital transformation affects customer experience at Garki Hospital Abuja.

Table 4.4 Healthcare delivery time before digitalization

	Frequency	Percent
5-6 hours	2	4.0
3-4 hours	39	78.0
1-2 hours	9	18.0
Total	**50**	**100.0**

Source: Field data (2023)

Most (78.0%) of the respondents revealed that before the introduction of digital tools, patients usually spent 3-4 hours to access healthcare delivery. It was observed that the time for healthcare in Garki Hospital, Abuja was quite long. The study identified the health care delivery time spent at Garki Hospital, Abuja time after IT implementation. Below in Table 4.5 are the results.

Table 4.5: Health care delivery time after IT implementation

After IT implementation	Frequency	Percent
3-4 hours	6	12.0
1-2 hours	7	14.0
Less than 1 hour	37	74.0
Total	**50**	**100.0**

Source: Field data (2023)

From Table 4.11, the majority of the respondents (74.0%) used less than 1 hour when they visit the hospital. However, 6 (12%) opined that in less than 3-4 hours, they receive treatment in Garki Hospital, Abuja. It is evident from the results that, respondents usually stay at Garki Hospital, Abuja for fewer hours for health service after the technology was introduced. Thus, the researcher infers that the length of hours had considerably been minimized to less than one hour with the introduction of digital technologies.

Results from interviews

The researchers identified from the participants, the available digital technologies used for healthcare services at Garki Hospital, Abuja. Many digital tools were pointed out by the respondents.

> *"The digital queue management system, which you will find upon entry to our reception once you get into the hospital the other bit has to do with electronic medical records which is the hospital information system we are using, this has come to replace previous paper folder system which we use as an organization. Beyond that, we also have our virtual care platform which gives access to hospital care, basic consultation with the doctor without you being physically on-site to receive that particular service. In terms of other engagements with our clients, we have what we call 'Life Chat Platforms' and other avenues we communicate with our patients versus just phone calls and emails so I will say there are some of the digital platforms that we have as an organization" (Respondent 1).*

> *"In 2015, Garki Hospital, Abuja embarked on a system to help manage our clinical care. Before then we had a manual system for almost every point of our service delivery, but to be more efficient and to save patient time. In 2015 June we alongside some companies developed and launched a hospital information system to help manage all of this so when a client comes in now from the very inception, from the front desk, right down to the cashiers and the vital rooms to emergency management processes, OPD services, pharmacy, laboratory, dental services, OPD ward services. Patient information is more accurate now".* (Respondent 2)

The interviewees responded to policies that guide staff, doctors, and clients on the use of digital tools in garki Hospital Abuja. Responses are captured below

> "*There are various policies that guide the use of various digital platforms. Starting with the kind of age we have, cybersecurity has become one of the biggest interests, so we have policies such as data protection and privacy within the organization. This has also been informed by the Data Protection Act, which is required by the government. The policy educates who has access to what platform; because for instance taking the electronic medical records only, there are various aspects and modules to this, so who has access to what model and what qualifies access to that particular model as well as the provision of what protocols and what the standard procedures are clearly defined in the policy*" (Respondent 1)

The interviewer inquired about how digital transformation affected worker satisfaction at Garki Hospital, Abuja. The two participants shared these views captured below.

"it also empowers the staffbecause at the end ofthe day it's an adverse skill that they have been able to equip themselves. Staff and doctors who use to do everything manually, now are introduced to a new skill, a new technology. These skills in terms of knowledge of a system are applicable in other areas (Respondent 1).

> *"the old system was more stressful, and once you have staffworking under a lot of stress thenyou can expect to have a lot of errors in terms. The kind of work, we do, requires little or no errors because we are dealing with human lives. So, in terms of satisfaction of staff, it has gone a long way to improve the efficiencies and positive experiences"* (Respondent 2).

The researchers found out from participants how digital transformation affected customer experiences at Garki Hospital, Abuja. In summary, by way of satisfaction on the patient side, new health services such as electronic medical records, virtual care, etc. have been introduced to improve the existing services. Additionally, health services are accessible anywhere, everywhere, and at anytime

Conclusion

The study concluded that many digital tools introduced by Garki Hospital, Abuja included ticketing system, electronic medical records, radiological tele-reporting, mobile health App, customer live chat platforms serenity health and Garki Hospital, Abuja virtual clinic. The patients of the Garki Hospital, Abuja revealed that digital innovations in Garki Hospital, have changed or altered the existing processes or operations of healthcare. Most of these changes occurred in records keeping and OPD, considerably improving healthcare processes. Again, it is concluded that these introductions were relevant, cost-effective, quality, equity, and sustainable in Garki Hospital, Abuja.

Most (78.0%) of the respondents revealed that before the introduction of digital tools, patients usually spent 3-4 hours to acces healthcare delivery. However, the length of hours had considerably been minimized to less than 1 hour with the introduction of digital technologies. More so, the study concludes that clients of Garki Hospital, Abuja experienced improved positive patient outcomes, closer healthcare to homes and convenience, maximize efficiency and effective monitoring in real-time, and many more. On that backdrop, the findings of the study underscored the need for patients of Garki Hospital, Abuja to be satisfied with healthcare services

Digital transformation has affected worker satisfaction at Garki Hospital, Abuja. It was revealed that the old system was more stressful, and once you have staff working under a lot of stress errors increases. Thus, technology introduction in healthcare has empowered the skills of the staff. These are not limited to medical doctors, record keepers, administrators, etc. In conclusion, digital transformation has influenced health service delivery. Some factors which have ensured the successful deployment of digitalization at the Garki Hospital, Abuja were stakeholder engagements and monitoring and evaluation. Periodically, the purpose of implementing a health technology is reviewed to see if it meets the intended need. When deviations and errors are identified, they are corrected.

Recommendations

It is recommended that adoption of the following strategies could be beneficial to the Garki Hospital Abuja

1. Management should be committed towards providing more funds for expanding and resourcing the technology department to enhance the digital processes through innovations and research.
2. To improve care delivery, patient experience, process management, and hospital architecture in Garki Hospital, Abuja, healthcare providers and management should incorporate technology. Unlike before, patients are now able to gain more insight into recovery process and how the health

process can be accelerated. Compared to a few years earlier, customer acceptance of digital health has increased.

3. The management of Garki Hospital, Abuja must continue to develop virtual care health services. Indeed, closer treatment has major advantages. The most recent advances in the Center allow healthcare providers to collect, record and analyze detailed information using sensors to track patients on a real-time basis.

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EMERGING TECHNOLOGIES FOR TEACHING AND LEARNING IN HIGHER EDUCATION: THE PROSPECTS AND PROBLEMS OF SMART CLASSROOM

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Abstract
Smart class services have been touted as a promising tool to enhance teaching and learning interactions. Initiatives on education reformation and relevant information technology deployment have been carried out by various learning institutions worldwide. However, previous studies often overlook the user perceptions on such applications which may lead to uncertainties or failures in the implementation of smart class services as users may not always accept or adopt such technologies. This paper examines the determinants of tertiary education Lecturers decision towards adoption of smart classroom technologies for teaching in Niger state.

Keywords: Tertiary Education, Decision, Adoption and Smart classroom technologies

Introduction

The advancement of Information Communication Technologies (ICTs) and related innovations have continued to change the mode of teaching and learning at all levels of education and higher learning institutions (Eligi & Mwantimwa, 2017). The 21st century student requires learning resource using technologies thus, the need to incorporate technology in the teaching/ learning processes by teachers and all educationists to fulfill some of the expectations of the contemporary students. In this modern time several technological tools are employed by different sectors such as health, business and many others as a result of their efficiency. The education sector should not be an exception due to the role it plays in both national and human capital developments also to move with the trend of global technological advancement. Hence, the need to adopt smart classroom technologies since traditional methods of teaching are no longer effective in technology driven era. A smart classroom is a technology-enhanced learning classroom that assist the way of teaching and learning digitally. The classroom is integrated with digital displays, tabs, desktop, laptops, projectors, scanners, flash drive, iPads white boards assistive listening devices and other audio/visual components that make lectures easier, engaging and more interactive.

A smart classroom is digitally equipped classroom with a huge variety of teaching-learning method using technology. These applications have been designed to assist the teacher in lesson planning or even giving them the ability to save an online-taught class for future reference. A smart classroom aids the transfer of knowledge using technological advancement in the field of signal processing, web technologies, hardware and software. The design principles of a smart classroom are aimed to bridge the gap between students and instructor to help the instructor teach more efficiently and to make the environment more conducive for teaching and learning. The smart classroom has tools to present digital content in the form of interactive whiteboard and projectors, tools for students to effectively interact with the instructor and other students, tools for automated assessment/feedback, cameras to record and store lectures and a sensor enabled smart physical environment that controls temperature, humidity, air quality and acoustics (Saini & Goel, 2019). The smart classroom technologies and yields better learning outcomes. This is because the use of traditional classroom in teaching/learning processes are no longer sufficient and efficient to meet the educational needs of modern time. Due to increasing demand and desire for technological advancement, the education sector is not left out in her quest to employ technologies such as visualizars smartboards, laptops/computers, internet connectivity, projectors, amplifiers, speakers, podium, microphones etc, in teaching/learning process.

The use of technologies is underlined by many scholars as a necessity for improvisation quality in teaching and learning (Gebremedin, 2015). Over the past decades, government and education systems around the world have regarded the use of Information and Communications Technologies as an important issue for improving the effectiveness of teaching and learning, since the use of ICT for educational purpose yields positive outcome on the part of the students such as active learning, increased motivation, providing efficient resources and better access to information. Alsadoon (2018) asserts that the perception of an individual about the usefulness of a technology is a stronger predictor of its use. Therefore, investigating determinants of tertiary education Lecturers decision towards adoption of smart technologies for teaching can assist when trying to predict their actual use in teaching and learning activities. The usefulness of smart classroom technologies is determined by the user which in turn motivate it's adoption in the process of teaching. Smart classroom technologies used in teaching provides staff and students with opportunities to collaborate in knowledge creation and critiquing of ideas given by others which are essential factors for their adoption and integration in teaching which crucial when trying to predict their actual use in teaching and learning activities. The usefulness of smart classroom technologies is dependent on the perception of the user which will in turn determine its adoption in the process of, teaching. Smart classroom technologies used in teaching provides staff and students with opportunities to collaborate in knowledge creation and critiquing of ideas given by others which are essential factors for the adoption and integration of technologies in teaching and learning.

Tertiary institutions are expected to introduce learners to the world of technologies and their usage at the early stage (from basic to secondary School levels) before they get to the tertiary education levels. Tertiary education refers to post-secondary education received at Universities (government or privately funded). It's the next level of education for those who complete their secondary education normally is conducted at Universities and colleges. Tertiary education is the phase of education proceeding compulsory education including higher education, typically there is no upper limit to the age at which an individual can participate in tertiary education (Lambert, 2020). Tertiary education often bridges the skills and knowledge gab between the general education that an individual receives at school and work.

Educators must make effort to ensure that young learners are inculcated the knowledge of technology through teaching. Teachers must also learn to fully integrate technologies in their methodologies, use it not just as visual aids but also as tools to engage learners.

Highlights of Classroom Technologies

The Association for Educational Communications and Technology has defined technology in education as the study and ethical practice of facilitating learning and improving performance by creating, using and managing appropriate technological processes and resources. The Concept of classroom technology is incorporating into school classrooms, laboratories, lecture halls and auditoriums for the benefit of supporting teaching and learning process. In today's world, technology is a major part of our lives such that students now entering schools are already familiar with these technologies. This makes it very important for teachers to stay ahead of the learning curve when it comes to technology and it's use in the classroom. Technology can add that extra zing and excitement to any lesson, improve the learning environment by making lessons more engaging and interactive (Carder, 2021). Here are some handy devices that will take lessons to the next level:

Computers or Laptops

This is possibly the most functional and necessary piece of technology in today's classrooms. Computers are electronic devices that we use to view, store, send and receive information, not only help with presenting lessons but also with management and organization e.g, preparing lesson plans, completing grade book checking emails and making posters etc. The computer also server as the main connector to all other technology. Since the computer is a programmable machine that responds to a specific set of instruction in

a well-defined manner and it can execute a pre-recorded instruction, students can use the computer to create projects or papers and practice important skills.

Multimedia Projector

These are compact devices that project images in high resolution. They can project images, presentations or videos from a computer, laptop or document camera onto a screen or wall. The projector is the gateway to all technologies used in the classroom because it helps create a visual connection for students from a variety of devices and programs. For example, if a PowerPoint presentation about water cycle is to be prepared, the use of a projector would be highly beneficial rather than having students gather around laptop in hopes that every student can see and hear the presentation, the multimedia Projector can display the presentation on a larger scale so that all the students are able to view the information easily from multiple locations throughout the classroom.

Interactive Whiteboard

An interactive Whiteboard is basically a screen that interacts with the images one projects by touching the screen or using special markers. An interactive Whiteboard is also known as a Smart board, is an interactive display in the format of a white that reacts to user input either directly or through other devices. Standard Whiteboards have been used commonly as a way people can share messages, present information and engage in collaborative brainstorming and idea development. This technology has the ability to connect to the internet and instantly digitize tasks and operations, interactive whiteboard allows images from a computer screen to be displayed onto classroom board using a digital Projector. The teacher or students can interact with the images directly on the screen using a tool or even a finger. With the computer the computer connected to the internet or local network, teachers can access information around the world. They can do a quick search and find a lesson they used previously. The interactive Whiteboard has a powerful benefit to both the teachers and the students since it opens up the students to collaborative and closer interactions to the lesson, multimedia content can be shared and used in lectures, keeping students engaged.

Document camera

A document camera is also known as visual presenters, visualizers, digital overheads or docucams, are real-time image capture devices for displaying an object. In the classrooms, the document camera is connected to the projector and students are able to view projected items on the wall screen. A document camera for the classroom allow teachers to show documents,3-dimension objects, slides and microscopic images as well as share images with connected students over the internet. This technology is useful to teachers, administrators, classrooms, school board presentations staff meetings etc. It allows students to see text or an object from anywhere in the classroom especially for large lecture halls, removes the need for paper handouts thereby providing better ways to manage a class including the capacity to jot down note on the screen for every student to see. Document camera also give teachers the ability to put up math manipulatives in front of the entire class, review and discuss quizzes and tests.

Google Classroom

Google Classroom is a free blended learning platform developed by Google for educational institutions that aims to simplify creating distributing and grading assignments. The primary purpose of Google Classroom is to streamline the process of sharing files between teachers and students. It is a free web-based platform that integrates your G workspace (G suite) for education account with all your G suite services, including Google Docs, Gmail and Google calendar. Google classroom enables teachers to organize various tasks from a single digital location. Instructors are able to give assignments, surveys and quizzes, grade students work etc. This application saves time and paper and makes it easy to create classes, distribute assignments, communicate and stay organized (Frank, 2016). Using Google Classroom enable teachers to quickly see who has or has not completed the work and provide direct real-time feedback and grade right in classroom. Despite the availability of these technologies the determination of lecturer's decision to adopt them in teaching is checked on the basis of Unified Theory of Acceptance and Use of Technology (UTAUT) by

Papagiannidis and Marikyan, 2023. This theory examines the acceptance of technology, determined by the effects of performance expectancy, effort expectancy, social influence and facilitating conditions. The theoretical model of UTAUT suggests that the actual use of technology is determined by behavioral intention and adopting technology is dependent on the four (4) key constructs mentioned above. To provide a holistic understanding of technology acceptance, Venkatesh *et al.*, (2003) set the objective for developing a UTAUT by integrating key constructs predicting behavioral intention and use. His theory stems from different disciplines and they cast diverse perspectives on technology acceptance and adoption; ie socio-psychological research on individual behavior. This theory is represented by Theory of Reasoned Action (TRA), Theory of Planned Behavior (TPB) and Social Cognitive Theory (SCT). Based on TRA and TPB, individual's behavior is measured by the effect of attitude towards behavior, subjective norm and perceived behavioral control on behavioral intention (Ajzen, 2011). The theories are used to explore the role of perceived difficulty in performing a task, effect of group norms and attitude on accepting technology (Zhang and Mao, 2020). Social Cognitive Theory (SCT) is based on the assumption that behavioral, cognitive and environmental factors (i.e. outcome expectations-performance, outcome expectations-personal, self-efficacy, affect and anxiety) have an interactive effect on individual's behavior. It describes the influence of individual experiences, actions of others and environmental factors on certain behaviors. This theory was founded most prominently by Albert Bandura (1989) who is known for his work on observational learning, self-efficacy and reciprocal determination. The theory assumes that we learn new behaviors by observing the behavior of others and the consequences of their behavior. If the behavior is rewarded (ie positive or negative reinforcement) then, there is likelihood for such behavior to be imitated, however if the behavior is punished, imitation is less likely. The theory is an extension of Social learning that includes the effects of Cognitive processes such as conceptions, judgment and motivation on individual's behavior and on the environment that influences them (Nickerson, 2023).

The theoretical model of UTAUT suggests that the actual use of technology is determined by behavioral intention. The perceived likelihood of adopting technology is dependent on the direct effect of four (4) key constructs; performance and, effort expectancy, social influence, facilitating conditions and the effect of predictors is moderated by age, gender, experience and voluntaries of use (Marikyan and Papagiannidis, 2023).

Performance expectancy: - This is the degree to which an individual believes that using the system will help him or her to attain gains in job performance. Performance expectancy is based on the constructs of Technology Acceptance Model, (TAM), TAM2, Combined Theory of Acceptance Model (CTAM), Theory of Planned Behavior (TPB), Motivational Model (MM), Innovation Diffusion Theory (IDT) and Social Cognitive Theory (SCT). It implies that the perceived usefulness, extrinsic motivation, job fit, relative advantage and outcome expectations are the strongest predictors of use intention (Thong and Xu, 2016).

Effort expectancy: - This is the degree of ease associated with the use of the system. Effort expectancy is constructed from perceived ease of use and complexity driven from TAM, IDT. The Diffusion of innovations theory describes how new ideas, behaviors, technologies, or goods spread through a population gradually, rather than all at once. Adoption starts with innovators and early adopters, then spreads through the population to the early majority and late majority. This theory was developed by E.M Rogers, a communication theorist in 1962. It explains the passage of a new idea through stages of adoption by different people who participate in using the new idea.

Social Influence: - This is the degree to which an individual perceives that an important others believes he or she should use the new system. Social Influence is similar to the subjective norms, social factors and image constructs used in TRA ,TPB, TAM2, and IDT, they argue that the behavior of people is adjusted to the perception of others about them (Marikyan and Papagiannidis, 2023). The effect of information system (IS) is significant when the use of technology is mandated; an individual might use technology as a result of compliance requirement and not because of personal interest or preferences.

Facilitating Conditions: - This is the degree to which an individual believes that an organization and technical infrastructure exist to support the use of the system. This construct is drawn from TPB, IDT, CTAMTPB and is formed from compatibility, perceived behavioral control. The moderation effects of age, gender, experience and voluntariness of use defines the strength of predictors on intention. Age moderated the effect of all the four (4) predictors mentioned above, gender effects the relationships between effort expectancy, performance expectancy and social influence, experience moderates the strength of the relationships between effort expectancy, social influence and facilitating conditions, while voluntariness of use has a moderating effect only on relationship between social influence and behavioral intention (Venkatesh et al.,2003., Marikyan and Papagiannidis, 2023).

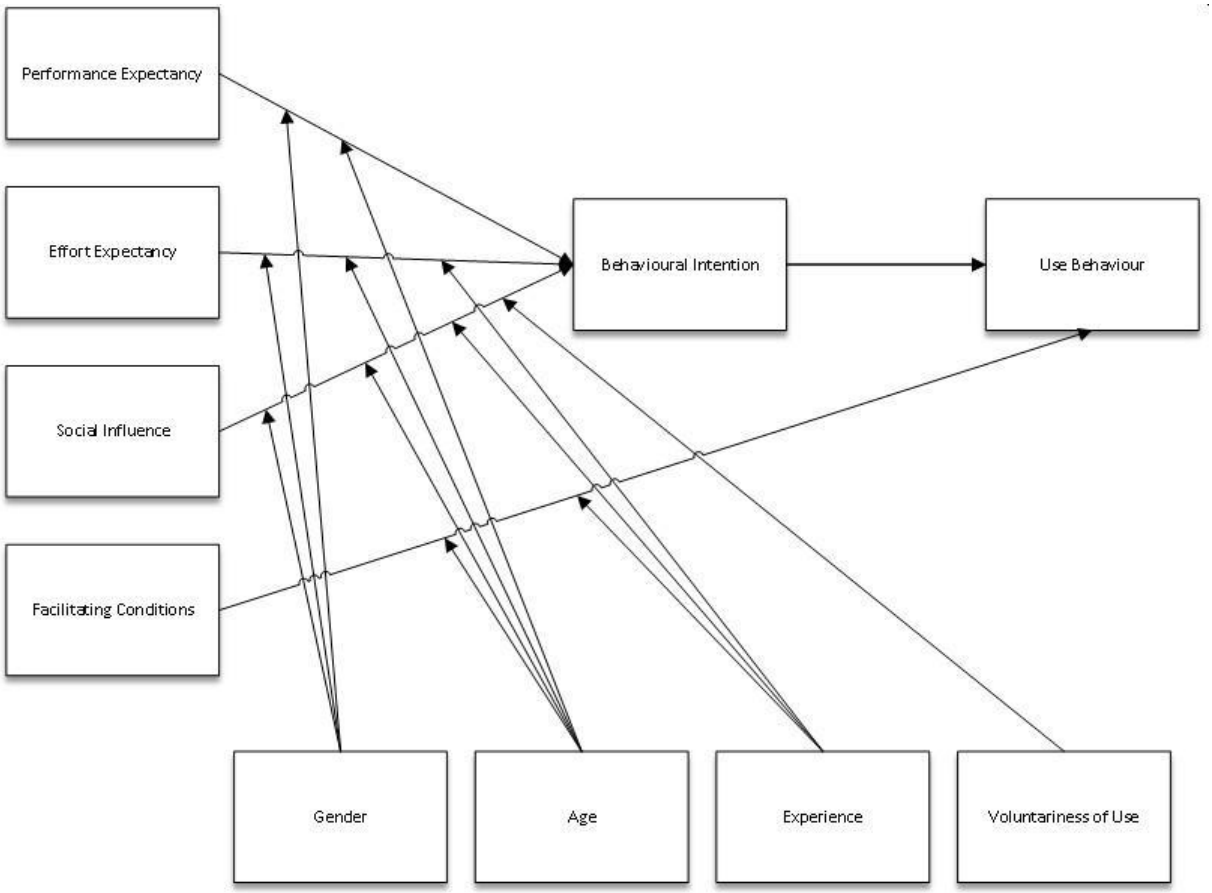

Fig 2. 1: Unified Theory of Acceptance and Use of Technology

CHALLENGES TO ADOPTION OF SMART TECHNOLOGIES

It's easy to look at all the benefits new technologies have brought to us globally and we may think "we will just buy and use the latest and greatest technologies right away in the teaching and I processes. But it's not that easy especially in large tertiary institutions due to several challenges that may hinder adoption and use of modern technologies in schools especially tertiary institutions. Some of these challenges may include:

- Legacy culture: This refers to reluctance to change among staff and management.
- Lecturers untrained on how to use new technologies.
- Price and time to procure the new tools and technologies.
- Speed of technology advances making it difficult or too hard to keep up.
- It's not easy to come up with a plan for new technology implementation.

Conclusion

In this paper, various views on the determinants of technology adoption or use by individuals (lecturers) in the classroom have been reviewed. In the course of this review, evidence has shown that although Nigeria had approved ICT policy, the country is yet to attain (100%) percent ICT compliant nation as survey found that use of technology in schools is still growing at slow rate and not all teachers and students use digital learning tools to learn every day. Equally, studies have revealed that most teachers in Nigerian institutions of learning do not have the capacity to integrate new technologies in the classroom (Umoru, 2012).

Recommendations

The following are the recommendations made based on the findings of this study; In line with the findings of the study, the following recommendations were made:

1. Colleges and other tertiary institutions should implement the smart technologies for teaching in teaching and learning process.
2. The regulatory bodies on education such as National University Commission (NUC) and National Commission for Colleges of Education (NCCE) should update their curriculum by integrating smart technologies for teaching in and learning process into the higher institutions.
3. The Ministry of Education empowered by the Federal and State government should make adequate provisions for ICT facilities, online resources, and internet connections in all the public universities and colleges of education.
4. Workshops, seminars and conferences should be organized by government and institutional authorities to equip lecturers with the needed ICT skills.

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EFFECTS OF REALISTIC MATHEMATICS EDUCATION AND MATHEMATICAL MODELLING APPROACHES ON GEOMETRIC ACHIEVEMENT AND ATTITUDE AMONG SENIOR SECONDARY SCHOOL STUDENTS IN NORTH CENTRAL, NIGERIA.

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Abstract
This study investigates the effects of Realistic Mathematics Education (RME) and Mathematical Modelling (MM) approaches on geometric achievement and attitudes among senior secondary school students in North Central, Nigeria. A pre-test and post-test control group factorial design were employed. Three research questions were answered, and Three hypotheses were tested in this study. The population of the study was made up of eight hundred and nineteen thousand nine hundred and eight (146,412) students in the Senior Secondary schools in North Central. Cluster sampling, purposive sampling and random sampling were used to select 361 students from twelve co-educational secondary schools in the North Central States of Nigeria that participated in the study. The schools were assigned to experimental groups; I, (RME), experimental group II (MM) and Control Group (Lecture Method). A Geometry Achievement Test (GAT) containing 20 – questions covering topics in Plane and Circle Geometry was used to collect data for both pre-tests and post-test while Mathematics Attitude Questionnaire (MAQ) was used for collecting data on attitude of students towards Geometry, experts validated the instruments. A Pearson product moment correlation and Cronbach alpha formula were used to determine the reliability coefficient of GAT and MAQ which yielded 0.80 and 0.87 respectively, establishing the robustness of these instruments. The data were analyzed using descriptive statistics (mean and standard deviation), inferential statistics, analysis of variance (ANOVA), Analysis of Covariance (ANCOVA) and Scheff post hoc test was used. The hypotheses were tested at 0.05 level of significance. Results indicate significant differences in mean achievement scores among students taught Geometry using RME, MM approaches, and conventional lectures. In addition, both RME and MM approaches contribute to improved attitudes towards Geometry. The study emphasizes the importance of personalized teaching approaches like RME and MM in enhancing achievement and attitudes towards Geometry. These findings have notable implications for the evolution of curricula and the enhancement of instructional strategies in mathematics education. The study provides valuable insights for educators seeking to improve geometry learning experiences and outcomes by employing effective instructional approaches.

Keywords; Effects, Attitude, Achievement, Mathematical Modelling, Mathematics representation, Realistic Mathematics Education

Introduction

Science, Technology, and Mathematics Education (STME) are regarded as key indicators of a nation's socio-economic and geopolitical development. Studies have shown the significant impact of STME on countries like China, which has become a major economic power due to its emphasis on scientific and technological development. In Nigeria, the National Policy on Education and curriculum reforms have underscored the importance of Mathematics as a compulsory subject in basic education, reflecting its vital role in contemporary society.

Despite the importance of Mathematics, student performance in Senior Secondary School examinations remains discouraging. Various studies have consistently reported low achievement levels among Nigerian students in secondary school Mathematics. This trend has raised concerns about the future of Mathematics Education in the country.

To address this issue, new teaching methodologies have been introduced, including Realistic Mathematics Education (RME). RME, developed in the Netherlands, emphasizes math as a human activity connected to real-life situations. It aims to make math learning enjoyable and meaningful by using real-world contexts as a starting point for learning. RME involves problem-solving, discussions, and rational solution development, helping students understand mathematical concepts in practical contexts. This approach is believed to improve students' mathematical representation and problem-solving skills.

Mathematical modeling is another approach that makes math relevant by representing real-world problems mathematically. It helps students understand and solve real-life issues, particularly in areas like geometry. Modeling is seen as a central aspect of successful math teaching and learning, fostering a "culture of mathematizing" in schools.

These teaching approaches align with constructivist learning theory, which emphasizes the role of experiences and connections in student education. Constructivism suggests that students construct knowledge based on their experiences, and teachers should create problem-solving environments where students can construct their own knowledge.

The study aims to investigate the effects of Realistic Mathematics Education and Mathematical Modeling on senior secondary students' achievement and attitudes toward Geometry in North Central Nigeria. It seeks to understand how these teaching approaches impact students in a specific geographical context and differs in scope, content, sample size, data collection, and analysis from previous studies in the field.

Purpose of the Study

The purpose of this study is to determine the Effects of Realistic Mathematics Education and Mathematical Modelling Approaches on Senior Secondary School Students' Achievement and Attitudes towards Geometry in North Central, Nigeria. Specifically, the study will be carried out to achieve the following objectives;

1. determine the main effects of Realistic Mathematic Education, Mathematical Modelling approaches and conventional lecture method on the student's geometry Achievement;
2. determine the attitude of students towards geometry when taught using Realistic mathematics education approach;
3. determine the attitude of students towards Geometry when taught using Mathematical Modelling approach

Research Questions

The following research questions were raised for the study.

1. What are the main effects of Realistic Mathematic Education, Mathematical Modelling approach and conventional lecture method on the student's Geometry Achievement?
2. What is the difference in the mean attitude of students towards Geometry before and after when taught using Realistic mathematics education approach?
3. What is the difference in the mean attitude of students towards Geometry before and after when taught using Mathematical Modelling approach?

Research Hypotheses

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

HO_1: There is no significant difference of Realistic Mathematics Education, Mathematical Modelling approach and conventional lecture method on the students' Geometry Achievement.

HO_2: There is no significant difference in the mean attitude scores of students towards Geometry before and after being taught using Realistic Mathematics Education approach.

HO_3: There is no significant difference in the mean attitude scores of students towards Geometry before and after being taught using Mathematical Modelling approach

Methodology

The study employed a pretest and posttest control group factorial design, utilizing a three by two (3 × 2) factorial design. This design involved three treatment levels (Realistic Mathematics Education (RME) and Mathematical Modelling (MM)) and two levels of gender (Male and Female) to test the study's hypotheses. The target population consisted of Senior Secondary school students in North Central Nigeria for the 2021/2022 academic session, with a total population of 146,412 senior secondary school Mathematics students in SSII. The selection of SSII was based on the focus of the study on challenging Mathematics concepts within the SSII syllabus. The sample for the study included 361 Mathematics students from 12 co-educational public senior secondary schools in the North-Central Geopolitical Zone of Nigeria. These schools were selected using purposive sampling based on similar environmental conditions, including manpower, gender composition, and school type (public schools). Within each sampled school, an intact class of SS 2 was randomly selected from each arm, resulting in three groups: experimental group I (107 students), experimental group II (126 students), and a control group (128 students). Data collection instruments included the Geometry Achievement Test (GAT) and the Mathematics Attitude Questionnaire (MAQ). GAT comprised 20 subjective items with a total score of 100 marks, covering plane and circle geometry content. MAQ was used to assess students' attitudes toward geometry and consisted of two parts: part one collected student bio-data, while part two included 50 items assessed on a 5-point Likert scale. The items covered four subscales: personal confidence in the subject matter, the usefulness of the subject's content, perception of the subject as a male domain, and perception of teachers' attitude. Scoring for positive and negative items differed, with positive items scored SA = 5, A = 4, U = 3, D = 2, and SD = 1, while negative items were scored SA = 1, A = 2, U = 3, D = 4, and SD = 5. The instruments underwent face, construct, and content validation by specialists in the field of Pure Mathematics and Science Education. Reliability analysis yielded a coefficient of 0.80 for GAT and 0.87 for MAQ. Data collection occurred in two stages: the first stage involved training mathematics teachers and administering pretests, while the second stage involved four weeks of exposing the experimental group to RME and MM activities using treatment instruments (worksheets), while the control group received traditional lectures. Posttests were administered to both groups to assess their achievement in mathematical RME and MM. Data analysis was conducted using mean and standard deviation for research questions and dependent t-tests and ANCOVA statistics for hypothesis testing, with a significance level of 0.05.

Results

Research Question One

What are the effects of realistic mathematic Education Mathematical Modelling approach and conventional lecture method on the student's Geometry Achievement?

Table 1: Mean and Standard Deviation of Pre-test and Post-test Achievement Scores of Experimental Group I, II and the Control Group

Group	N	Pretest		Post-test		Mean difference
		$\bar{X}$	SD	$\bar{X}$	SD	
Experimental Group I	128	32.69	12.93	83.39	8.97	50.70
Experimental Group II	107	38.23	10.77	79.60	8.21	41.37
Control Group	126	38.11	12.35	66.51	15.23	28.40

Table 1 shows the mean and standard deviation achievement scores of experimental groups I, experimental group II and control groups at pre-test and post-test. From the result, it can be deduced that the mean and standard deviation scores at pre-test and post-test for Experimental Group I (RME) as = 32 .69, SD= 12.93

and $\bar{X}$= 83.39, SD= 8.97 respectively. This gives the mean difference of 50.93 in favour of post-test. Similarly, the mean and standard deviation scores at pre-test and post-test for Experimental Group II (MM) are $\bar{X}$= 38.23, SD= 10.77 and $\bar{X}$= 79.60, SD= 8.21 respectively. This gives the mean difference of 41.37 in favour of post-test. On the other hand, the mean and standard deviation scores at pre-test and post-test for the Control Group (lecture methods) are $\bar{X}$= 38.11, SD= 12.35 and $\bar{X}$= 66.51, SD= 15.23 respectively. This gives the mean difference of 28.40 in favour of post-test. The table also reveals that Experimental Group I, II and control group had a mean difference of 50.93, 41.37 and 15.23 respectively and with experimental group I having the highest mean gain of 50.93. As a result of this identified difference in mean achievement scores, hypothesis I was tested at 0.05 level to determine if the observed difference was significant. To determine if the difference is significant, ANCOVA was used as presented in Table 3.

Research Question Two

What is the difference in the mean attitude of students towards Geometry when taught using Realistic mathematics education approach?

Table 2: Mean and Standard Deviation of Experimental Group 1 students' attitude towards Geometry.

Groups	N	Mean	S. D	Mean difference
Before	128	67.09	12.72	15.99
After	128	83.08	14.01	

Table 2 reveals that experimental group 1 has (Mean = 67.09 and S. D= 12.72.); at pre-test while at post-test experimental group 1 has (Mean = 83.08 and S. D= 14.01). This indicates that students had better attitude towards Geometry when exposed to Realistic Mathematics Education approach than before they were exposed to Realistic Mathematics Education with a mean difference of 15.99. To determine if the difference in the attitude is significant, ANOVA was used as presented in Table 4

Research Question Three

What is the difference in the mean attitude of students towards Geometry before and after when taught Geometry using Mathematical Modelling approach?

Table 4.6a: Mean and Standard Deviation of Experimental Group 2 students' attitude towards Geometry.

Groups	N	Mean	S. D	Mean Difference
Before	107	61.35	7.73	15.16
After	107	76.51	6.64	

Table 4.6a reveals that experimental group 2 has (Mean = 61.35 and S. D= 7.73.); at pre-test while at post-test it has (Mean = 76.51 and S. D= 6.64). This indicates that students had better attitude towards Geometry when exposed to Mathematical Modelling approach than before they were exposed to Mathematical modelling with a mean difference of 15.16. To determine if the difference in the attitude is significant, Dependent sample t-test was used as presented in Table 5

Hypotheses One

There is no significant difference between the mean achievement scores of senior secondary school students towards Geometry when taught using Realistic Mathematics Education, Mathematical Modelling approaches and conventional lecture.

Source	Type III Sum of Squares	Df	Mean Square	F	P
Corrected Model	18753.327[a]	3	6251.109	48.416	.000
Intercept	207708.592	1	207708.592	1608.750	.000
Covariate	9.727	1	9.727	.075	.784

Treatment	18459.443	2	9229.721	71.486	.000
Error	46092.906	357	129.112		
Total	2177891.000	361			
Corrected Total	64846.233	360			

*: Significant at P < 0.05

Table 4.2b showed the ANCOVA result of the comparison of posttest scores of students in Experimental groups and the control group. An examination of the table shows (F (2, 360) = 9229.721, P < 0.05). On this basis, hypothesis one was rejected. Therefore, there was significant difference between students' Geometry Achievement when taught using Realistic Mathematics Education, Mathematical Modelling approach than those taught using conventional lecture. Scheffe post- hoc test was carried out to find out where the differences lie as shown in table 3(a).

Table 3(a): Scheffe Post-hoc Analysis of Mean score of students in Experimental groups and control group

Treatment	Experimental I (RME)	Experimental II (MM)	Control (LM)
Experimental I (RME)	-	3.79*	16.50*
Experimental II (MM)	-3.79*	-	12.71*
Control (LM)	-16.50*	-12.71*	-

*: Significant at P < 0.05

Table 3(a) showed the Scheffe post- hoc analysis of mean score of students in Experimental groups and control group. The table indicate that significant difference exists between RME vs MM, RME vs LM, MM vs LM and LM vs MM with mean difference of 3.79, 16.50 and 12.71 respectively indicating those taught using RME and MM had a higher mean score when taught Geometry than those taught using LM.

Hypotheses two

There is no significant difference in the mean attitude scores of students towards Geometry before and after taught using Realistic Mathematics Education approach.

Table 4: Summary of Dependent t-test Analysis of students' attitude towards Geometry when taught using RME approach

Groups	N	Mean (x)	SD	Df	T	P	Remark
Before	128	67.09	12.72	127	8.821	0.000	Significant
After	128	83.08	14.01				

Table 4 shows the analysis of dependent sample t-test of mean attitude scores of students towards Geometry before and after exposure to Realistic Mathematics Education Approach. It reveals that the calculated t–value = 8.821, df = 127, p = 0.000 indicating P < 0.05. Hence, Hypothesis two was rejected. This mean, there was significant difference in the mean attitude scores of students taught Geometry before and after exposure to Realistic Mathematics Education.

Hypotheses Three

There is no significant difference in the mean attitude scores of students towards Geometry before and after taught using Realistic Mathematics Education approach.

Table 5: Summary of Dependent t-test Analysis of students' attitude towards Geometry when taught using MM approach

Groups	N	Mean (x)	SD	Df	t	P	Remark
Before	107	61.35	7.73	106	14.641	0.000	Significant
After	107	76.51	6.64				

Table 5 shows the analysis of dependent sample t-test of mean attitude scores of students towards Geometry before and after exposure to Mathematical Modelling Approach. It reveals that the calculated t–value = 14.641, df = 106, p = 0.000 indicating $P < 0.05$. Hence, Hypothesis three was rejected. This mean, there was significant difference in the mean attitude scores of students taught Geometry before and after exposure to Mathematical modeling.

Discussion of the Findings

The study's results highlight the advantages of utilizing Realistic Mathematics Education (RME) and Mathematical Modeling (MM) approaches in teaching Geometry, demonstrating their superiority over traditional lecture-based methods. RME's hands-on approach immerses students in interactive and practical learning experiences, significantly improving their academic performance. This experiential approach helps students establish meaningful connections between mathematical concepts and real-world scenarios, enhancing their understanding of Geometry concepts. Furthermore, MM complements RME by facilitating personalized support and a constructivist learning style, empowering students to construct their knowledge through problem-solving and critical thinking. This not only deepens their Geometry understanding but also equips them with transferable skills for real-world challenges.

These findings align with earlier research by Effandi et al. (2017), Zakaria and Syamaun (2017), Nicola (2011), Baskan and Alev (2013), and Sokolowski (2015), all supporting the positive impact of RME and MM on students' mathematics achievement. This collective evidence suggests that these teaching approaches have the potential to revolutionize mathematics education.

Regarding students' attitudes towards Geometry, the study shows a significant improvement in mean attitude scores after being taught using the RME approach. This finding corresponds with Verschaffel et al.'s (2019) research, which also found that RME positively influenced students' attitudes by connecting mathematics to real-world situations. Leung and Wong (2017) found similar positive changes in primary school students' attitudes toward math with RME. However, Henningsen and Stein (2017) found that while RME improved problem-solving skills, it did not consistently change attitude scores, suggesting that attitude change may not always accompany skill improvement.

Concerning the MM approach, there was a significant difference in mean attitude scores before and after instruction, aligning with Blum and Leiss (2020), who found a positive attitude change toward Geometry through MM. Gravemeijer et al. (2017) also emphasized MM's potential in improving attitudes through active participation and inquiry-based learning. However, Chen et al.'s (2017) study provides a counter-perspective, suggesting that the MM approach may not uniformly lead to positive attitude changes in students.

Conclusion

Based on the findings of this study, it can be deduced that the use of Realistic Mathematics Education (RME) approach for teaching and learning of secondary schools' Geometry is more effective than Mathematical Modeling (MM) approach and lecture method though both Realistic Mathematics Education (RME) and Mathematical Modeling (MM) approaches has positive effect on students' academic achievement and attitude of students towards geometry. The two approaches improve students Geometry representation and problem-solving skills. Through the use of this approaches in teaching and learning of

difficult concepts in Mathematics most especially in Geometry, lessons can be easily delivered to learners in inspiring, understandable and exciting ways. This will undoubtedly positively improve students' achievement and attitude towards geometry. If these approaches are adopted by teachers and students, RME can therefore be used to complement classroom instruction in Mathematics. Consequently, the use of MM could be regarded as one of the veritable approaches for enhancing achievement and attitude of students towards geometry in North Central Nigeria.

Recommendations

Based on the major findings of this study, the following recommendations are proffered as follows:

1. Incorporate targeted activities within Realistic Mathematics Education (RME) and Mathematical Modelling (MM) approaches to specifically enhance students' geometry representation skills. Visual aids, diagrams, and real-world examples should be employed to facilitate understanding.

2. Craft structured problem-solving exercises aligned with the principles of RME and MM. Encourage students to apply mathematical concepts in real-life scenarios, fostering improved problem-solving abilities.

3. Regularly evaluate students' attitudes towards Geometry before and after exposure to the Realistic Mathematics Education approach. This assessment can track attitude improvements and identify areas for further development.

4. Advocate for the incorporation of both Realistic Mathematics Education (RME) and Mathematical Modelling (MM) approaches into the senior secondary school syllabus. These innovative trends have global significance and should be embraced in Nigeria's education system.

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JUVENILE DELINQUENCY AS A BLOCKING STONE TO THE EFFECTIVE ATTAINMENT OF STEM TVET EDUCATION OBJECTIVES IN NIGERIA SECONDARY SCHOOLS

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Abstract
To attain any scientific, technological, political, social and economic development in any society; education is regarded as an important and requisite tool. Several countries of the world for decades have been investing massively on this dimension with varied levels of achievement, Nigeria inclusive. Science, Technology, Engineering and Mathematics(STEM) education and Technical and Vocational Education and Training (TVET) are two vital programmes implemented worldwide to boost the acquisition of knowledge and the 21st century skills necessary to transform the contemporary societies in to a scientific and technologically advanced societies. Nigeria as a nation has joined the move for several years but to some extent, cannot be said to have attained the desired objectives. The paper explained the negative influence of juvenile delinquency on the two programmes which undermines the achievement of the set objectives all these while. The authors discussed on the two programmes and their objectives, and further buttressed on juvenile delinquency and the possible avenues through which it can affect the programmes The target learners are the teenagers who also are the subject of delinquent acts. Once the learners continue to be away from classes, experience mental disturbances through drug abuse, disrespect teachers and become violent in schools; then effective teaching and learning of STEM and TVET will remain a mirage than reality in Nigeria. It is recommended among others that all hands should be on deck to control delinquent behavious among students as to pave way for effective implementation of STEM education and TVET in Nigeria.

Keywords: Juvenile delinquency, socio-economic status, STEM education, TVET.

Introduction

The significance of Science, Technology, Engineering and Mathematics education to the national development of any nation can never be over emphasized. The resultant effects of the multifaceted investments in STEM is the key factor for the technological advancement of developed and developing countries of the contemporary world. In essence, this implies that no nation can experience scientific, technological, economic, political as well as educational developments without substantially adventuring in to STEM at any point in time.

Technical and Vocational. Education and Training (TVET) has been alternative human resource development programme across the world that is geared towards the attainment of national development. It comprises acquisition of knowledge, practical skills and attitude in Science Technology that relates to the various occupations in social and economic life (Atsumbe, 2017). Nigeria for several decades have been investing much in the programme in order to develop workforce needed to enhance the attainment of national development, particularly in scientific and technological advancements.

STEM Education Objectives and Prospects

STEM is an acronym of Science, Technology, Engineering and Mathematics which encompasses disciplines that are highly relevant for the production of scientists and engineers capable of bringing about technological development of a given society. In Nigeria particular, it was formally tagged as SMET standing for Science, mathematics and Engineering which later became STEM with the influence of

National Science Foundation 9NSF) in the 1990s (Fomunyam, 2019). Emphasis on STEM was laid on preparing future generations to be successful in their careers. The skills gained from STEM education extend beyond those needed to be successful in STEM fields, preparing children with varied interests who move into any industry to have valuable skill sets that allow them to be successful.

STEM education teaches children more than science and mathematics concepts. The focus on hands-on learning with real-world applications helps develop a variety of skill sets, including creativity and 21st-century skills. 21st-century skills include media and technology literacy, productivity, social skills, communication, flexibility and initiative. Other skills attained through STEM education include problem solving, critical thinking, creativity, curiosity, decision making, leadership, entrepreneurship, acceptance of failure and more (Fomunyam, 2019).

Regardless of the future career path considered by learners, the aforementioned 21st century skills go a long way in transforming learners to become innovative in their living which is crucial to the scientific and technological developments. The ability of an individual to think critically and challenge standards is the basis of innovation at any point in time. Preparing today's children to become the innovators and inventors of tomorrow begins with STEM education programs which provide opportunities to take traditional learning and pivot it to prioritize the hands-on experience and real-world application necessary for developing an innovative mind which as a result, leads to national development.

National Goals of STEM Education in Nigeria

Every important programme has some definite goals to be achieved at the end of its execution. So is the case of STEM education in Nigeria. There are several goals set to be achieved by STEM education in Nigeria as it is in other developing countries. Joseph et al. (2023) explained some of them as follow:

The first objective of STEM education is to expose students to effective inter-disciplinary communication. Technologists provide gadgets that can make the work of the team more effective. Engineers design and run platforms to solve challenges to enhance transformation. Through collaboration, lots of experiences are interchanged and implemented in order to innovate or solve a particular problem. A lot of societal challenges are being addressed as a result of this approach in STEM education.

The second objective targets students to have access to quality education and lifelong learning opportunities. This Goal emphasizes on the acquisition of lower and higher-order skills; access to STEM education, higher education; training, knowledge, skills and values required for the effective contribution to the nation.

Third, STEM education prepares students for the future. It encourages team work and the interaction of experts from different spheres of life. The most significant attribute expected in a learner is a mindset that allows one to become a part of the highly qualified workforce, which functions in collaboration. Evidently, teamwork leads to a significant increase in productivity, work satisfaction, and profitability.

The forth objective to be achieved by STEM education is prepare students for effective inter-disciplinary communication. Experts in Technology provide gadgets that can make the work of the team more effective. Engineers help to solve challenges by designing and running platforms that enable transformation. Through collaboration in a team work, lots of experiences are interchanged and implemented in order to innovate or solve a particular scientific or technological problem. Several societal challenges have been addressed as a result of this approach in STEM education.

Finally, the fifth objective set to be achieved in STEM education is to have increased access to Information and Communication Technology (ICT) and Infrastructure which provides the basic physical facilities relevant for industrialization which consequently bring about economic growth and job creation

All these objectives are still being pursued by the government for years which if well achieved could lead the country to the highest level of development. On the other angle, we have an alternative programme known as Technical and Vocational Education and Training (TVET) which also is being geared towards development of the country.

TVET OBJECTIVES IN NIGERIA

TVET is a learning experience relevant to the contemporary dynamic societies that speedily move towards attainment of economic, social, political and economic developments. According to International Labour Organization(ILO) (2010), TVET is simply those aspects of educational process that involves the study of technologies and allied sciences and acquisition of knowledge, practical skills and attitudes relating to occupation in various economic life. Philosophically, TVET focuses on employability skills that are inevitable in the world of work. In other words, it solely concerned with training individuals that can easily be employed in sciences, engineering, crafts e.t,c, at initial stage of life to prevent redundancy, poverty and unemployment among others. All these factors mentioned have potential adverse effects on national economy and development of our societies.

For example in Nigeria, TVET focuses on the provision of workforce with the requisite knowledge, skills and attitudes contributing to increase productivity and economic development.

It has several objectives as explained by Atsumbe (2017), which include:

i. providing technical knowledge and vocational skills tht are relevant in agricultural, industrial and economic developments of the nation
ii. providing introductory professional training in engineering and allied technologies to the citizens
iii. producing manpower capable of applying scientific knowledge and skills in solving diversed challenges of the society
iv. nurturing individuals with skills that enhance the production of craftsmen, technicians and entrepreneurs in the society

From the highlighted TVET objectives, it can be deduced that any society that can achieve the stated objectives is liable to experience tremendous employment opportunities, reduced poverty rate and at the peak, general economic development.

Juvenile Delinquency In Nigeria

The essence of education is to nurture an individual to become relevant na d productive in a society by enriched cognitive, psychomotor and affective domains in life. By implication, education engulf knowledge, skills and character capable of transforming an individual in to a positive contributor to the development of a given society. Unfortunately, there is every tendency for a child or an individual to be affected by the influence of the uneducated members of the society that can hinder the acquisition of such attributes of an educated elite as expected, leading to the manifestation of negative behaviours in the society. Such unwanted negative behaviours are usually termed as juvenile acts or delinquency. Juvenile acts are described as the offences committed by young people (Coughin & Vuchinich, 2016). Delinquents break the norms and values of the society and can defile any form of authority deliberately as a result of deficient transformation of affective domain.

Juvenile delinquency comprises legal deviances ranging from common littering to murder by the teenagers in a community. Though it is assumed that teenagers are yet to comprehend fully the consequences of their actions because of the incomplete mental or cognitive development which makes the law to be lenient to them. Nevertheless the reduced punishment they receive is to prevent and discourage them from committing another illegal act subsequently (Elliot, 2014). In Nigeria, concerned citizens and scholars have attributed juvenile delinquency to various factors gangs, poverty, and impoverished environments (Ikediashi and Akande, 2015; Olashore *et al.*, 2017).

Kindermann (2013) quoted the World Youth Report as saying that‘ ’young people who are at the risk of juvenile delinquency often live in different circumstances such as; parental alcoholism, poverty, breakdown of the family, overcrowding, abusive conditions in the home, death of parents, orphans without the means of subsistence, where housing and other basic necessities are at great risk of falling into juvenile delinquency Adegoke (2015) opined that the number of students affected by juvenile delinquency is estimated to have increased from 80 million to 160 million. On the basis of the foregoing the researcher further stressed that juvenile delinquency in Nigeria do not operated in well organized gangs, but there are instances of assault and vandalism committed by small group of juveniles including looting and other acts of vandalism especially when encouraged during political campaigns and sex offences.

The term delinquent act was established so that law breakers could avoid the disgrace of being classified in illegal records as criminals. A delinquent in Nigeria is a person who is typically under the age of nineteen and commits an act that otherwise could have been charged as a crime if they were adults. According to Moffit (2016), a higher proportion of youths have experienced arrest by their early 20’s than in the past although some scholars have concluded that this may reflect more aggressive criminal justice and zero tolerance policies rather than changes in youths’behaviour. Furthermore, juvenile delinquency can range from status offences such as; underage smoking, alcohol drinking to property and violent crimes.

Negative Messages from Mass Media

The influence of the media on the psychosocial behavior of the juveniles is profound, as a result, some research findings proved that excessive television watching have a deleterious effect on learning and academic performance of students. According to Thornberry and Krohn (2017), media portrayals of violence have been well established as a risk factor causing juvenile delinquency. The media is believed to have a very high tendency of influencing juveniles negatively into delinquent behaviors. This is because, the high levels of exposure to violence on television have been found as a factor contributing to juvenile delinquency. Kumpfer and Magalhães (2018) are also of the view that extensive television viewing regardless of content has been found to negatively affect juvenile behavior leading to low level of academic performance of student’. More so, video and computer games that triggers impulsive and reflexive responses among juveniles that in effect contribute to the development of a tolerance for juvenile delinquency, if not to strain juveniles’ on how to be delinquent.

Juvenile delinquency is one of the most visible forms of behavioral problems in human society. According to them, world newspaper and broadcast media reports daily on the extent of juvenile delinquency among students’. Juvenile delinquency deeply harms not only it’s victims but also their families, friends and society. Its effects are seen not only in deaths, illness and disability, but also in terms of quality of life. The effects of mass media on juveniles’ academic performance have become very significant not only because of its communicability but also as a result of its negative impact on juvenile delinquency (Thornberry and Krohn, 2017). Juveniles’ are exposed to different social environments and hence, they react differently to mass media. This is due to the fact that, a typical African child has different social environment from that of a child in developed country like Britain or America.

However, in Nigeria, juveniles are not exposed to those hobbies their counterparts in developed countries are exposed to. There are few recreational facilities in most of these developing countries. For instance, in Nigeria, children only have recreational centers in a few other cities. This consequently makes them rely on watching television and home videos for long hours immediately after closing from school about 2:00pm till late hours in the night. In the process, they are exposed to so many hours of television commercials and programs which eventually leads to juvenile delinquency and subsequently results in low academic performance. Thornberry and Krohn, (2017), states that juveniles are by mass media because; they are the ideal target, simply because they are man avid viewers. Most big name brands and advertising agencies are used to influence children as consumers. Thus, their behaviour is a reflection of such influence; they choose what they consume, insist on their favorite brands and influence their family’s choice.

Moreover, television and other broadcast media have been in existence over a century. However, there have been serious concerns about the negative impact of mass media on children's behavior since inception. Since 1950's there has been growing pressure mounted by parents, teachers and social scientists on their legislators and government to do something about the amount of delinquency within the mass media, particularly television. On the basis of the initial worry about violence and other obnoxious issues around mass media, many professionals and parents are now questioning the kind of programs designed by mass media for juveniles', the amount of advertising directed at young viewers and the way mass media portray men, women and ethnic minorities and the effect of time that children are exposed to mass media. The perceived effects of the media on children are manifold. The media has been blamed for alienation, copycat killings, producing apathy among the population, reinforcing prejudices and trivializing important issues.

A study conducted by Alnasir and Al-Falaij (2016) revealed that the most direct source of juvenile delinquency can be found in the family's failure to maintain social control through its inability to effectively transmit the dominant value of society. Families are regarded the most important thing explaining juvenile delinquency. They believe parent who are criminal are more likely to teach their child an adverse lesson about life when the child witnesses the deviant act of the parents. The influence of parent on the adolescent is a very complex one, for instance, Simons and Lorenz (2017) discovered that at the early life stage of the adolescent, the parents are more influential in his or her life but as the adolescent moves to late stage of adolescent, the peers influence becomes more increasingly.

Effects of delinquent Acts innthe Society

There is a wide range of negative effects of delinquent acts on the individual and his/her relationship with the environment. Antisocial behavior tends to limit the individual's ability to be socialized into the society of which he/she is a member. The individual fails to effectively internalize the norms and values of the society, thus negatively affecting his/her physical, mental and spiritual well-being (Rinaldi & Howe, 2012).

Henggeler*et al.* (2019) are of the opinion that one of the negative effects of delinquent act is that the individual loses out on the necessary nurturing and support from the family. It is also commonly known that delinquents who abuse dangerous substances are at risk of engaging in risky behaviours such as unprotected sex, which may lead to teenage pregnancy, illegal abortions, STDs and HIV/AIDS. The offender is open to further multiple risk factors, amongst which are defiant and impulsive behaviors. Henggeler*et al.* (2019) further posits that chronic offending may lead to unemployment later in life, and those who may be employed, may struggle with the work environment. Extensive research data also indicates that offenders may befriend delinquent peers and remain trapped in a life-long, antisocial and dangerous lifestyle. Weak authority structures tend to deprive antisocial children of the opportunity to learn "the value of discipline and self-discipline". If the delinquency becomes chronic and the youth is incarcerated, he may be tried and sentenced as an adult. In addition, future career choices may be negatively impacted by antisocial behavior (Rinaldi & Howe, 2012). It is now clear that this is one of the reasons why the family plays a crucial role in the rearing of children and is a major buffer against youth antisocial conduct (Rinaldi & Howe, 2012).

However, once a family member develops a tendency to engage in offending behaviour, the family is adversely affected in various ways. Firstly, parents struggle to cope with their delinquent youth. It has also been noted that a decline in the functionality of the family unit exist once the family becomes dysfunctional, delinquency escalates. The school, like the home, has a major influence on the social development of the youth. However, it is also the locus for various forms of juvenile misconduct (Rinaldi & Howe, 2012). The latter scholars also contend that juvenile delinquency within the school not only disrupts harmonious teaching and learning activities, but also endangers teachers and learners.

Juvenile delinquency also affects the teachers of these students. Teachers are often confronted daily by acts of learner misconduct directed at themselves and other learners. Quite often, the media cites various

incidents of bullying, aggression, fights, violent outbursts, vandalism, theft, the use of illegal substances, carrying of dangerous weapons and inappropriate language directed at teachers and learners (Thornberry &Krohn, 2017). Such behaviour by juvenile delinquents has harmful effects on the perpetrators and others inside and outside the school environment.In some schools, teachers have been reported to abandon their classes, and this leads to high rates of teacher absenteeism. Teachers in crime-riddled schools often go through the following experiences:

i Feelings of hopelessness;
ii. Sudden drop in work performance;
iii. Very high or low energy levels;
iv. Social withdrawal;
v. Frequent tearfulness; and
vi. Beginning or increased substance abuse

Teachers have been found to harbour feelings of frustration and inadequacy caused by the aforementioned experiences, consequently, rendering them unable to deal with learner delinquency. Since the abolishment of corporal punishment, learners have been known to misbehave with impunity and continue to exhibit undesirable behaviours. They:

i. bunk classes deliberately;
ii. do not submit assignments;
iii. disrespect teachers and SMTs;
iv. vandalise and steal property;
v. bully other learners and teachers; and
vi. engage in inappropriate sexual acts in full view of others within the school premises.

The latter make up a few of the numerous acts of misconduct displayed by learners the researcher has personally observed. Learners, on the other hand, experience a range of effects which include some of those listed as follows:

i. School phobia;
ii. Truancy;
iii. Behavioural problems;
iv. Stress indicated by physical and emotional changes; and
v. Inability to cope with learning activities (Thornberry &Krohn, 2017).

How Juvenile Delinquency Undermines the Achievement Of STEM Education and TVET Objectives in Nigeria

The main aim of the STEM and TEVET in Nigeria as explained in the previous discussions is to nurture individuals that are well equipped with knowledge, skills and attitudes capable of transforming the society in to well developed in science and technology generally. This indicates that the most important candidates in the movement are the younger members of the society who are fresh and kicking with a sound energy and healthy brain to accommodate the training. If the participants are faulty, then the whole programmes are liable to fail at any point in time. This could be the result of increasing rate juvenile delinquency if not arrested.

It was discussed previously that juvenile delinquency has effects on both the teachers and students who are the parties of the implementation of the duo programs in schools. On the part of the teachers, studies indicated that it leads to teacher's social withdrawal, underperformance, substance abuse among others (Thornberry &Krohn, 2017), which creates gap between teachers and students and cripple effective teaching and learning activities in schools. This is a call for serious concern, because teachers are the custodian of knowledge, the curriculum implementers and the trainers as well in any learning institution. Thus if teachers are found wanting, or happened to be victim of social abnormal behaviors like drug

addiction, then the whole aspects and the objectives of the STEM education and TVET are unachievable as teaching and learning will seize to exist.

On the part of the students who are the more crucial participants in the two programmes, the effects of delinquent attitude are enormous, ranging from running from classes, not submitting assignments, disrespecting teachers, School phobia; Truancy; Behavioural problems; Stress indicated by physical and emotional changes; and inability to cope with learning activities (Thornberry &Krohn, 2017). These negative developments among students are serious barriers to the smooth implementation of TVET and STEM education in any given society. In a situation where students absent themselves from classes, or disrespect teachers or have learning phobia as a result of drugs addiction; how can effective learning takes place? Moreover, a learner expected to learn sciences and possess the 21st century skills in order to contribute to the development of the society if found emotionally unstable due to drugs effect, can never assimilate effectively. The situation here is in deviance to the theory of learning that stipulates S-R connection and significance of readiness to learn as important ingredients for effective learning in the classroom. Therefore for the effective implementation of TVET and STEM education in Nigeria, juvenile delinquency should become a history in the academic environment so that the target participants will judiciously utilize the opportunities to become responsible and productive members of the society.

Conclusion

From the discourse of this paper, the authors concluded that juvenile delinquency is a threat to the effective implementation of STEM education and TVET and achievement of their objectives if left uncontrolled and unattended to in the learning institutions of Nigeria. By extension, the authors also concluded that juvenile delinquency is a barrier to the attainment of national development in Nigeria and the world in general/

Recommendations

The following recommendations are given by the authors as follow:

1. Students should be constantly diagnosed for abnormal behaviours on time as to take immediate appropriate measures
2. Teachers should be encouraged to monitor the activities and behaviours of students in the classes and around the school environment as to take necessary corrective measures.
3. There should be functional counseling services in schools across the country to monitor students behaviours and render assistance through counseling at the appropriate time
4. Teachers should be careful of intimate relationship with students especially those who manifest delinquent behaviours. This is to prevent teachers from falling victims of copying negative behaviours from their students, such as substance abuse.
5. There should be constant monitoring of resources invested in STEM and TVET by the government to control mismanagement and other corrupt practices in Nigeria

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PERCEPTION AND ATTITUDE OF STUDENTS TOWARD ELECTRONIC EXAMINATION IN ALIKO DANGOTE UNIVERSITY OF SCIENCE AND TECHNOLOGY WUDIL, KANO STATE

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Abstract

An electronic examination is a form of summative and formative assessment that is timed, scheduled, supervised, and evaluated using computer systems programmed applications, and operating systems. However, the electronic examination makes marking easy, saves time, and reduces logistical engagement and waste of resources such as pen, papers, booklets etc. The exposure and development of electronic examination was driven by Information and Communication Technologies (ICTs). This study is for the researcher to carry out a survey by preparing questionnaires in other to examine the perception and attitude of students towards electronic examination in Aliko Dangote University of Science and Technology Wudil, Kano State. It is tempting to assume that students entering school today are computer illiterate and would prefer computer-based activities to more traditional activities such as reading a book. In the light of this, understanding the attitude and perception of students towards this e-exams becomes important. The results from this research will be of great benefits to the following group of people; Students, lecturers in university, curriculum developers and ministry of education. The research design that was employed is survey research design. The survey research is the type of research in which group of individuals are studied by collecting and analysing data from only few individuals which are considered to be representative of the entire group. The population of the study consists of undergraduate students in Faculty of Science and Technology Education (FASTE) and Faculty of Science (FASCI) ADUSTECH-Wudil, Kano state. The population of undergraduate students in both faculties is estimated at 20,000. Result from Table 4.1 revealed that higher percentage of the student in both faculties were between 'strongly agreed' and agreed' to the cases that was represented to them in regards to their attitude with percent of 43.3 and 47.9 respectively for FASTE and FASCI. In summary about the operation of computers revealed that students in FASCI can operate computer efficiently more than students in FASTE. Also, FASTE has more students who have been operating computers before gaining admission and computer ownership. It's recommended that sufficient funds should be made available for the provision of ICT tools in all Nigerian tertiary institutions including Aliko Dangote University of Science and Technology Wudil, Kano State and Teachers in sectors of learning should make use of ICT in setting exam questions for students. Students should be given proper orientation on the modalities of e-exams. This may go a long way in changing wrong ideologies or thoughts and thereby creating a clean slate for easy assessment.

Keywords: Students' Perception, Attitude, Electronic Examination**.**

Background to the Study

The electronic examination is a form of summative and formative assessment which is timed, scheduled, supervised and evaluated using computer systems and programmed application and operating system. However, the electronic examination makes marking easy, saves time and reduces logistical engagement and waste of resources such as pen, papers, booklets etc. The exposure and development of electronic examination was driven by Information and Communication Technologies (ICTs) According to Yusuf & Umar (2018) who maintained that ICTs have potential to accelerate, enrich and deepen skills to motivate and engage students to help relate school experience to work practice as well as strengthening teaching and learning and helping school change. Without misconstruing the concept, ICT is a modern pillar of development in education sector.

The perception of students towards electronic examination is the way students think, believe and feel about electronic examination. The internet and ICT provide useful solutions in the education field that electronic exams have been understood as one method of course evaluation (AL- Mashaqbeh & Al Hamad, 2010). This study will make us understand what students feel or think towards electronic examination. The attitude of students towards e-exam can be defined as the character portrayed by students towards electronic examinations, students' attitude towards e-exam determines their ability and willingness towards it. This study will examine students' attitude towards electronic examination.

Electronic examination is suitable in both educational and pedagogical aspects. (Bassey et al, 2007). Examination on its own is one of the best methods of assessing the knowledge and ability of an individual. Valid and reliable assessment improves the quality of learning, teaching and academic programs (Dermo, 2009, Rastgoo, Namvar, & Iran, 2010) and is important for learners, teachers, and educational institutions. Also, various methods have been employed in examining the capability of an individual, starting from manual means of using paper and pencil to electronic, from oral to written, practical to theoretical and many others. Examination is a medium that is mostly used in schools and other non-school setting for measurement and evaluation of performance after a lesson, lecture, within a session and after a session or for the purpose of recruitment. Academically, it occurs at the end of semester, term or session in order to determine how well the student has understood what has been taught and also to assess the performance of the student. At every level of education such as the primary, secondary or tertiary institution, every student is subjected to examination after a successful completion of semester or term studies. During the examination period, halls are prepared, examination questions are set and invigilators are available to oversee the conduct of the examinations at designated venues.

In this present dispensation, technology has made it easier for us by introducing electronic examination to schools and organizations; this makes it easier for teachers or instructors to assess students and also to monitor students' progress. Terzis and Economides (2011) pointed out that the effective development of an electronic examination depends on students' acceptance towards it. In the olden days, examination questions were handwritten then typed (using typewriter) before administering on the candidates, this is now an old fashion with the introduction of computer system that takes less time to produce examination questions with higher quality. Over the last quarter of a century, the increasing availability of information and communication technologies (ICTs) has resulted in changes in terms of teaching and learning systems across educational sectors (Sarkar, 2012) Progressively, after several testing using computer network, applications and other facilities, electronic examination was introduced, this is referred to as e-exam.

Effective online formative assessment can make students to be committed to their academics and can motivate them to study ahead of the teacher. Regardless of the assessment type, an electronic exam is a way to demonstrate student's individual performance. As Chien, Wu, and Hsu (2014) have cited from several sources regarding the importance of people's attitudes, opinions and views on this technology, studying users' attitudes towards this technology is important. Furthermore, with an electronic exam in a camera-controlled room the students can be identified more carefully compared to, for example, online exams. There are several factors that affect the performance of learners during an electronic examination, such as the quality of a computer screen; however, there are other factors that are less noticeable, for instance, the testers' attitude to electronic testing (Tella & Bashorun, 2012). The aspect of ICT that has brought about the revolution in students' learning is e-learning. It is learning that is enabled by the application of digital technologies such as web pages, video Conference systems and CD-ROMs.

It is important to realize that learners are both emotional and intellectual; and emotions have much effect on people's perception and what they do (Ndume, 2008).Previous studies on attitudes towards electronic examination have focused on teachers' beliefs rather than students' attitudes towards electronic examination, as is observed in the study of Chien et al. (2014), Jamil, Tariq, Shami, and Zakriys (2012)

and J.-Y. Kim (2015).It is important to know how students use and experience e-learning/technology in their learning activities as this will aid in the development of tools, pedagogy and teaching Practice. This study is for the researcher to carry out a survey by preparing questionnaires in other to examine the perception and attitude of students towards electronic examination in Aliko Dangote University of Science and Technology Wudil, Kano State.

Statement of the Research Problem

There are numerous variables that impacts on student's performance when questions are presented on a computer, such as the quality of the monitor (Schenkman, 1999). According to Tella (2012), an individual's attitude and perception is an important variable in the learning process. The attitude and perception of students have implicated their general performance. It is therefore imperative to understand students' perceptions and attitude towards e-exams as it is formed in the process of experience and their changes is possible due to internal and external factors. Hlvaka (1992) observed that research assessing the attitude and perception of the undergraduate to a computer-based test is lacking. This fact that few literatures exist in this regard, is a reflection of the reason that a research such as this is being carried out. This research has never been conducted in the context of comparing attitude and perceptions of students of campuses in Aliko Dangote University of Science and Technology Wudil, Kano State. Therefore, this study seeks to fill the existing gap by assessing students' response to e-exams in Aliko Dangote University of Science and Technology Wudil.

Aims and Objectives of the Study

The aim of this study is to determine students' perception and attitude towards electronic examination in Aliko Dangote University of Science and Technology Wudil, Kano State specifically; the objectives of the study are to;

i. Investigate the perception of students towards electronic examination in Aliko Dangote University of Science and Technology Wudil.
ii. Assess the attitude of students towards electronic examination in Aliko Dangote University of Science and Technology Wudil.

Research Questions

The following research question guided the study;

i. What is the attitude of students towards electronic examination?
ii. What is the perception of students towards electronic examination?

Methodology

The research design that was employed is survey research design. The survey research is the type of research in which group of individuals are studied by collecting and analysing data from only few individuals which are considered to be representative of the entire group. The population of the study consists of undergraduate students in Faculty of Science and Technology Education (FASTE) and Faculty of Science (FASCI) ADUSTECH-Wudil, Kano state. The population of undergraduate students in both faculties is estimated at 20,000. Samples were drawn using simple random sampling. For the purpose of this study, Simple Random Sampling technique was adopted because it is the most basic form of sampling. Due to complexity in size of the population, every member of the population was not captured but by using this technique, everyone has equal chance of being selected. Therefore, Questionnaire on students' perception and attitude towards electronic exam in ADUSTECH-Wudil, were administered to the ABOVE mentioned, the tools used for analysing the data obtained from the questionnaire, was Microsoft excel for descriptive statistics and Statistical Package for Social Science (SPSS) for inferential statistics.In the process of validation, copies of questionnaire were given to experts in Technology education; these experts were expected to review the research questions and the questionnaire carefully to determine the appropriateness and adequacy of the instrument.

Results and Discussion

RQ 1. What is the attitude of students towards electronic examination?

Table: Attitude of Students towards Electronic examination in both faculties

Statements	FASTE					FASCI			
	SA	**A**	**U**	**SD**	**D**	**SA**	**A**	**SD**	**D**
Introduction of E-exams is a good development	73.5	21.4	0	1.5	3.6	71.4	24	5	4.1
E-exams suitable for any Course	56.6	15.3	0	9.7	18.4	62.2	23.5	1.5	11.7
E-exams is a better means of assessment than pen-paper system	57.7	19.4	1.5	9.7	11.7	65.3	15.8	4.1	12.8
E-exams have high failure rate	28.6	32.1	4.6	21.4	13.3	23	37	14.8	11.2
E-exams is more Secure than pen-paper system	56.6	24.5	2.0	2.6	14.3	64.8	24.5	1.5	8.2
E-exams is more stressful than paper-pen based exams	35.7	24.5	0	7.1	32.7	60.2	17.3	9.2	10.7
E-exams in unreliable	26	23.5	7.1	10.7	32.7	43.9	31.1	11.7	10.7
Easier to cheat in E-exams	28.6	19.9	2	3.6	45.9	21.9	20.9	10.7	44.4
At disadvantage when undertaking E-exams	40.8	18.9	2.6	6.1	31.6	29.6	31.1	9.7	27.6
E-exams to replace pen-paper based exams	33.2	28.1	5.1	17.3	16.3	34.2	24.5	22.4	10.7
E-exams help in improving learning	38.8	27.6	3.1	12.8	17.9	50.5	23	8.2	14.8
Mean Percent	**43.3**	**23.2**	**3.5**	**9.3**	**21.7**	**47.9**	**24.8**	**8.9**	**15.2**

Source: Field Survey, 2021

Where; SA= Strongly Agree, A= Agree, U= Undecided, SD= Strongly Disagree, D=Disagree

The data presented in Table 4.1 shows the percentage of student's attitude towards e-exams from both Faculty of Science and Technology Education (FASTE) and Faculty of Science (FASCI). It was observed from the mean percentage that most students from both Faculties 'strongly agreed to the questions asked about their thoughts on e-exams, while lesser students strongly disagreed to most of the questions asked. It is worth noting that the ratio of the attitude of students in FASTE to that of FASCI is high, with FASTE holding more ratio than FASCI students.

4.2 RQ 2. What is the perception of students towards electronic examination?

Table 1.2 Perception of students towards Electronic examination in faculties

Statements	FASTE					FASCI			
	SA	**A**	**U**	**SD**	**D**	**SA**	**A**	**SD**	**D**
There are adequate facilities to undertake e-exams	21.4	41.8	5.6	13.8	17.3	5.6	48.5	16.8	24.5
E-exam provides essay process to write examination	16.8	39.8	13.8	15.3	14.3	4.6	52	13.3	23.5
E-exams provides opportunity to obtain good grade	10.7	34.2	12.2	26.5	16.3	7.1	52.6	22.4	14.3
Computer Application and Server fail during E-exams	12.8	15.8	29.6	40.8	0	16.3	14.8	23	44.9
Technical Problems during exams make E-exams impractical	20.4	14.8	2	16.8	45.4	26	16.3	3.6	12.8
Time allocated for E-exams is Fair	36.2	37.8	1	12.2	12.8	44.9	40.8	5.1	4.1
Format of questioning in e-exams is fair	32.7	41.8	1.5	5.1	18.9	22.4	40.8	2.6	32.7
Mean Percent	**21.6**	**30.2**	**9.4**	**18.6**	**17.8**	**18.12**	**37.9**	**12.4**	**22.4**

Source: Field Survey, 2021

Where; SA= Strongly Agree, A= Agree, U= Undecided, SD= Strongly Disagree, D=Disagree

Table 4.2 highlights the percent of perception of students on e-exams. It can be observed that there is consensus in the response in regards to the questions asked from both students of the campuses under study. It is further observed from the mean percent that 30.2% students in FASTE agreed to the questions asked while 37.9 percent in FASCI agreed to the cases they were exposed to, and few responses 17.8% and 22.4% were in disagreement in both campuses respectively.

Summary of Findings

This project is basically on the survey of students' perception and attitude towards electronic examination in Aliko Dangote University of Science and Technology Wudil, Kano State. The questionnaire administered to students was divided into 4 major sub-topics which include; Demographic Data of the Respondents, General Computer Skills, Attitude towards E-examination, and Perceived Impact of E-examination. 8 departments from both campuses were selected randomly for this research and this lasted for the period of 6weeks.

Observations about the operation of computers revealed that students in FASCI can operate computer efficiently more than students in FASTE. Also, FASTE has more students who have been operating computers before gaining admission and computer ownership.

Conclusion

The study clearly indicated that the attitude of students towards e-exams in both campuses (FASTE and FASCI) is significantly different for each other. Also, the perception of students on e-exams is not significantly different on both campuses. These implications may have positive or negative impact on students' performance level undergoing e-exams in respect to the campus the student base.

Recommendations

To ensure that Electronic Examinations are extensively used in Nigerian tertiary institutions, the following recommendations are put forward;

1. Students should be given proper orientation on the modalities of e-exams. This may go a long way in changing wrong ideologies or thoughts and thereby creating a clean slate for easy assessment.
2. This study focused on perception and attitudes between students in FASTE and FASCI. Further studies should be carried out to assess the implication of these attitudes and perceptions on performance of students undergoing e-exams.
3. Sufficient funds should be made available for the provision of ICT tools in all Nigerian tertiary institutions including Aliko Dangote University of Science and Technology Wudil, Kano State.
4. Teachers should make use of ICT in setting exam questions for students.

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PRE-SERVICE SCEINCE EDUCATION TEACHER'S PERCEPTION ON TECHNOLOGY-BASED LEARNING IN COLLEGES OF EDUCATION IN KANO STATE, NIGERIA

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Abstract

*The purpose of this study is assessing technology-based learning among pre-service Science Education teachers in colleges of education in Kano State. A descriptive cross-sectional survey was adopted for this study. 2452 pre-service Science Education teachers in colleges of education in Niger State form the population of the study. 277 pre-service teachers (127 of which are male and 150 female) were selected as the sample size using Taro Yamene's formula for sample size determination, purposive sampling was employed to select Federal College of Education Kano and Federal College of Education Technical Bichi, and random sampling was used to select NCE II pre-service teachers. Three research guided the study. The data were collected using structured questionnaires on pre-service teachers' perceived usefulness, ease of use and behavioural intention to adopt technology-based learning for instruction. The data were analysed using Mean and Standard Deviation. The findings of the study showed that pre-service Science Education teachers perceived technology based learning useful and easy to use for instruction and their behavioural intention was also positive with grand mean of 3.30, 3.74 and 4.05 respectively. It also shows that female had higher mean rating ($\overline{X}$= 37.21, SD = 2.30 & $\overline{X}$ = 33.11, SD = 2.54**)** than their male ($\overline{X}$ = 37.55, SD = 1.91 & $\overline{X}$ = 32.83, SD = 2.55) counterparts on the perceived usefulness and ease of use of technology-based learning. It also revealed that male had higher mean ($\overline{X}$ = 40.88 & SD = 1.64) rating than their female ($\overline{X}$ = 40.24 & SD = 1.56) counterparts on the behavioural intention towards of technology-based learning. It was concluded that technology is perceived useful and user friendly among the population. It was recommended among others that, since technology-based learning is seen as useful and easy to use by the pre-service teachers lecturers should be ready to use it as one of the technique to be employed in classroom teaching and learning; 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.*

Keywords: Technology-Based Learning, Pre-Service Science Education Teachers, Colleges of Education

Introduction

The focus of 21st-century education must be on the integration of Information and Communication Technology (ICT) into teaching and learning. The application of computer technology in the classroom environment is vital in enhancing teaching and enriching learning (Falode, 2018). Technology integration includes educational software, computers, simulations, and other resources that enhance learning. One significant benefit of modern technology is the advent of technology-based learning (TBL). The importance of technology-based learning (TBL) cannot be overstated, including accessibility for all students, learning that matches learners‟ needs, timely updates, immediate feedback, and captivating learners‟ attention during learning, and encouraging critical thinking and creativity, among others.

Technology-based learning (TBL) involves the use of electronic technology, either partially or entirely. This can include online and web-based education, intranet sites, audio and video conferencing, internet chat rooms, simulations, electronic gaming, CD-ROMs, and various mobile options. Ghavifekr and

Rosdy (2015) have concluded that TBL involves the use of electronic technology such as the internet, intranet, audio and video conferencing, and webcasts, among others. Planning and policy-making are necessary for implementing technology-based teaching and learning in schools. Researchers and policymakers must work together to achieve this. The education system has changed rapidly with the development of learning technologies in the late 20th century, offering a proactive, easy access, and comprehensive teaching and learning environment. Ejoh (2020) stated that in developing countries like Nigeria, evaluating teaching and learning initiatives is essential to identify a model that will best suit schools and skill development for students.

Several models have been developed to address users' responses to new technologies for learning, such as the technology acceptance model (TAM). According to Bumin et al. (2019), the widespread usage of every new technology requires acceptance and adoption. TAM is one of the most commonly used behavioral models, predicting individual acceptance and use of new information technology (Davis et al., 1989). TAM uses the theory of reasoned action (TRA) as a theoretical basis but replaces attitude measures with two technology acceptance measures: ease of use (EOU) and perceived usefulness (PU). TAM posited that EOU and PU, not attitude, ultimately determine a person's behavioral intention to use information technology (IT) (Davis et al., 1989). PU refers to the belief that using a specific IT will enhance job performance, while EOU refers to the expectation that using a specific IT will be relatively easy (Davis, 1989). TAM suggests that an application that is perceived to be easier to use than another is more likely to be accepted by the user because effort is a finite resource that a person may allocate to various activities for which he or she is responsible.

In TAM, PU is directly impacted by EOU, with intention to use mediating actual system use (Davis, 1989). Attitude to use concerns the user's evaluation of the desirability of using a particular information system application (Davis, 1989). Attitude toward technology is defined as an "individual's positive or negative feelings (evaluative effect) about using a specific technology" (Venkatesh et al., 2012). It determines the learner's willingness and psychological readiness to pay adequate attention to the concept learned. Positive attitude towards technology use will produce quality education.

However, the inadequate resourcing of technology and instructional materials to engage learners is a concern in Nigeria (Suleiman *et al.*, 2020; Zakariya, 2017). The education system faces challenges, including limited available funding to meet the changing technology demands in sub-Saharan Africa and Nigeria (Awofala & Lawani, 2020; Solomon & Fidelis, 2018). With the United Nations Educational, Scientific, and Cultural Organization (UNESCO) recommending a 26% budgetary allocation and Nigeria allocating less than 10% on education, funding challenges need to be highlighted (Ukaigwe & Nwosu, 2019). The National Teacher Education Policy (2014) enforced the need for quality teachers and instruction with its objective "to produce highly knowledgeable, skilled, and creative teachers who are capable of producing students who can compete globally".

Globally, every nation strives towards the provision of quality education for its citizens through quality teaching and learning because of the realisation that education is necessary to engineer and consolidate any nation‟s developmental process. However, achieving quality education would be a mirage if teacher training programmes are not in good shape. Teacher training programme refers to a programme that is geared towards the development of teachers‟ proficiency and competence that would enable and empower the teachers to meet the requirements of the profession and face the challenges therein (Oancea, 2014). The professionals who engage in this training are called teacher educators (Allen, 2011). Those primarily enrolled in teacher training programmes are often referred to as pre-service teachers. Pre-service teachers are those who will work in the educational sector of the economy to contribute their quotas towards making Nigeria a developed nation. Pre-service teachers are students who are studying educational courses or learning the art of teaching profession in various higher institutions of learning

(Tukura & Falode, 2020). Gender is a general term which refers to the sexual categories of male and female.

Gender is the socio-cultural constructed characteristics and roles which are ascribed to males and females in any society (Nannim, 2018). Cislaghi and Heise (2019) defined it as the social meaning of being male or female, including the construction of identities, expectations, behaviours, and power relationships that derive from social interaction. There are a lot of arguments about the character of males and females in education concerning adopting or rejecting a new technology. For instance, the results from the work of Gambari *et al.* (2013) and Yaki *et al.* (2020) indicated that there is no significant difference in the perceived usefulness between male and female teachers and students. But the results of Egbo *et al.* (2011) and Ramírez-Correa *et al.* (2015) indicated a few statistically significant differences between males and females when adopting ICT and e-learning platforms, according to the tested models. However, unless the hypotheses have been tested, the researcher cannot conclude yet that there exist (or not) some significant differences between male and female pre-service teachers‟ perceptions of technology-based learning. These tools, ranging from computer-assisted instruction to collaborative and social learning platforms, are user-friendly and easily accessible. Therefore, it is imperative to assess how Pre-service Science education Teachers in Colleges of Education in Niger State are utilizing technology-based learning platforms.

Statement of the Research Problem

Science education can be a difficult subject for many students, especially those who only learn through textbooks in traditional classrooms. The abstract nature of Science education often makes it seem boring and hard to understand. Educators must find ways to make Science education more enjoyable for students. Experimental and inquiry-based learning are two approaches that teachers can use to make Science education lessons more engaging. However, these methods face challenges in many learning contexts, from post-primary schools to tertiary levels. The main issues include the cost and availability of resources such as reagents, chemicals, specimens, and apparatus, as well as overcrowded laboratory spaces, time limitations, and ethical considerations. Other challenges include incomprehensible processes, self-doubt, visual disturbances, difficulty using apparatus, and limited instructional guidance.

To address these challenges, the researcher suggests using technology-based learning (TBL) to stimulate students' interest and help them develop a positive attitude towards Science education. This is particularly important for students pursuing courses in Medicine, Pharmacy, and Nursing. The study aims to determine if pre-service teachers in Niger State are ready to adopt TBL as an instructional delivery strategy and if they perceive it as useful and easy to use. With the increasing digitalization of schools and tertiary institutions, the adoption of TBL may provide a suitable strategy for effective teaching and learning of Science education. The study on Technology-Based Learning among Pre-service Science education Teachers in Colleges of Education in Kano State aimed to fill the gap in research on this topic in the Nigerian context.

Aim and Objectives of the study

The study aimed at “assessing technology-based learning among pre-service Science education teachers in Colleges of Education in Kano State. The objectives of the study are to;

1 determine the pre-service Science education teachers‟ perceived usefulness of technology-based learning in Colleges of Education in Kano State.
2 determine the pre-service Science education teachers‟ to perceived ease of use of technology based learning.
3 determine the behavioural intention of pre-service Science education teachers towards technology-based learning.

Research Questions

The following research questions guided the study;

i. What is the pre-service Science education teachers' perceived usefulness of technology-based learning in Colleges of Education in Kano State?
ii. What is the pre-service Science education teachers' perceived ease of use of technology-based learning in Colleges of Education?
iii. What is the behavioural intention of pre-service Science education teachers towards technology based learning in Colleges of Education?

Methodology

This study adopted a cross-sectional survey design. Surveys are conducted to gather information that reflects the population's attitudes, behaviors, opinions, and beliefs that cannot be observed directly. The success of survey research depends on how closely the answers that people give to survey questions match how people think and act in reality (Arevik, 2014). In a cross-sectional design, data are collected from many different individuals at one point in time, the researcher can only observe variables without influencing (manipulating) them. It is a cost-effective and easy way to gather initial data and identify correlations that can then be explored in a longitudinal study (Thomas, 2020).

The population of this study comprises of 2452 pre-service Science education teachers in Colleges of Education in Kano State, and the target population is 897 NCE II pre-service Science education teachers. This is because they have spent one academic session in the school and have covered a large volume of the syllabus, hence the desired result is guaranteed. The population is presented in a tabular form below;

Table 1.1 Population of all pre-service Science education teachers in Colleges of Education in Kano State.

S/N	INSTITUTION	POPULATION
1	Federal College of Education, Kano	1379
2	Federal College of Education, Technical Bich	1073
TOTAL		**2452**

Source; (Head of Departments office 2021)

The study adopted a multi-stage sampling technique to carefully select the respondents. Purposive sampling was employed to select two F.C.E Kano and F.C.E T. Bichi because they are the part of the colleges that offer Science education and other science education courses. NCE II preservice teachers were then randomly selected using simple random sampling method.

Results and Discussion

Answers to Research Questions

Research Questions One: What is the pre-service science education teachers' perceived usefulness of technology-based learning in Colleges of Education in Kano State? To answer this research question, the mean and standard deviation was employed, and the analysis is presented in Table 1.2**.**

Table 1.2: Mean and Standard Deviation of pre-service Science education teachers perceived usefulness of technology-based learning

S/N	ITEMS	N	X	SD	DECISION
1	Technology-based learning makes me think critically on how to achieve my learning objectives.	277 4.08		.435	Agree

2	I experience fulfilment each time I download Science education lecture materials online.	277	4.17	.379	Agree
3	Technology-based learning motivate me to learn, thereby enriching my understanding of the concepts of Science education	277	4.22	.413	Agree
4	Technology-based learning provide a stimulating Science education learning environment, and utilizing it is such a good idea	277	4.10	.382	Agree
5	Technology-based learning captivates learners‟ attention during learning through graphics and pictures	277	4.14	.348	Agree
6	I experience technophobia (technological anxiety) when utilizing technology-based learning platform to study Science education	277	2.21	.824	Disagree
7	Technology-based learning maximizes interactivity among students. Utilizing it in the teaching and learning of Science education will enhance creativity	277	4.08	.362	Agree
8	People remember less of what they hear, more of what they see and hear, and most of what they see, hear and do. The fact that the computer can exercise various senses and present information in a variety of media can enhance the learning process	277	4.06	.334	Agree
9	The potential benefit of technology-based learning is accompanied with some challenges that may have negative impact on the learners, hence the aim of integrating it into teaching and learning of Science education might be defeated	277	2.21	.803	Disagree
10	Using technology is an innovation, I will seek opportunities to adopt it for learning of Science education concepts	277	4.10	.302	Agree
	Grand Mean		**3.74**		**Agree**

Table 4.1 shows the results of pre-service Science education teachers‟ perceived usefulness of technology based learning. The average mean of 3.0 was the bench mark for agree and less than 3.0 for disagree on each item. Consequently, items 1-5, 7, 8 and 10 shows the mean of between 4.08– 4.22 and the grand mean of 3.74, indicating that technology-based learning is perceived as useful for learning of Science education concepts. The finding of item 6 (X=2.21) and 9 (X=2.21), which are negative items show that the respondents did not agree that they experience technophobia when utilizing technology-based learning and the aim of integrating it into teaching and learning of Science education might be defeated.

Research Question Two

What is the pre-service Science education teachers‟ perceived ease of use of technology-based learning in Colleges of Education?

Mean and standard deviation was used to answer this research question, and the analysis is presented in Table 1.3

Table 1.3: Mean and Standard Deviation of pre-service Science education teachers' perceived ease of use of technology-based learning

S/N	ITEMS	N	X	SD	Decision
1	I can use technology to learn with less or without any form of assistance.	277	3.60	763	Agree
2	Utilizing technology-based learning for learning Science education is easy and user friendly	277	4.17	.379	Agree
3	I find technology-based learning very flexible for learning Science education concepts	277	4.22	.413	Agree
4	Using digital technology is easy, simple and understandable	277	3.58	.778	Agree
5	I get stressed by the use of digital technologies for learning purpose	277	2.58	.850	Disagree
6	I find it cumbersome to use digital technologies	277	1.91	.371	Disagree
7	I need to consult the user manual often when using digital technologies	277	1.97	.293	Disagree
8	Revising my course-wares is easier with technology based learning	277	3.57	.798	Agree
9	I find it easy to recover from errors encountered while using digital technologies	277	3.60	.763	Agree
10	I am rarely frustrated when using the digital technologies	277	3.77	.622	Agree
	Grand Mean		**3.30**		**Agree**

Table 4.2 presents the results of pre-service Science education teachers" perceived ease of use of technology-based learning. The average mean of 3.0 was the bench mark for agree and less than 3.0 for disagree on each item. However, items 1–4 and 8–10 shows the mean of between 3.57– 4.22, and the grand mean of 3.30, indicating that technology-based learning is perceived as easy to use in learning of Science education concepts. The finding of item 5-7 (X=2.58, 1.91 & 1.97), which are negative items show that the respondents did not agree that they; get stressed, found it cumbersome, need to consult the user manual often when using digital technologies.

Research Question Three

What is the behavioural intention of pre-service Science education teachers towards technology-based learning in Colleges of Education?

Mean and standard deviation was used to answer this research question, and the analysis is presented in Table 4.3

Table 4.3: Mean and Standard Deviation of the behavioural intention of pre-service Science education teachers towards technology-based learning

S/N	ITEMS	N	X	SD	Decision
1	I consider technology-based learning as innovation, and I am ready to adopt it for learning of Science edu.	277	4.12	.418	Agree
2	I believe that I possess adequate skills to use digital technologies for learning of Science education	277	3.71	.635	Agree
3	Based on my experience, I am very likely to use digital technologies in my learning	277	4.11	.502	Agree
4	I think it is valuable to use technological tools in learning.	277	4.14	.348	Agree
5	I am ready to accept and adopt technology-based learning for all Science education courses with enabling environment	277	4.14	.348	Agree
6	It is a positive influence for me to use technology in learning of Science education concepts	277	4.04	.204	Agree
7	Technology-Based Learning would increase my level of productivity	277	4.14	.348	Agree
8	I basically intend to utilize technology-based learning for learning Science education	277	4.10	.302	Agree
9	I plan to use technology-based learning very often in future learning	277	3.96	.196	Agree
10	I will recommend the utilization of technology based learning in the Science education classes	277	4.07	.259	Agree
	Grand Mean		4.05		Agree

Table 4.3 presents the results of the behavioural intention of pre-service Science education teachers towards technology-based learning. The average mean of 3.0 was the bench mark for agree and less than 3.0 for disagree on each item. The results indicates that, items 1-10 shows the grand mean of 4.05, translating that pre-service Science education Teachers have positive attitude towards technology-based learning.

Discussion of the Findings

The study's findings clearly demonstrate that pre-service Science education teachers view technology-based learning as highly valuable for comprehending Science education concepts. These findings are consistent with the research of Al-Aulamie (2013), which identified perceived usefulness as the most significant determinant of behavioural intention among the proposed variables. Additionally, Muniasamy et al. (2014) showed a positive relationship between perceived usefulness and behavioural intention of e-learning systems in Saudi Arabia, while Abdullah and Toycan (2017) and Tanduklangi (2017) concluded that students' perceived usefulness has a positive influence on their intention to use LMS. Similarly, students in an e-learning environment (Shah et al., 2013), websites for learning (Sharma & Chandel, 2013), library mobile applications (Yoon, 2016), and e-portfolios (Abdullah et al., 2016) all

reported the same result. Liao et al. (2018) discovered that users' perceived usefulness and perceived ease of use could directly impact their willingness to adopt an e-book production assessment system, while Mohammed et al. (2019) found that students perceived the usefulness and ease of use of the WhatsApp platform for learning Science education to be positive.

Furthermore, pre-service public undergraduate teachers have a positive perception of computer based examinations (Yaki & Gaiya, 2020), and preservice teachers have positive perceptions regarding the perceived ease of use, perceived usefulness, and behavioural intentions to adopt Computer-Based Examination. Akhigbe *et al.* (2021) disclosed that pre-service teachers have positive perceptions regarding the perceived ease of use, perceived usefulness and behavioural intentions to adopt collaborative mobile learning as a pedagogical alternative to face-to-face instruction.

This research contradicts the findings of Park (2009), who found that perceived usefulness does not have a positive influence on students' intention to use LMS in South Korea. However, in line with previous literature regarding technology acceptance, this research posits that perceiving technology-based learning as useful leads to pre-service teachers' intention to use the system. It is noteworthy that Nikolopoulou and Gialamas (2013) reported teachers' negative attitudes towards digital technology for teaching, which could be attributed to their negative perceptions

The study further reveals that pre-service teachers have a positive behavioural intention towards technology-based learning. This finding supports that of Alharbi and Drew (2014) who conducted a research study on the use of Technology Acceptance Model to examine academics‟ behavioural intention to use technology such as learning management systems. They found that respondents‟ perceived usefulness, perceived ease of use, and behavioural intention towards technology integration was positive. This finding could be attributed to pre-service teachers perceive usefulness and ease of use of digital technology which could have influenced their intention to adopt technology-based learning.

Taher (2012) reveal that students' perception of ease of use, usefulness, attitudes towards online learning, and the social influence of students' referent group were identified as significant determinants of students' intention to practice online learning.

Conclusion

Based on the findings of this study, it can be concluded that technology-based learning is perceived by pre-service teachers as both useful and easy to use. Furthermore, their intention to adopt technology-based learning is positive. Technology is seen as a useful tool that can enhance learning at all levels of education. Therefore, integrating technology into classroom instruction is an important topic in educational discourse. The findings show that technology has infiltrated the personal and instructional life of pre-service teachers, as demonstrated by their positive perception and intention to integrate technology into classroom instruction. Respondents perceived technology to have no or minimal negative effects, making technology-based learning a friend rather than a foe.

Effective technology integration must begin at the very first stage, ensuring that pre-service teachers can make the best use of it. Proper implementation and support by school management are crucial for the success of technology-based learning. Teachers must be given time to learn and explore technology-based learning, facing the "trial-and-error" phase before they are completely comfortable with its usage for teaching and learning. Technology-based learning components promote active learning and ownership of the learning experience for students. It provides students with immediate opportunities to research topics they are studying in class and build on information acquired from traditional classroom instruction. The use of technology in teaching and learning is more about practicality than theories, and it can provide students with access to the best programs offered by a variety of educational institutions.

Recommendations

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

According to the study, technology-based learning is both useful and easy for pre-service teachers to use. Therefore, lecturers should consider utilizing it in the classroom to enhance teaching, stimulate interest, and improve academic performance. In order to effectively implement technology-based learning, devices should be provided for use in Colleges of Education.

The study also found that pre-service teachers have a positive attitude towards technology based learning. Therefore, the National Commission for Colleges of Education and other stakeholders should create an enabling environment for their effective use of technology based learning platforms. Regular orientations, symposia, conferences, seminars, and workshops should be organized to keep pre-service teachers up-to-date with the latest technological trends.

Gender-related issues are still a concern when it comes to technology acceptance and use. Policymakers should be aware of potential gender differences related to technology use and take steps to address them. Teachers should also encourage all students, regardless of gender, to feel confident about using computers.

To support the integration of technology into education, government, non-governmental organizations, alumni associations, and other association should provide schools with necessary infrastructure, such as computer systems, software, manpower, and routine maintenance.

Additionally, more research should be conducted in this field, and funding should be provided by organizations such as the National Educational Research and Development Agency and other research institutes.

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AVAILABILITY AND UTILIZATION OF AUDIO-VISUAL TEACHING RESOURCES IN SENIOR SECONDARY SCHOOL KANO METROPOLIS

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Abstract
This study examined the availability and utilization of audio-visual teaching resources in senior secondary schools in Kano Metropolis. The design was made along the lines of a descriptive survey while the study population comprised all the secondary schools in Kano Metropolis. The sample consisted of two (2) randomly selected secondary schools and seventy-nine (79) respondents drawn randomly from the study population. The instrument used to collect data for the study was a questionnaire titled "Availability and Utilization of Audio-Visual Teaching Resources" (AUAVTR)" while the data collected was analysed using mean and percentage. The findings showed that audio-visual teaching resources are available but are not utilized in senior secondary schools in Kano Metropolis. The null hypothesis was tested for the study at 0.05 level of significance. The finding revealed that, there was no significant difference in the gender of teachers and the utilization of audio-visual teaching resources at senior secondary schools; The study recommended among others that, the government and secondary school management authorities should make adequate provision for funds to enable secondary schools acquire audio-visual resources and effectively utilize them for teaching and learning.

Introduction
The use of audio-visual teaching resources has been considered to be vital in classroom teaching and learning. Saidu (2016) opined that learning can be reinforced with different teaching and learning resources because they stimulate, motivate as well as capture the learners' attention during the instructional process. It is due to the aforementioned reasons that audio-visual teaching resources are now being adopted as a tool for effective teaching and learning. When audio-visual materials or resources are used alongside teaching, there is a high tendency for knowledge retention and proper storage of information disseminated by the teacher. Ho and Intai (2018) noted that the use of a teacher-centered approach and the traditional methodology used in teaching made the subjects and topics taught to students appear abstract. Teaching and learning can be considered as boring if audio-visual resources are not put to use. Shabiralyani et al (2015) observed that people generally remember 10% of what they read, 20% of what they hear, 30% of what they see, 50% of what they hear and see, 70% of what they say, and 90% of what they say as they do a thing. Considering the fact, that audio-visual resources are capable of stimulating the senses of hearing and seeing simultaneously and allow for interaction between the resources and the students, it is noteworthy of commending the use of audio and visual resources in teaching and learning.

Audio-visual is defined as the mix of different digital media types such as text, images, audio and video into a coordinated multi-sensory interactive application or presentation to convey a message or information to an audience. Audio-Visual teaching resources are the types of designated teaching and learning materials that may be locally or commercially produced. They appeal both to the sense of seeing and hearing. They come in various forms, such as; charts, illustrated pictures, pictorial materials and other two-dimensional objects (2D) and three-dimensional objects (3D).

Zainuddin (2012) noted that 2 dimensional (2D) materials refer to materials with length and width. The material is flat and is not designed to provide depth. Examples include; still images, diagrams, pictures, flipcharts, graphs, posters, charts, maps etc., while 3 dimensional (3D) materials are seen as those materials

that have length, width, height, depth. Some of the examples of 3D objects include: cones, cubes, dioramas, realia, models, mockups, puppets, projectors. Audio-visual instructional materials are in the form of visuals and sound e.g. television, projector, etc. which appeal to the sense of seeing and hearing. The visual aids are important teaching and learning materials that could be used to facilitate the teaching and learning (Saidu, 2016).

Audio visual resources in teaching generally make the teaching and learning process interesting, exciting and activity based in classroom teaching. For teaching to be effective, it is necessary for teachers to make and use different types of instructional materials. For example, Biology taught in secondary school which focuses on the anatomy of living things and the various functions of the body requires the use of instructional materials to illustrate and serve as a model of what is been taught to the students. Subjects taught at secondary school levels will be better facilitated when suitable and relevant instructional materials are prepared and utilized during teaching and learning (Dhakal, 2017). For teaching and learning activities to be effective and purposeful, the teacher has to make and use appropriate instructional materials. The teacher must know the instructional materials that are available for teaching and be able to utilize them for achieving the educational objectives. This implies that the use of instructional materials is inevitable if effective teaching and learning must be achieved. When audio-visual resources are properly used, they help to consolidate learning in the learner's mind. The use of audio-visual resources therefore, becomes very crucial in improving the overall quality of the learning experiences of students. Therefore, the selection and use of audio-visual resources in teaching and learning are determined by the particular aspect of the subject that is to be taught by the teacher and what he intends to teach at a particular point in time. This study throws light to the availability of audio-visual materials and examines the extent of utilization of the available instructional materials in teaching and learning process in secondary schools.

Statement of the Problem

In teaching, most concepts are being taught theoretically with little or no efforts been put for the students to visualize what is been said. Hardly can any subject or concepts be taught effectively to learners theoretically without the use of relevant materials such as instructional media. The teaching method of some teachers may have been the major source of students performing poorly in their academics. Today most teachers still prefer to use the 'chalk and talk' or the 'marker and board' method in teaching and learning even if the available teaching resources are made available by the school. Researchers have affirmed that the utilization of audiovisual resources will greatly influence academic achievement in a subject or concept that is to be taught by the teacher by making the lesson concrete and eliminating or reducing abstraction in teaching and learning. When audio-visual resources are employed or used to complement theoretical teaching, learning will become exciting for the learners and reduces the level of boredom. Research has shown that sounds, images, animations and videos are capable of capturing learners' attention and hence motivate them to learn. This study therefore focuses on availability and the utilization of audio-visual resources in senior secondary schools in Kano Metropolis.

Aim and Objectives of the Study

The aim and objectives of this study is to investigate the availability and utilization of audio-visual teaching resources in senior secondary schools in Kano Metropolis. Specifically, the study has the following objectives:

1. To determine the availability of audio-visual resources in senior secondary school in Kano.
2. To find out if audiovisual resources are properly utilized and managed by teachers in senior secondary schools in Kano Metropolis.
3. To determine if gender of teachers plays a role in the utilization of audiovisual instructional materials in senior secondary schools in Kano Metropolis.

Research Questions

The following research questions will guide the study:

1. What are the audio-visual teaching resources available for teaching and learning in senior secondary schools in Kano Metropolis?
2. Are audiovisual teaching resources used during teaching and learning?
3. What is the influence of gender on the utilization of audio-visual teaching resources?

Research Hypothesis

The following hypotheses were formulated for this study

$H0_1$: There is no significant difference in the influence of gender of utilization of audio-visual resources in senior secondary schools in Kano Metropolis

Methodology

The research design employed for this study is a descriptive survey. This design was considered appropriate for the study considering the nature of the research problem, objective and research questions that the study aimed to address. Descriptive survey design is also a method used when gathering large-scale data in order to make generalization and to generate context free data. Therefore, the descriptive survey design was selected for this study because the data collected was used to describe the present situation with regards to the problems under investigation. The total population of the study consisted of all the teachers in senior secondary schools in Metropolitan Local Government Area of Kano state. The target population for this study is one hundred (100), teachers in senior secondary schools. The sample size consists of 79 respondents comprising of seventy-nine respondents. Among all the schools in Kano Metropolis, Kano State, two (2) were randomly selected, as shown in the bellow table:

Table 1: Sample Distribution

S/N	School	Population
1	Federal Government College Kano	38
2	Government secondary school Goron Dutse, Kano	41
	Total	**79**

The research instrument is a questionnaire titled "Availability and Utilization of Audio-Visual Teaching Resources" (AUAVTR) was used for data collection in this research. The instrument for data collection was a structured 20 items questionnaire. The questionnaire items were grouped into three sections; A, B and C. Section A handles the bio data of the respondents. The instrument used in this study was validated by two experts in the field of educational technology, this was to determine the face and content validity of the instruments. However, all necessary corrections and modifications made by the experts were effected and items or research statement(s) reconstructed based on the satisfactory comments of the validators. In a method of data collection the researcher visited the two (2) secondary schools and administered the questionnaire on the selected teachers. All the questionnaires were collected from the respondents as soon as they finished with their response. Their responses were scored and organized in tabular forms.

Results and Discussion of Findings

The purpose of the study is to determine the availability and utilization of audio-visual teaching resources in selected senior secondary schools in Kano Metropolis. This chapter discusses the data analysis, presentation of the results of data analyzed and discussion of the results. The data were analyzed using the Statistical Package for Social Sciences (SPSS) Version 25. The bio data of the respondents was analyzed using frequencies and percentage table, while the research questions were analyzed using mean and standard deviation.

A total of seventy-nine (79) questionnaire was retrieved out of the seventy (79) questionnaire distributed. This is shown in the table below based on genders of the respondents;

Table 2: Gender Distribution of students

Gender	Frequency	Percent
Male	45	57.0
Female	34	43.0
Total	79	100.0

Table 2 shows the respondents by their gender. The male respondents are greater than that of the female respondents, with the males making 57.0% of the sampled population and females making up the remaining 43.0% of the population.

Analysis of Research Questions

In the analysis of the variables, the researcher made use of the descriptive analysis. These variables are assessed independently with specific research questions and objectives as follows:

Research Question 1: what are the audio-visual teaching resources available for teaching and learning in senior secondary schools in Kano Metropolis? The response is shown in table 4.2

Table 3: Availability of audio-visual teaching resources

S/N	Items	N	Mean	S D	Decision
1	Computers are available in the classroom for teaching and learning	79	2.48	1.10	Not Available
2	Projectors are available for use when teaching in the classroom	79	2.77	0.73	Available
3	There are monitors in the classroom during instructional delivery	79	2.80	0.95	Available
4	Smartphones are available in the classroom for teaching and learning	79	2.90	1.21	Available
5	Videotapes are found in the classroom for teaching and learning	79	2.77	1.17	Available
6	Radios are available in the classroom for teaching and learning	79	3.23	1.15	Available
7	Televisions are available for visual teaching in the classroom	79	2.32	1.02	Not Available
8	DVD player are found in the classroom for teaching and learning	79	2.51	1.27	Available
9	VCD player are available in the classroom for teaching and learning	79	2.71	1.05	Available
10	Motion picture are found in the classroom for teaching and learning	79	2.09	0.95	Not Available
	Grand Mean	**79**	**2.65**		Available

Decision mean: 2.50

Table 3 shows the Mean and Standard Deviation of student's response on the availability of audio-visual teaching resources in secondary schools in Kano Metropolis. The table reveals the computed mean score of 2.48 with Standard Deviation of 1.10 for item one, 2.77 with Standard Deviation of 0.73 for item two, 2.80 with Standard Deviation of 0.95 for item three, 2.90 with Standard Deviation of 1.21 for item four, 2.77 with Standard Deviation of 1.17 for item five, 3.23 with Standard Deviation of 1.15 for item six, 2.32 with Standard Deviation of 1.02 for item seven, 2.51 with Standard Deviation of 1.27 for item eight, 2.71 with Standard Deviation of 1.05 for item nine, 2.09 with Standard Deviation of 0.95 for item ten. The table revealed further that, the grand mean score of responses to the ten items was 2.65 which was greater than

the decision mean score of 2.50. This implies the availability audio-visual teaching resources in secondary schools in Kano Metropolis.

Research Question 2: Are audiovisual teaching resources utilized during teaching and learning? The answer is revealed in Table 4

Table 4: Utilization of audio-visual teaching resources

S/N	Items	N	Mean	SD	Decision
1	Computers are utilized when teaching in the classroom	79	2.13	0.96	Not Utilized
2	Projectors are used for teaching in the classroom	79	2.52	1.18	Utilized
3	Monitors are used regularly during teaching and learning	79	2.63	0.90	Utilized
4	Smartphones are used in the classroom for teaching and learning	79	2.58	0.94	Utilized
5	Videotapes are used in the classroom to deliver instruction.	79	2.27	0.54	Not Utilized
6	Radios are used during teaching and learning	79	1.91	0.81	Not Utilized
7	Television are used to teaching and watch educational videos in the classroom	79	2.10	0.92	Not Utilized
8	DVD players are used during teaching and learning	79	2.30	0.72	Not Utilized
9	VCD players are used for classroom instruction	79	2.43	0.95	Not Utilized
10	Motion pictures are used for teaching in the classroom for teaching and learning	79	2.80	1.04	Utilized
	Grand Mean	**79**		**2.36**	**Utilized**

Decision Mean: 2.50

From Table 4, The table reveals the computed mean score of 2.13 with Standard Deviation of 0.96 for item one, 2.52 with Standard Deviation of 1.18 for item two, 2.63 with Standard Deviation of 0.90 for item three, 2.58 with Standard Deviation of 0.94 for item four, 2.27 with Standard Deviation of 0.54 for item five, 1.91 with Standard Deviation of 0.81 for item six, 2.10 with Standard Deviation of 0.92 for item seven, 2.30 with Standard Deviation of 0.72 for item eight, 2.43 with Standard Deviation of 0.95 for item nine, 2.80 with Standard Deviation of 1.04 for item ten. The table revealed further that, the grand mean score of responses to the ten items was 2.36 which was less than the decision mean score of 2.50. This implies that audio-visual teaching resources are not been utilized in senior secondary schools in Kano Metropolis.

Hypothesis Testing

$H0_1$: There is no significant difference on the influence of gender of utilization of audio-visual resources in senior secondary schools in Kano Metropolis.

Table 5: t-test for the gender difference and the utilization of audio-visual resources

Group	N	Df	$\bar{x}$	SD	t-value	p-value	Decision
Male	45		2.32	0.41			
		77			-1.11	0.26	NS
Female	34		2.42	0.29			

Not Significant at 0.26>0.05 level

The t-test for table 5 revealed that there was no significant difference on the influence of gender of utilization of audio-visual resources in senior secondary schools in Kano Metropolis. The p-value of 0.26>0.05 which was greater than 0.05 which was the level of significance, confirmed that there is no significant difference on the influence of gender of utilization of audio-visual resources in senior secondary schools in Kano Metropolis. Hence, the null hypothesis was accepted which implies there is no significant

difference on the influence of gender of utilization of audio-visual resources in senior secondary schools in Kano Metropolis.

Discussion of Findings

Findings revealed that audio-visual teaching resources are available in senior secondary schools in Kano Metropolis as the responses gave a grand mean score of 2.65 indicating the availability of audio-visual teaching resources, the grand mean scores on the availability of audio-visual teaching resources was above the established mean of 2.50. This finding is in line with Onuoha and Chukwueke (2020) who revealed that audio-visual teaching resources are available in secondary schools.

The data analyzed also revealed that there was no adequate utilization of audio-visual teaching resources in teaching Biology in senior secondary schools in Kano Metropolis, with the grand mean score of 2.36 which is below the already established decision mean of 2.50. indicating the non-utilization of graphic instructional materials which was in line with findings of Lucky and Amugen (2014) who revealed that audio-visual teaching resources are not utilized in secondary schools.

The t-test statistics also revealed that there was no significant difference in the gender of teachers and the utilization of audio-visual teaching resources in teaching of Biology at senior secondary schools as the p-value gave a score of 0.55 which was above 0.05 level of significance.

Major Findings of the Study

The following findings have been made from the research work

1. The findings of the study revealed that audio-visual teaching resources are available in secondary schools in Kano Metropolis.
2. The findings of this study also revealed that audio-visual teaching resources are not utilized in secondary schools in Kano Metropolis.
3. The findings of this study also revealed that there was no gender difference in the use of audio-visual teaching resources in secondary schools in Kano Metropolis.

Recommendations

The following can be recommended after critical examination of the responses and review of the previous literature.

1. The government and secondary school management authorities should make adequate provision for funds to enable secondary schools acquire audio visual resources and effectively utilize them for teaching and learning.
2. Education stakeholders in the country should finance provision of computers, power generator, audio-visual Aids, and expand computer laboratories in all secondary schools. This will enhance the use of computers in the teaching and learning.
3. Most of the audio-visual teaching resources available in secondary schools are not being utilized. To this end, the management of the schools should intensify efforts in ensuring effective utilization of audio-visual teaching resources available in the secondary schools.
4. The students should be frequently tutored on the use of audio-visual teaching resources as easier way of learning. This will ensure the application of proper caution in handling the audio-visual teaching resources by the students as well as embracing them in enhancing their teaching and learning processes.
5. The teachers are at the frontline of ensuring adequate utilization of audio-visual teaching resources for teaching and learning. However, most of them shy away from these devices as a result of poor knowledge on their usage. Based on this, secondary school authorities should make effort in ensuring that these teachers are trained and re-trained on the use of audio-visual teaching resources for teaching and learning.

6. Most of these audio-visual teaching resources require constant power supply for its utilization. Consequent upon this, management and authorities of secondary schools should ensure the provision of standby generators or solar panels as alternatives to the frequent power failures often experienced in the nation.

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APPLYING ADDIE MODEL IN DEVELOPING DIGITAL NERVOUS SYSTEM IN TEACHING SECONDARY SCHOOL BIOLOGY IN KANO STATE, NIGERIA

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Abstract

The study applied Analysis, Design, Development, Implementation, Evaluation (ADDIE) model in developing a digital nervous system for secondary school Biology instruction in Nigeria. Design and development research was adopted in which three research questions were raised and answered qualitatively. The finding unveiled the analysis of the objectives of secondary school Biology syllabus and documented the processes involved in the design of digital nervous system model prototype. The processes were explained in some six logical steps culminating to six stages involved in the development of the digital nervous system model. It is recommended that as the objectives of nervous system model in Nigeria secondary school Biology syllabus were identified, the model should be adopted and instructional designers should be supported by relevant government agencies like Scientific Equipment Development Institute (SEDI), Federal Ministry of Science and Technology and associations of educational technology researchers to develop instructional models in other science related concepts. This is to meet the varying needs of end users in Nigerian secondary schools

Keywords: Digital Nervous System Model, Biology, instruction

Introduction

Current developments in science and technology have greatly affected the lives of human being that is why science and technology have always been recognized as critical factors in the process of development. For continuity in life, Narula (2014) remarked that the knowledge of science and technology should be pursued by nations longing for sustainable development. In line with this, policy makers in developed and developing countries have recognized the importance of science to both social and economic growth (Dusto, 2013 & Narula, 2014). Science contributes significantly to the quality of life in many areas like health, nutrition, agriculture and industrial development. Despite its significant contribution, there is still lack of quality manpower in those areas pointing to the fact that supportive manpower training should be the focus of all stakeholders in Nigeria (Aina, 2013). Presently in Nigeria, science related subjects are taught as integrated science at junior secondary schools, and as separate subjects; Physics, Chemistry and Biology at senior secondary schools (National Policy on Education, 2004). Is this approach enough to breeds the required manpower in the present and future science and technology professions? Certainly, Nigeria needs professional scientist and skilled technologist to drive the future economy of the country. To achieve this, special attention has to be paid to science related subjects like Physics, Chemistry and Biology at senior secondary school level.

Biology is a central subject that concern human lives and also a natural science subject that includes the study of biosphere encompassing the earth's surface. It deals with the study of life and living organisms and it is the subject that is closet man as a living entity (Cimer, 2011). Considering its characteristics and importance, Biology as a subject continues to manifest at tertiary level of education as a course of study. Araoye (2009) opined that exposure to Biology education offers the learners a wide range of opportunities including careers in agriculture, medicine, surgery, pharmacy, veterinary medicine, human anatomy and a host of all other life sciences. Due to its importance, Biology is made compulsory for all science students in the Senior Secondary School Certificate Examination (SSCE) in Nigeria (Ahmed &Abimbola, 2011). At secondary school level in Nigeria, students' failure in Biology is due to poorly equipped laboratories,

inexperienced biology teachers, high population in the classes which affects class control and inappropriate choice of instructional delivery among others (Akanbi & Kolawole, 2014). Researchers have attributed students' poor performance in Biology to the abstract concepts of internally situated organs and systems which ordinarily cannot be easily accessed (Angadi & Ganihar, 2015; Hartoyo & Abdul-Gafur, 2019). Such complex internal structures include blood circulatory system, respiratory system, tissue, supporting systems and the nervous system among others (Singer, 2015).

The nervous system for example, which is internally situated in human body, transmits signals between the brain and the rest of the body. In this way, the nervous system controls the ability to move, breathe, see, think, and more (James, 2018). The basic unit of the nervous system is the nerve cell or neuron. Hartoyo and Abdul-Gafur (2019) described these concepts as abstract in nature because they cannot ordinarily be seen except when dissects are carried out on animals. However, Akanbi and Kolawole (2014) posited that conducting dissection on animals for instructional purposes are expensive and difficult to handle in ordinary biology laboratories. Therefore according to James (2018), students find learning about internally situated systems such as the nervous system difficult due to the abstractness of concepts, inadequate instructional resources and inappropriate of instructional strategies.

To achieve excellence in teaching and learning the nervous system in secondary schools, Andria, Kathy and Karen (2018) suggested that a good use of instructional strategies will not only increase students' learning outcomes but also make instructional presentation lively. Instructional strategies include all approaches that a teacher may take to actively engage students in learning. Many instructional strategies have been proposed for teaching internally situated systems, such as field trips to abattoirs, dissections, and recently video instructions among others (Oloyede & Bandele, 2015). However, Alabi (2014) noted that these instructional strategies over the years have failed to improve students learning outcomes in Biology. Hartoyo and Abdul-Gafur (2019) noted that developing a model for biology instruction will dramatically change the way knowledge is communicated and deciphered by biology students. Alternatively, an instructional strategy that could be designed to remove barriers to meaningful learning and arouse students' interest in biology is the use of a model capable of digitalizing the processes and functions of the internal organs and enhancing students' achievement (Andria *et al.,* 2018). Digital models are electronically simplified structures of reality which represent supposedly significant figures in a generalized form. That is why Salavati (2013) described models as excellent tools used in explaining abstract concepts with electronic means to replicate an object.

Aim and Objectives of the Study

The aim of this study was to apply the Analysis, Design, Development, Implementation, Evaluation (ADDIE) model in developing a digital nervous system for secondary school Biology instruction in Nigeria.

Research Questions

The study sought to answer the following research questions;

1. What are the objectives of nervous system model in Nigeria secondary school Biology syllabus?
2. What are the processes involved in the designing of a digital nervous system model prototype?
3. What are the procedures involved in the development of the digital nervous system model?
4.

Methodology

Research and Development involving the use of Qualitative research approach was adopted in the study. At analysis stage, the instructional needs, tasks and contents for the students through collection and analysis of objectives of teaching nervous system in Nigeria secondary school Biology syllabus, the objectives of teaching nervous system in Nigeria secondary school Biology syllabus were analyzed by the researcher in collaboration with Biology teachers. The Nigeria secondary school Biology syllabus as contained in the Nigerian Education Research and Development Council (NERDC) was the document used by the teachers and was consulted as reference material.

At prototype design stage, the objectives at the analyses stage are transformed into the specification for the lesson. These involves planning, carrying out illustration, demonstrations and other work. In writing the performance objectives for identified concept, the contents for each topic were highlighted and structured from simple to complex, known to unknown, abstract to concrete, with 90% coverage of the concept. As information was being gathered in the Analysis phase, the developer used the information to create an instructional design plan for the digital nervous system model. At development stage, resources needed to build and transform the planned activities were put together with the help of digital nervous system model developer, to use the instructional content to develop a nervous system model for the purpose of teaching Biology concepts.

The instrument was the developed digital nervous system model was subjected to face and content validation by Biology teachers, Educational Technology specialists from the Department of Technology and Vocational Education Training Aliko Dangote University of Science and Technology Wudil, Biology experts from the Department of Science Education Bayero University Kano in terms of appropriateness for teaching, clarity, simplicity, and suitability for the level of students. The data was analyzed using qualitative methods.

Results

Research Questions one: What are the objectives of nervous system model in Nigeria secondary school Biology syllabus?

In answering research question one, the objectives of teaching nervous system in Nigeria secondary school Biology syllabus were analyzed by the researcher in collaboration with Biology teachers.

Based on expert analysis, the objectives of teaching nervous system had been predetermined by the NERDC; the teaching process is adjudged to be full of abstraction delivered through verbal explanation; the current teaching iterations had failed to achieve the desired learning outcomes. Consequently, expert analysis revealed that the current teaching process would not deliver the objectives of nervous system in Nigeria secondary school Biology syllabus. Henceforth, modelling the nervous system and its components parts could be a step towards meeting the learner's needs. Based on the information gathered at analysis level, the model was conceptualized to be design in line with the stated objectives of nervous system for teaching secondary school Biology in Nigeria.

Research Questions two; what are the processes involved in the designing of a prototype digital nervous system model?

In answering research question two, the basic features of the model and the principles used in designing the prototype digital nervous system model were documented and described in five developmental steps as follows;

Step I: Conceptualization and mental design of the model; in response to non-actualization of the identified objectives of nervous system for teaching secondary school Biology in Nigeria. Innovative ideas were gathered from Biology teachers and the researcher who collectively conceptualized how to achieve these objectives. These ideas were further reviewed by the researcher and applied on ¾ thick design papers.

Step II: Panel review process; a critical panel review process was organised by the researcher in collaboration with educational technology experts who scrutinize the drafted design of the digital nervous system model. The panel review raised observations for improvement of the design process and these were incorporated subsequently. The final draft of the drawings was produced on thick design papers and handed over to the technicians to commence prototype production.

Step III: Armature production; the technicians after careful study of the draft, created an armature for the sculpture nervous system model with an outline of all the drafted drawings thus, giving a practical idea of

how the model would be. The armature production was to implement the drawings of the nervous system architecture for further expert review and feedback. It also makes the technicians to practice building the model while taking necessary adjustment in the design process.

Step IV: Educational technology experts review; the produces armature digital nervous system model was presented to educational technology experts for critical review and analysis. These experts identified the strength and weakness of the model in teaching nervous system to secondary school Biology students and directed on how the final model would be build.

Step V: Supervisory team review; In all the previous stages, the supervisory team were carried along and feedback from these experts were reviewed and integrated in to the design process. However, at this stage, the supervisory team reviewed the entire design process with a reflection on the objectives of teaching secondary school nervous system as contained in the syllabus. Furthermore, a final go ahead for the development of the prototype was given.

Research Questions three; What are the procedures involved in the development of the digital nervous system model?
In answering research question three, practical procedural stages were followed in the development of the digital nervous system model. These stages were documented in detailed as field notes and video-taped with a smart phone as they occurred. The documented field notes and the video-taped procedures were reviewed and presented as follows;

Stage I: Material selection; first, commercially designed electric wires calibrated with standard bulbs and wiring system were obtained from local shops. These electrical circuits determine the relevant signal paths required through the circuits representing the description of the neuronal functions and then carry out a series of digital simulations. Additionally, successive control unit system was obtain and characterized for capacitance and they were setup with release and hold buttons. Secondly, white cement material with top bond gum was obtained for casting the model. Thirdly, a quality plywood material measured 18mm was obtained; aluminium frame of 26 X 14 mm was obtained and reserved for casing the prototype. Finally, auto car paint was selected and spray machines were collected and booked for the finishing work.

Stage II: Preparing the plywood;a set of ¾ plywood was procured from the market and cut in to a size of approximately $3^{1/2} \times 4^{1/2}$ feet with an area of approximately $2{\times}105\mu m^2$ being available for standard model placement due to the dumbbell-shaped outline of the model. This allowed for a large area left as merging for scientific levelling. The left and right edges were left for casing while the back sides are used for power distribution.

Stage III: Casting the models; the process of casting the model requires a white Portland cement, plastic bucket, paper strips, water, wire, brick towel, sandpaper and concrete sealant. The white cement is a highly refined limestone powder used as a base to create mortar when mixed with water and then allowed to dry, the cement becomes hard. At the production stage, the technician put on a mask and protective gloves then added white Portland cement with water in a 5-gallon bucket; a product designed specifically for use with concrete to provide strength and prevent cracking while giving the mixture a smooth, clay-like consistency.

The process continues by mixing and steering until the cement sculpting base reaches the consistency of modeling clay. Then, the prototype nervous system model was created by building the dimensions to accommodate the thickness of the cement. The cement was shaped to taste while wet as it molds like clay. Immediately, after the casting process was completed, the model was shaped and polished before it completely dry using rough and smooth sandpaper to smoothen the cement and create fine details. Afterward, the model was allowed to cure for three days. To consolidate the curating process, a concrete

sealant was used to cover the cement sculpture to prevent it from cracking due to changes in temperature or humidity over its lifetime.

Stage IV: Drilling and Painting the models; In each model, hand drilling machine was used to drill holes on every part of the structures for the fixing of the bulbs; the painting process was completed in three days top bond and water were mixed, this was used for the first coating, and this was done to avoid sinking of the oil paint into the molded structure, applying the first single layer paint as a basecoat and allowed them to dry. Essentially, single stage enamel paints have the basecoat and clear coat mixed together in order to get the colours right and make the painted material shiny and bright. For instance, the background of the model was painted white; the casted model was painted brown while the linings of the nervous system were painted blue. The painting process was done using a hand brush and spray machine under a closed environment with pressure control to prevent dust from contaminating the process.

Stage V: Electrical installation; the analog circuits with coated wires with different colour bulbs (Blue, Red and Yellow) were spread over the model linings, they have been placed horizontally and vertically denoting central and peripheral nervous system. The analog circuits architecture is arranged such that they are combined into one large analog macro block to represent human brain and neurons. The control unit was divided into several subunits.

Stage VI: Labelling and Casing the models; after the painting process, the models were well annotated and a key made available beneath each models with different colours of bulbs indicating different parts in the structures. The model was covered with an open and close case to provide a protection against any physical damage. Light aluminium materials of 26 X 14 mm were used as frames for casing the model because, they are resistant to rust and do not add weight to the model. The four angles of the frame were closely screwed at 45^0 using quality screws while the two open and close hinges were tightly fastened with rivet bits. Similarly, a flex containing the researcher identity was used in covering the face of the model.

Conclusion

The key insight from this research is that the need to model the nervous systems and its components parts was established by the practicing experts: the Biology teachers and the processes involved in designing a prototype digital nervous system model was equally established to be in five developmental steps. As demonstrated in the study, the procedures involved in the development of digital nervous system model were found to be in six stages. It was therefore, concluded that it is possible to developed a home-based digital nervous system for Biology instructions in Nigeria.

Recommendations

Based on the findings of this study, it is recommended that as the objectives of nervous system model in Nigeria secondary school Biology syllabus were identified, instructional designers should be supported by relevant government agencies like Scientific Equipment Development Institute (SEDI), Federal Ministry of Science and Technology and associations of educational technology researchers to develop instructional models in other science related concepts. This is to meet the varying needs of end users in Nigerian secondary schools; also the processes used in designing the prototype digital nervous system model should be perfected by a team of interested researchers in order to establish the validity and reliability of these procedural steps. With this in mind, future researchers would have a clear roadmap from which to design instructional resource there by reducing time wastages and design errors. In addition the procedures followed in the development of digital nervous system model were established to be hierarchical in nature. Such procedures should be replicated by future researchers, educational technology experts and instructional developers in order to validate these stages.

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INTEGRATING FLIPPED CLASSROOM AND CROSSOVER INNOVATIVE INSTRUCTIONAL STRATEGIES INTO STEM AND TVET AS A MILESTONE TOWARDS ACHIEVING QUALITY EDUCATION IN NIGERIA

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Abstract
Nigeria is one of the developing countries that adopted Science, Technology, Engineering and Mathematics (STEM) education and Technical, Vocational Education and Training (TVET) as to enhance national development in science, technology and vocational education. STEM and TVET education comprises science and technology-related subjects that are learned to train individuals to become doctors, engineers and other scientists and vocational skills that are relevant to the growth and development of our contemporary societies. The paper explored the content and prospects of STEM education and also glanced at some of the challenges it faces in Nigeria. The challenges include decayed infrastructure, poor teachers' salaries, imbalanced curriculum, and brain drain among others. As a programme that advocates for the acquisition of 21st-century skills, the authors fished out two important and relevant innovative teaching strategies which are Flipped Classroom and Cross-Over Instructional Strategies. The two strategies were fully discussed based on their innovative potential. The authors recommended that teachers should be encouraged, motivated and educated to adopt the use of Flipped Classrooms and Cross-Over Instructional Strategies in schools to enhance the possession of 21st-century skills among learners which by extension will go a long way in facilitating the achievement of STEM and TVET education goals in Nigeria.

Keywords: STEM Education, TVET Education, Flipping Teaching Strategy, Cross-Over Teaching Strategy, National Developmen

Introduction

The significance of education lies in its capacity to propel individuals forward and foster meaningful connections. Secondary education holds significant importance within the education system (Ige, 2020). Besides linking primary and college education, it provides an opportunity for children to expand their knowledge, acquire fresh skills, and cultivate personal attributes that go beyond the scope of primary school learning (Chinelo, 2011; Ige, 2011; Ige, 2020). Going to secondary school in Nigeria is crucial because the education received in primary school does not adequately equip students with the necessary skills in reading, writing, science, technology, engineering, mathematics, technical, and vocational education and training (STEM and TVET) for long-term proficiency.

From the outset, it is evident that Nigeria faces numerous challenges in ensuring a high-quality education system, requiring significant efforts to be made (Adeyinka, 2021). Among the challenges identified by researchers, authors and educational practitioners impeding quality education is teaching methods. Teaching is a complex process where teachers use different methods to share ideas, knowledge, values, experiences, and concepts to help students improve their behaviour for the better. Teaching is like an art that you need to practice. Consistent practice entails the utilization of various teaching methods by enthusiastic instructors (Umer & Siddiqui, 2013). Teaching methods are ways that teachers use in the classroom to help students learn better. Teachers share what they know, teach facts, and test students to see how much they have learned. Teachers use effective teaching methods to help students achieve more success. The way teachers teach can give us a clue about how well students will do (Martínez-Clares & González-Morga, 2018).

Research shows that teachers use different teaching methods like lectures, Q&A, discussions, and demonstrations in the classroom to help students improve their scores (Hussain, Hamdani, Quraishi, & Zeeshan, 2010; Ekeyi, 2013; Falode, Adewale, Ilobeneke, Falode, & Robinson, 2015; Hassan & Akbar, 2020). These are traditional teaching methods that have proved ineffective in transferring 21st-century skills. Contemporary and innovative teaching strategies have given students the privilege to break the monotony of the traditional classroom situation. Innovative teaching strategies refer to the new and improved system, structure, processes, techniques, methods, and procedures that a teacher employs in the classroom during instruction to assist student learning. Innovative teaching strategies may include whole-class performance-based assessments, a series of individual and group activities to accommodate learning rates and styles and different abilities, skills, and understandings that allow each student to participate and succeed (George & Salmon, 2019). Students use their personal and social capabilities to cooperate and collaborate effectively with peers in learning activities, to assess their abilities, susceptibilities, and peers' strengths so that they can develop a range of interpersonal skills such as teamwork, negotiation, communication, and leadership.

A 21st-century teacher knows that using new and different teaching methods is important for effective teaching and learning in today's world. This is about making a happy classroom environment where students feel close to the teacher, to other students, and to what they are learning.

Flipped classroom instructional strategy, is a new model for effective teaching. Leo and Puzio in Gambari, et al. (2016) referred to it as the process by which students gain first-hand exposure to learning content outside the class, usually via reading or lecture videos, and then use class time to do the harder work of assimilating that knowledge through problem-solving, discussion, or debates. A flipped classroom is a form of blended learning in which learners learn content online by listening to audio lectures or watching video lectures, mostly at their various home, and assignment is done together in the class with teachers and students discussing and solving questions (Bergmann & Sams, 2012; Gambari et al., 2016). Students can work together on a task, exchange their opinions, experiences, and views, and discuss and negotiate strategies, actions and results through flipped classroom (Ichinose & Clinkenbeard, 2016; Zhonggen & Guifang, 2016; Gambari et al., 2016). These actions can provide students with the opportunity to help, discuss, review teach, and influence each other and thereby enhance a motivational situation for developing a learning community. In a flipped classroom, the teacher's role is of a mentor or facilitator of the learning process. The achievements of individual members within the group are shared among the group members.

On the other hand, crossover learning is one of the strategic pedagogical tools for effective teaching or learning. The "2015 Innovating Pedagogy Report" highlights Crossover Learning as one of ten innovations that are on the brink of having a profound influence on education (Sharples et al., 2015). Crossover learning combines the strengths of both formal and informal learning environments and aims to provide students with the best of both worlds. This innovative approach is in response to what pedagogical research has been saying for decades: learners need to learn how, not what to think. However, it is on these premises that this paper discusses the impact, difficulties, and strategies to combine modern teaching with STEM and TVET education for a quality education system in Nigeria.

Conceptual Clarification

Science, Technology, Engineering and Mathematics (STEM) Education

STEM is an acronym for Science, Technology, Engineering and Mathematics which encompasses disciplines that are highly relevant for the production of scientists and engineers capable of bringing about technological development of a given society. In Nigeria, it was formally tagged as SMET standing for Science, Mathematics and Engineering which later became STEM with the influence of the National Science Foundation (NSF) in the 1990s (Fomunyam, 2019). Emphasis on STEM was laid on preparing future generations to be successful in their careers. The skills gained from STEM education extend beyond those needed to be successful in STEM fields, preparing children with varied interests who move into any industry to have valuable skill sets that allow them to be successful.

STEM education teaches children more than science and mathematics concepts. The focus on hands-on learning with real-world applications helps develop a variety of skill sets, including creativity and 21st-century skills. 21st-century skills include media and technology literacy, productivity, social skills, communication, flexibility and initiative. Other skills attained through STEM education include problem-solving, critical thinking, creativity, curiosity, decision-making, leadership, entrepreneurship, acceptance of failure and more (Fomunyam, 2019).

Regardless of the future career path considered by learners, the aforementioned 21st-century skills go a long way in transforming learners to become innovative in their living which is crucial to scientific and technological developments. The ability of an individual to think critically and challenge standards is the basis of innovation at any point in time. Preparing today's children to become the innovators and inventors of tomorrow begins with STEM education programs which provide opportunities to take traditional learning and pivot it to prioritize the hands-on experience and real-world application necessary for developing an innovative mind which as a result, leads to national development.

National Goals of STEM Education in Nigeria

STEM education in Nigeria has several predetermined goals to be achieved as obtainable in other developing countries. Joseph et al. (2023) highlighted some of the STEM education goals as follows:

First, it targets students to have access to quality education and lifelong learning opportunities. This Goal focuses on the acquisition of foundational and higher-order skills; greater and more equitable access to STEM education and training and higher education; training throughout life; and the knowledge, skills and values needed to function well and contribute to society.

Second, STEM education prepares students for the unforeseeable future. It is teamwork and the collaboration of professionals from different disciplines. All required in a learner under STEM education is 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.

Third, STEM education exposes students to effective interdisciplinary communication. Experts in Technology provide gadgets that can make the work of the team more effective. Engineers help to solve challenges by designing and running platforms that enable transformation. Through collaboration in teamwork, lots of experiences are interchanged and implemented to innovate or solve a particular scientific or technological problem. Several societal challenges have been addressed as a result of this approach in STEM education.

Fourth, STEM education paves the way for multiple educational and employment chances. Scientists and engineers in today's world have a better chance to work because their expertise is deemed more relevant to society especially the developing countries like Nigeria where scientific and technological advancement is not well achieved.

Fifth, STEM education increases access to Information and Communication Technology (ICT) and Infrastructure provides the basic physical facilities relevant for industrialization which in turn drives economic growth and job creation, thereby reducing income inequality. It is also a mastermind of innovation that expands the technological capabilities of industrial sectors and leads to the development of new skills.

Concept of Instructional Strategy

To simply define the term strategy, it implies thoughtful planning of the classroom instructional process. Instruction or teaching strategy therefore refers to thoughtful planning of the instructional process to ensure effectiveness. Awotua-Efebo (2017) defined teaching strategies as all those teaching methods available to a teacher during the teaching process for communicating ideas, knowledge, skills, attitudes, etc., to the students so that at the end of instruction, the students can behave in the manner stated in the objective for the lesson. Instructional strategy enables students to focus their attention on learning for better understanding and helps teachers provide a suitable platform for strategic learning. It is an integral component of the lesson planning. The instructional strategy could be broadly classified into innovative and conventional.

Concept of Flipped Classroom Teaching Strategy

The classic concept of a flipped classroom, according to Bergmann Overmyer & Wilie (2015), involves substituting videos for direct instruction and enticing students to concentrate on significant learning activities with their teachers inside the classroom. According to the argument, the flipped classroom is misunderstood, and this misunderstanding can be rectified by defining the flipped classroom as individualized instruction where students take ownership of their learning. The flipped classroom also gives the teacher more facilitation and engagement time with the students, as well as more one-on-one time. Another way to describe the flipped classroom is to develop problem-based learning within the classroom and substitute instructional videos for direct instruction to give students access to educational material whenever and wherever they need it (Bergmann & Sams, 2012; Hamdan, McKnight, McKnight, & Arfstrom, 2013). According to Hamdan et al. (2013), screencasts of computer work, videos of teachers instructing, or gathering video lessons from reputable websites can all be used to offer training.

Also, the concept means completely rethinking how to do the job you have done in a certain way for years (Alvarez, 2012; Femi-Adeoye, 2021). A flipped classroom addresses how students learn best. A flipped classroom involves teachers who either create or link to content-related instructional materials. Students do not learn in the same paces and the same ways. That is always been a complicating factor in teaching. The question of how to meet twenty-five or more unique students at their levels keeps teachers up at night (Femi-Adeoye, 2021).

A flipped classroom gives room for teachers to see clearly when a student is having a problem with concepts and work with them directly to get through it. This increased interaction with students so they can tailor their instruction to the needs of each one. Students can also work at their own pace. Flipped classroom is a way of shifting from passive learning to active learning. And also a paradigm shifts from teacher-centred strategies to student-centred strategies.

In an attempt to further explain the concept, to Chang and Hwang (2018), the key benefit of a flipped classroom is having students evaluate their application knowledge through inquiry and group discussion during workshop-style class periods. As a result, teachers encourage students to take part in group discussions or individual research as coaches or advisers. Flipped learning therefore has a greater potential to improve students' attitude and motivation toward learning than traditional instruction.

According to Bakla (2018), it involves encouraging students' active learning through activities like reading textbooks, taking advance notes, creating Google platforms for teacher-student collaboration, requesting that students watch instructional videos in advance, creating Facebook communities or groups for teacher-student discussion, and creating an online evaluation system for students' responses to or completion of self-learning checklists. The promotion of students' motivation and learning effectiveness was shown by the outcomes.

More so, Alexander (2018) explained that flipping contributed to increased work satisfaction and improved academic performance among pupils. Teachers also observed a noticeable change in their pupils' learning attitudes, and some delighted educators declared that they would continue to use the flipped learning methodology. According to Karabulut et al. (2018), flipped learning can improve student cooperation and critical thinking in addition to academic performance. It can also alter students' attitudes toward learning and teacher-student interactions. As a result, many teachers want to use these innovative teaching techniques.

Lin et al. (2018) used mobile learning with a flipped classroom to teach mathematics in elementary schools. The findings demonstrated that, in comparison to traditional teaching, flipped learning increased students' learning interests and motivation and raised students' learning effectiveness; teachers and students both gave flipped learning a favourable review (see fig below).

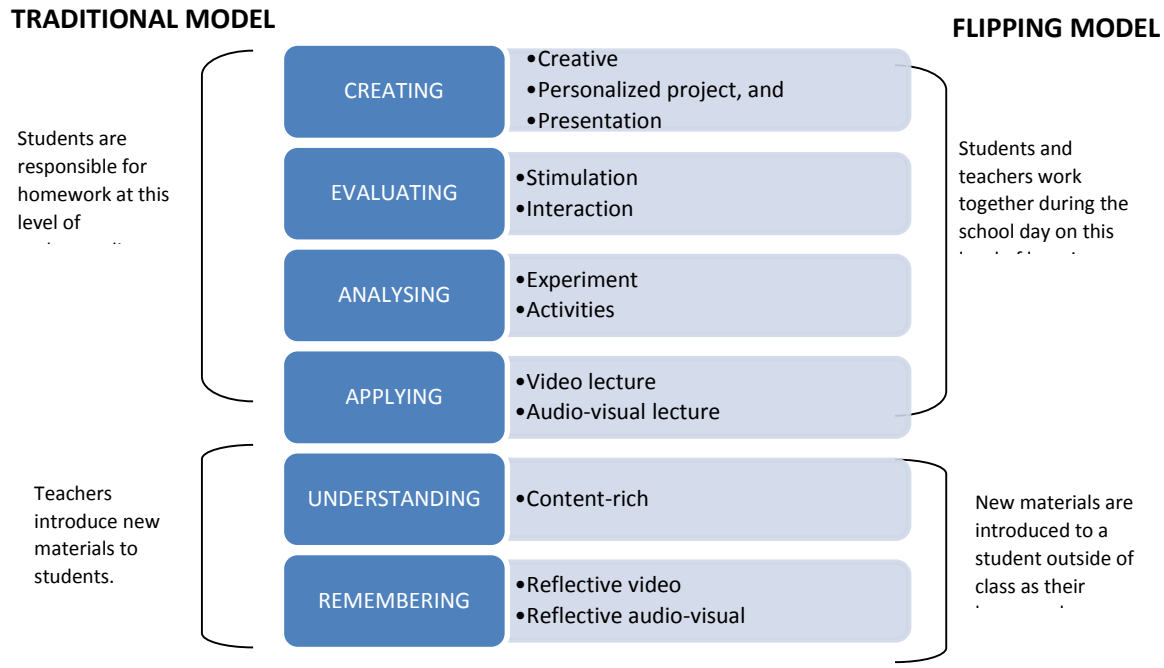

Fig 1. Bloom taxonomy [Describing the significance of how flipping and traditional model work]

Concept of Crossover Teaching Method

Few authors have contributed to defining the concept of crossover teaching strategies. The not-so-common modern teaching method is Crossover learning which uses both formal and informal teaching and learning environments. It is one of the perfect ways to give the best education to learners (Sujata, n.d). Crossover learning effectively engages learners and provides authentic yet innovative results.

According to Sujata (n.d), a formal setting is a traditional setting, i.e., a Classroom to provide education. While, the informal environment of teaching is museums, seminars, and after-school places. Schools and colleges teach with content, and study material and use every day experiences to add knowledge. On the other hand, informal learning generates curiosity and interest and increases understanding by asking questions to their teacher. Teachers should introduce new queries or questions in the formal setting and answers that students should try to find in informal settings such as by exploring that question on their museum visit. The learners can take notes or collect pictures as their data and produce them as information once they are back in the Classroom. They can share collected information with other classmates and can discuss it for better results.

Concept of Quality Education

Defining or giving a universal description of "quality education" is not very easy because every country takes pride in having a good education. But Nigeria's situation is quite fascinating because it transitioned from informal (traditional) education to less formal colonial education, and eventually to a locally developed education system with some influence from the British colonial and commonwealth leaders. The education system in Nigeria has been in place for around fifty-four years since gaining independence. But how good is the quality of education in Nigeria, as defined by the term "quality education"? According to Pigozzi (2008:4), quality education takes into account the past, applies to the present, and considers the future.

Quality education means learning and using knowledge smartly. It involves people being able to learn on their own and work well with others. A good education shows that cultures and languages change, individuals are important in the bigger picture, and it's crucial to live fairly now and for the future.

Impact of Integrating Crossover Learning Strategy for Quality Education

A recent study looked at the idea of Crossover learning and how it can be used to connect informal and formal learning. The study explored how this concept is currently being used and how it may be used in the future. The researchers found that Crossover learning can serve as a bridge between different learning environments. These connections go both ways. Learning in schools and colleges can become better with the help of experiences from our daily lives. Similarly, informal learning can become more meaningful by asking questions and gaining knowledge from the classroom. These experiences that are related to one another make people more interested and motivated to learn. Crossover learning combines different subjects and real-life situations in the curriculum. This helps students use information and skills from different areas of learning to solve difficult problems, instead of keeping them separate. This method helps develop thinking skills, creativity, and new ideas. Research from Bellanca and Brandt (2010) found that crossover learning helps students get more interested in their studies, become better at solving problems, and get ready for the changing challenges of the 21st century.

The benefits of this approach when integrated into classroom learning situations include: it enables the students to;

- Learn to work together as a team and complete tasks.
- Learn how to improve their abilities to solve challenging issues.
- Identify a solution for diverse situations through the application of acquired knowledge from a taught lesson or task (Osuji & Awala, 2019).
- Create a more captivating and enjoyable learning experience by decreasing the pressure associated with tests and extensive examination of intricate scenarios.
- To put it simply, retention means remembering things better, more engagement in learning practice means being more interested and involved in learning activities, and transfer of knowledge means being able to use what you have learned in different situations. Therefore using this approach aids retention, engagement and transfer of knowledge (Okeke & Ordu, 2018).

Combining various learning approaches, such as collaborative work, independent study, and experimenting with different methods, has the potential to greatly enhance the effectiveness of learning. In a flipped classroom, students can work together either in person or online. This helps them learn better by interacting with each other and working as a team. Students can teach themselves by looking up more information and doing projects on their own, even when they are not in class. Crossover learning means combining different subjects in projects or tasks that make students use what they have learned in those subjects.

Impact of Integrating Flipping Classrooms for Quality Education

A flipped classroom is becoming more popular and more important in education. In 2018, a study was done by Day in Boston to compare two groups of students. One group followed the usual teaching methods, while the other group tried a different approach called a flipped classroom. The study found that students who used flipped classrooms did better in their final grades compared to those in traditional classrooms. An examination of investigations discovered that the flipped classroom method has many advantages (Day, 2018). According to Awidi and Paynter (2019), the flipped classroom is a way of teaching that can greatly improve how much students participate, learn, and achieve. The flipped classroom approach helps students learn by actively participating in activities and gaining practical experience. However, some researchers found that social learning helps make the flipped classroom more effective. Other studies have shown that the flipped classroom is a good way to make students more motivated and help them learn better.

The benefits of this flipped classroom include:

- ensuring that pupils have unlimited access to a variety of materials or information on any subject.
- allowing pupils to speak, listen, and offer criticism or reflection on their actions.
- encouraging students to exercise more sophisticated abilities like evaluation and constructive criticism.
- encouraging pupils to cultivate virtues like kindness, patience, and encouragement in the classroom and outside of it as they exchange ideas during activities.
- establishing connections between students and classmates abroad so they can work together on initiatives about art, science, social change, and more.
- establishing a forum where students can write comments on the website or critique peer efforts (Muhammed et al., 2016).

Impact of Crossover and Flipped Classroom in STEM and TVET

Crossover and flipped techniques are new teaching methods that help students in Science, Technical, and Mathematics by solving their inherent difficulties and consistencies. These methods allow students to engage and take part in the lesson, while also giving them a chance to relax and do other activities that stimulate their minds and emotions. Abdullahi (2020) and Adeoye (2022) found out in their research the variability of crossover and flipped classrooms in mathematics learning outcomes. Abdullahi (2020) stated that flipped classrooms guarantee the use of technology that enhances time management and students' understanding of abstract concepts while the spaced learning techniques promote learning experience and outdoor engagements that make the students fit and provide sufficient rest.

In the view of Adeoye (2022), flipped and crossover techniques are both student-centred because the techniques allow for the active participation of learners while the Teacher acts as a facilitator or moderator of the learning processes. He said that using these techniques helps students understand concepts better, makes them more interested in science, technical and mathematics, improves their attitude and engagement, reduces laziness, encourages sharing experiences with others, and allows teachers and students to use technology to make learning easier. Thus, the impact of flipped and crossover techniques in STEM and TVET teaching and learning is overwhelming, because both the teacher and their students interact and discuss freely without hindrances. One major advantage of both techniques is that they guarantee the development of long-lasting skills of exploration, inquiring scientific investigation and problem-solving that have greater value in our day-to-day engagement. The methods specifically equipped the learner with the necessary skills for independent and blended learning. Caleb (2019) summarizes the benefits of flipped and crossover learning to include.

i. help to create a map of ideas that enhances understanding and remembering.
ii. make some complex ideas easier to understand by relating them to things in real life and comparing them.
iii. teaching with the link between formal and informal helps students develop both emotional and psychological skills.
iv. keeping students interested in STEM and TVET during the entire lesson by using audiovisual tools.

v. encourage students to learn on their own and work together in groups, because it helps them interact with their teachers, classmates, and learning materials.

Challenges of STEM Education in Nigeria

In the history of Nigeria, no policy, programme or intervention has ever been put in place without facing hindrances. There are several challenges attributed to the smooth running of STEM in Nigeria as explained by Fomunyan (2019), which include:

(i) **Disproportionate enrolment of students:** This simply implies that the number of students expected to be studying STEM-based disciplines is very low compared to other areas. This is caused by poor performance experienced in annual School Leaving Certificate Examinations such as NECO, WAEC, and NABTEB which are commonly required for further studies at the tertiary level of education. Reasons behind this unfortunate development include the fact that most students are passive learners, this so because most teachers perceive students to be like an object upon which information is passed without any need for interaction (Fomunyan, 2019)

(ii) **Different curricula for teachers and students:** It is observed that the curricula used by teachers during their training differed from those used by the students during classroom instruction. This is a great mismatch that hinders the achievement of STEM in learning institutions

(iii) **Explosive enrollment in schools:** As a result of the impact of Universal Basic Education (UBE) established in 1999, several schools were overcrowded with inadequate facilities and a learner population. This of course deteriorates the quality of teaching STEM in Nigerian schools

(iv) **Inadequate Infrastructure:** Inadequate classes, offices, laboratories, and libraries are indeed among the factors affecting the achievement of STEM education goals in Nigerian schools. No effective teaching and learning can take place in any learning institution devoid of all these mentioned facilities.

(v) **Poor ICT compliance:** Several schools are lacking computers, internet facilities and other necessary digital equipment that can facilitate teaching and learning in this digital era. The use of computers and their related facilities enhances effective learning of sciences.

(vi) **Poor teachers' salaries and incentives:** It is obvious in Nigeria that teachers' salaries at all levels of education are not satisfactory, let alone other incentives expected to be enjoyed by civil servants. This goes a long way in demotivating the teachers which in turn, affects the quality of classroom instruction

(vii) **Brain drain:** In Nigeria, as a result of the negligence of the government to pay better salaries to doctors, engineers, lawyers, etc. daily thousands of Nigerians travel overseas to secure better-paid jobs. This undermines the achievement of STEM in Nigeria drastically, and if not controlled, the goals might become difficult to achieve.

All the challenges mentioned previously are capable of deterring the attainment of STEM education goals of any nation as long as they remain unattended to.

Challenges of Integrating Modern Teaching Strategies

Modern ways of teaching have some difficulties and limits that need to be dealt with. For example, teachers have to work hard to get ready and make plans so they can find or make online stuff, create activities for the class, and check how students are doing and participating. Furthermore, students need to have technology that they can use easily to access online resources, and for teachers to be able to use technology effectively to give and control these resources. Moreover, some students, parents, or administrators may resist or doubt this model or innovative approach because they are not familiar with it and they prefer traditional teaching methods. Lastly, students might have a hard time staying organized and managing their time to finish the online work before class. They may also struggle with the harder tasks that they have to do during class.

For example, in group presentations or collaborative strategy, some students don't like that individual members in a group don't get credit for their effort because the final grade is based on the group as a whole.

Some students may want to include a way to evaluate their team members individually to make sure everyone is responsible. Sometimes, students say they don't like doing group presentations because it makes them feel uneasy or scared.

The main problems that came up when using the Flipped Classroom method in a graduate-level setting were twofold. These included difficulties with how comfortable students felt and problems with using technology. The Flipped Classroom posed a significant technological challenge. And it's also important to make sure that students feel safe, and supported, and that they enjoy learning in class.

Effective Strategies for Integrating Modern Teaching Strategies in STEM and TVET

It is necessary to monitor and modify the learning environment to establish a positive and durable atmosphere for learning. There are some parts of the flipped classroom and cross-teaching strategy that need to be made better. Firstly, the video lectures should be changed a lot and teachers should think about using a different recording tool that is easier for users chunks or parts) instead of one long video. Students should watch 2-3 videos that are 20 to 30 minutes long each. This way, they can focus completely and pay full attention to the content without getting distracted. In simpler words, the shorter videos will let students stop and come back to their videos later. They can also watch each part of the video at different times during the week, based on their schedule. The sound in the videos should be much better by trying to get rid of any noise in the background. Next, administrators should make a website where the teacher can talk to the students and answer any important questions before they come to class. To make sure the videos are released on time to the students, we need to get rid of administrative obstacles and give the instructor more control.

To make sure that the crossover teaching strategy works well and is enjoyable for everyone, there are some solutions and best practices to follow. It is necessary to talk clearly and often with students, parents, and administrators about the goals, advantages, and expectations of using a crossover teaching strategy. Furthermore, it is important to choose online materials with caution and creativity. These materials should be suitable, interesting, and fitting for the student's academic level and preferred way of learning. When planning activities for class, it is important to work together and be open to changes, considering the online materials as well. Teachers should assess how well students are learning by looking at all the information that is available online and in the class. This assessment should help students improve and show what they have achieved. Different tools can be used to give students feedback that helps them learn and improve.

Conclusion

For a country like Nigeria to achieve STEM and TVET education goals, more concern is needed in the aspect of grooming the students with the 21st-century skills that are paramount to the scientific and technological breakthrough of any nation. Innovative teaching strategies such as Flipped Classroom and Cross-Over are vital tools for the effective teaching and learning of STEM in schools to attain the set goals and by extension enhance the achievement of national development.

Recommendations

The authors recommended the following as to enhance the attainment of STEM and TVET education goals:

- All hands must be on deck to support STEM and TVET education in learning institutions. By implication, the government, teachers, students and parents have to anchor the programme with financial and moral support.
- Both government and non-governmental organizations should invest fully in STEM and TVET education by providing the necessary infrastructure for the smooth running of STEM and TVET education in schools.
- Teachers should be trained, encouraged and motivated to explore and adopt the use of innovative teaching strategies in classroom instruction to enhance learning of STEM and TVET.
- Teachers' salaries and other incentives should be improved and paid regularly to improve productivity.

- There should be strong monitoring of activities to avert the influence of corruption on the programme which can undermine the achievement of STEM and TVET education in Nigeria

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EFFECTS OF CONTEXT-BASED AND INQUIRY-BASED INSTRUCTIONAL APPROACHES ON STUDENTS' ACHIEVEMENT IN BIOLOGY IN NIGER STATE

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Abstract
The study investigated the effects of context and inquiry-based instructional approaches on students' achievement in Biology in Niger State, Nigeria. The research adopted a quasi-experimental design involving a pretest, posttest, non-equivalent, non-randomized experimental control group design. The population of the study was 57,947 Senior Secondary School two (SSII) students. The sample for the research study comprised 225 male and 187 females making a total of 412 students drawn from nine co-educational senior secondary schools selected randomly through a stratified sampling technique. The instruments for the study are Treatment Instruments and Test Instruments. The treatment instruments are a Context-based instructional approach and an Inquiry-based instructional approach while the Test Instrument is the Ecology Achievement Test (ECOLAT). The ECOLAT contains 50 items and was used as a pretest to determine the students' entry behavior and a post-test to determine the student's achievement. The Instruments were subjected to face and content validation by 3 experts. ECOLAT was pilot-tested and reliability coefficient of r = 0.79 was obtained. Experimental groups one and two were exposed to context and inquiry-based teaching approaches respectively and control group was exposed to traditional teaching methods. Mean and Standard deviation was used to answer the research questions while ANCOVA and MANCOVA were used to analyze the research hypotheses. The results revealed that the two experimental methods were very effective in enhancing the academic achievement of biology students in Ecology concepts better than the traditional method. The study also found out that the multivariate effect of gender was not statistically significant on the combined pretest and posttest test mean scores of students taught Ecological Concepts with the two experimental methods. Conclusion was established that context and inquiry based instructional approaches were very effective in enhancing the academic achievement and they are gender friendly in ecology concepts among senior secondary school biology students of Niger State The study recommended among others that Science teachers should incorporate the idea of using Context and Inquiry based instructional approaches in teaching science subjects in secondary schools to enhance students' achievement. Also, since the two experimental methods are gender friendly, they were recommended to be used as means of disseminating instructions in secondary schools in order to reduce the gap in the performance of male and female students.

Keywords: Context-based approach, Inquiry-based approach, Achievement and Gender

Introduction

The importance of good teaching methods in the teaching-learning process cannot be over-emphasized. It is obvious that if teaching processes are to be productive, an active teaching method that allows learners' participation in the learning process must be encouraged in our classrooms. Many teaching approaches have facilitated improvement in teaching and learning processes, some of the known approaches such as the field trip, lecture method, concept mapping, game method, discussion method, role-playing, cooperative learning, and many more have produced different results when used in classroom instruction in formal school systems. The need to adopt newer techniques to stimulate constructive social activities within and outside the formal education system cannot be over-emphasized and this could be successfully done through science.

The emphasis placed on science and its essential role in national development made it relevant and practically necessary for it to be taught in an organised and well-structured pattern that involves activities

for both teachers and students (CAIE, 2019). This is because when science is delivered using methods that involve activities for both students and teachers, teaching becomes effective, learning becomes more meaningful, and these, in turn, bring positive development to the educational system. Knowledge of science enables learners to acquire technical know-how in solving problems in an ever-changing society (Lee *et al*., 2020). Furthermore, scientific ideas make students independent and thus task themselves to cope with their environment, making life easier. The economic and political strength of a country is always assessed in terms of its achievement in science and technology. This is why the National Policy on Education (FRN, 2014) emphasised the provision of science education at all levels of education in Nigeria. The policymakers of education in Nigeria believe that the provision of science education at all levels of education in Nigeria could improve the economic and political strength of the country.

The significance of Biology cannot be over-emphasized as it is important in food production, hybridization, cross-breeding, in-vitro fertilisation, blood transfusion, marriage counseling, pest control, development of early maturing of plants and animals (Inyang, 2021). All these aspects of life mentioned above and many more are very important for the effective living of the human race on this earth and they can never be studied without the knowledge of Biology. A very important topic in biology is Ecology which is a practical science that involves finding out how living organisms depend on themselves and their non-living environment for their survival, measuring factors affecting the environment, and studying the distribution of living organisms (Sarojini, 2010). For this important concept in biology to be taught properly in secondary schools, the need to use active-learning instruction among students is inevitable.

Studies have shown that active-learning instruction among students can be highly effective in facilitating the development of conceptual understanding and scientific thinking skills (Peters *et al*., 2020; Freeman *et al.,* 2014). Based on the report by the above researchers, it is believed that active learning processes such as context-based and inquiry-based instructional strategies could be effective methods of teaching biology and could be a priority at all levels of our secondary education system, hence the need for examining them in this study.

The context-based approach is described as the starting point for developing scientific ideas in science teaching. In this approach, real-life contexts are used to introduce concepts into the classroom to improve learning and application of knowledge (Gercek & Ozgur, 2015). It is the use of real-life and fictitious examples in an environment of teaching to learn through the actual practical experience with a subject rather than just its mere theoretical parts (Grospietsch & Mayer, 2018). Practical learning experience could make learning more permanent and retained because of the adage that says 'seeing is better than hearing'. Furthermore, the context-based learning strategy is student-centered, giving students a more active and self-steering role, thereby making students to be actively aware and involved in all activities going on in the class and not allowing the class activities to be dominated by the class teacher (Susanne, 2016).

Inquiry-based Instructional Strategy is a style or method of teaching where the learner seeks to discover and create answers to recognised problems through the procedure of doing a diligent search (Shaibu, 2017). Diligent search is a process of seeking the truth or a query into an idea that is not known previously. The search shed light extensively on the unknown. Inquiry-based teaching strategy has developed independent and critical thinking skills, positive attitudes and curiosity toward science, and increased achievement in biological content (Franklin, 2015). The development of independent and critical thinking skills, positive attitudes, and curiosity toward science by Biology students may go a long way in solving the problem of underperformance in biology. Furthermore, Marcus (2017) describes an inquiry-based teaching strategy as a learning and teaching method that prioritizes student questions, ideas, and analyses. When students' questions, ideas, and analysis are prioritized in a teaching and learning situation, it becomes a student-centred teaching method, making learning more interesting, meaningful, and permanent. According to Marcus (2017), inquiry-based learning focuses on investigating an open question or problem from the

student's point of view. Here students must use evidence-based reasoning and creative problem-solving to reach a conclusion, which they must defend or present in order to improve students' achievement in biology.

Achievement is also known as a learning outcome. The learning outcome is the knowledge we acquire from the teaching process. It is the extent a student has attained in their academic work at any level of education (Bajon, 2015). The author, Bajon (2015) further defined achievement as the act of successful performance and also an act of achieving a result gained by efforts, the quantity and quality of a student's work. Achievement is when a student shows a positive performance in his/her study, this positive performance usually gives the teacher feedback that he/she has done a great job in his/her teaching. Therefore, achievement may be defined as the act of achieving or successful performance (Anra & Yamin, 2017). The academic achievement of the student is the ability of the student to study and remember facts and being able to communicate his knowledge either practically, orally or in written form in an examination condition (Peter *et al.*, 2014). This can be achieved by using appropriate methods of instruction that are gender friendly.

Gender is one factor that is very important in the relationship between instructional strategy and cognitive achievement. Gender issues have been related to student's achievement in academic tasks in several studies but without any definite conclusion (Ekineh & Adolphus, 2019). Some literary works have revealed that there is no significant difference in the academic achievement of both male and female students (Le *et al.*, 2019 & Ikechukwu, 2022). Others discovered that females performed better than their male counterparts in their studies (Vooren *et al.*, 2022) while Ibrahim (2016) discovered in his research work that males performed better than females academically.

Statement of the Research Problem

The problem of underachievement by students in Biology may be due to the nature and type of instructional strategies adopted by Biology teachers, which is mostly lecture methods. Different kinds of Instructional strategies have been used by teachers in teaching biology and it's still facing the problem of poor performance over the years. The Chief examiner reports in WAEC 2016, 2017 & 2018 stated that students' performance in some concepts of ecology such as adaptation in organisms, ecosystem, association in organisms, soil organisms, and pollution has been unsatisfactory. Poor performance of students in Biology in five years WAEC report of Niger State between 2017 and 2021 is not a good one as well. Hence, it is necessary to look into current methods of teaching science to get suitable approaches that would lead to effective teaching and learning of ecology and biology in general that will in turn improve the biology performance of Senior Secondary School Students in Niger State. Based on the reasons above, this study focused on "context and inquiry-based instructional approaches on secondary school students' achievement in biology in Niger state, Nigeria".

Aim and Objectives of the Study

The aim of this research is to determine the effects of the context-based and inquiry-based instructional approaches on students' achievement in Biology in Niger State.

Therefore, the study strived to achieve the following:

i. Examine the effect of context and inquiry-based instructional approaches on achievement in ecological concepts among senior secondary school students in Niger State.
ii. Find out the effect of Context and Inquiry-based instructional approaches on the achievement of male and female students taught Ecological concepts in senior secondary schools in Niger State.

Research Questions

The following research questions were raised:

i. What are the effects of Context and Inquiry-based instructional approaches on secondary school students' achievement in Ecological concepts in Niger State?

ii. What is the effect of Context and Inquiry-based instructional approaches on the achievement of male and female students taught Ecological concepts in senior secondary schools in Niger State?

Hypotheses

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

HO_1: There is no significant difference in the achievement scores of students taught ecological concepts using context and inquiry-based instructional approaches and those taught with the traditional method.

HO_2: There is no significant difference in the mean achievement scores of male and female students taught Ecological Concepts with Context and Inquiry-based instructional approaches.

Methodology

The research adopted a quasi-experimental research design which was a pretest, posttest, non-equivalent, non-randomised experimental control group design. The population of the study comprises 57,947 Senior Secondary School two (SSII) students, which comprises 32,029 males and 25,917 females spread across Senior Secondary Schools in Niger State. The sample for this research study comprised 225 males and 187 females making a total of 412 students and they were drawn from nine co-educational senior secondary schools selected randomly through a stratified sampling technique from the three (3) senatorial zones of the state (zones A, B & C). The Treatment instruments for the study are Context and Inquiry-Based Instructional Approaches. The Test Instrument for the study is the Ecology Achievement Test (ECOLAT) which contains 50 multiple-choice questions with four options (A-D) in which only one of the options is correct. ECOLAT was used at the pretest to determine the students' entry behaviour and also at the post-test to determine the student's achievement. The Instruments were subjected to face and content validation by 3 experts. The two experimental groups and control group were all given a pretest before the treatment. Experimental group one was exposed to a context-based teaching approach, experimental group two was exposed to an inquiry-based teaching approach while control group was exposed to traditional teaching methods as treatments. The treatment was administered on the groups for six weeks while the posttest was conducted on the groups after treatment. Mean and Standard deviation was used to answer the research questions while ANCOVA and MANCOVA was used to analyze the research hypotheses.

Results

Research Question One: What are the effects of Context and Inquiry-based instructional approaches and traditional methods on secondary school students' achievement in Ecological concepts in Niger State?

Table 1: Mean and Standard Deviation of Pretest and Posttest Scores of Context-Based Instructional Approach, Inquiry-Based Instructional Approach and Traditional Method on Secondary School Students' Achievement in Ecological Concepts.

Group	N	Pretest		Posttest		Mean Gain	Mean Difference
		$\bar{X}$	SD	$\bar{X}$	SD		
Context-Based	152	24.95	5.19	74.18	10.29	49.23	6.59
Inquiry-Based	153	25.63	7.22	68.27	12.15	42.64	
Traditional Method	107	24.95	5.193	43.88	9.79	18.93	23.71

Table 1 shows the mean and standard deviation of achievement scores of the two experimental groups and the control group in the pretest and posttest. The result revealed that the mean and standard deviation scores of the pretest and posttest of experimental group one, context-based are $\bar{X}$ =24.95, SD = 5.19 and $\bar{X}$ = 74.18, SD = 10.29 respectively. This gives a mean gain of 49.23. The table also shows the mean and standard

deviation of the pretest and posttest of the Inquiry-based as $\bar{X}$ = 25.63, SD = 7.22 and $\bar{X}$ =68.27, SD 12.15 respectively. This also gives a mean gain score of 42.64. On the other hand, The mean and standard deviation of the pretest and posttest of the Traditional method are $\bar{X}$ = 24.95, SD = 5.19 and $\bar{X}$ =43.88, SD= 9.79 respectively. The results revealed that experimental group one, and two and the control group, had mean gains of 49.23, 42.64, and 18.93 respectively with a mean difference of 6.59 between experimental groups 1 and 2, a mean difference of 23.71 between experimental group 2 and the traditional method and mean difference of 30.30 between experimental group 1 and traditional method. Therefore, both Context-Based and Inquiry-Based instructional strategies improve the achievement of biology students in Ecology far better than the traditional method while the experimental group one which is Context-Based has the highest mean gain.

Research Question Two: What are the effects of Context and Inquiry-based instructional approaches on the achievement of male and female students taught Ecological concepts in senior secondary schools in Niger State?

Table 2: Mean and Standard Deviation of Pretest and Posttest Achievement Scores of Male and Female Experimental Groups Context-based and Inquiry-based

Group		N	Pretest		Posttest		Mean Gain
			$\bar{X}$	SD	$\bar{X}$	SD	
Context-based	Male	77	26.36	7.12	74.52	10.49	48.16
	Female	75	26.59	7.26	73.84	10.14	47.25
Inquiry-based	Male	72	22.31	5.08	69.25	12.10	46.94
	Female	81	22.22	4.82	67.41	12.21	45.19

Table 2 shows the mean and standard deviation of the pretest and posttest achievement scores of male and female of the two experimental groups (Context-based and Inquiry-based). From the result, it can be seen that mean score of the pretest and posttest score of male in context-based group are $\bar{X}$ = 26.36, SD = 7.12 and $\bar{X}$ = 74.52, SD = 10.49 respectively. The mean gain is 48.16. Similarly, the mean and standard deviation of pretest and posttest score of female in context-based are $\bar{X}$ = 26.59, SD = 7.26 and $\bar{X}$ = 73.84, SD = 10.14 respectively, the mean gain for the female here is 47.25. The male has slightly more gain score than the female. From the table also, the mean and standard deviation of the pretest and posttest scores of male in experimental group two(Inquiry-Based) can be seen that mean score of the pretest and posttest score of the male are $\bar{X}$ = 22.31, SD = 5.08 and $\bar{X}$ = 69.25, SD = 12.10 respectively. The mean gain for the male here is 46.94. Also, the mean and standard deviation of pretest and posttest score of female in inquiry-based are $\bar{X}$ = 22.2, SD = 4.82 and $\bar{X}$ = 67.41, SD = 12.21 and the mean gain is 45.19.

Hypothesis One: There is no significant difference in the achievement scores of students taught Ecological Concepts using Context and Inquiry-based instructional approaches and those taught with the traditional method.

Table 3a: ANCOVA Analysis of achievement scores of students taught Ecological Concepts using Context-based, Inquiry-based and traditional methods.

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	69321.831[a]	3	23107.277	228.911	.000
Intercept	56401.216	1	56401.216	558.735	.000
PRETEST	7445.392	1	7445.392	73.757	.000
GROUP	59915.282	2	29957.641	296.773	.000
Error	41185.341	408	100.944		
Total	1804337.000	412			
Corrected Total	110507.172	411			

Table 3a shows the ANCOVA comparison of Posttest Scores of the experimental groups (Context and Inquiry based instructional approaches) and traditional method. An examination of table shows F (2, 408) = 296.773, $p < 0.05$, the results of the analysis indicate that hypothesis one was rejected on the basis that the main effect (treatment) was significant. The results revealed that the Context-based instructional approach, Inquiry-based instructional approach and traditional method produced a significant effect on the posttest achievement scores of students when covariate effect (pretest) was controlled. The result indicates that the treatments used, which are Context and Inquiry based instructional approaches and traditional method accounted for the difference in the posttest achievement scores of the students. This implies that a statistical significant difference exists among the three groups. Since it was established that there was a significant difference in the post-test scores of the groups, Sidak post-hoc test analysis was done to identify the direction of the difference among the treatment groups as shown in Table 3b.

Table 3b: Sidak Post-hoc Analyses of the Groups Mean Scores Context-based, Inquiry-based instructional approaches and traditional method

(I) GROUP	(J) GROUP	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence Interval for Difference[b] Lower Bound	Upper Bound
Tradition method	Context-based	-29.875*	1.269	.000	-32.917	-26.833
	Inquiry-based	-23.968*	1.267	.000	-27.006	-20.930
Context-based	Tradition method	29.875*	1.269	.000	26.833	32.917
	Inquiry-based	5.907*	1.151	.000	3.148	8.666
Inquiry-based	Tradition method	23.968*	1.267	.000	20.930	27.006
	Context-based	-5.907*	1.151	.000	-8.666	-3.148

Sidak post-hoc analysis on Table 3b indicated that the observed significant difference between traditional method and Context-based instructional approaches group is with the mean difference of 29.87, P-value of .000 which was significant at 0.05 level in favour of the context based group. There was also a significant difference between traditional method and inquiry instructional approach, the mean difference is 23.96, *P*-value of .000 which was also significant at 0.05 levels. The mean difference here is in favour of inquiry-based learning group. Similarly, there was a significant difference between context-based and inquiry-based learning strategy group with the mean difference of 5.90, p=0.00, the mean difference is in favour of the

context-based group. Therefore, context-based and inquiry-based groups did better than the traditional method, however, the group that contributed most to making it significant was found to be context-based group because of its highest mean differences of 29.87 when compared with other groups. There was significant difference between the 3 groups, therefore, hypothesis one is rejected.

Hypothesis Two: There is no significant difference in the mean achievement scores of male and female students taught Ecological Concepts with Context and Inquiry-based instructional approaches.

Table 4: MANCOVA Analysis of mean achievement scores of male and female students taught Ecological Concepts with Context and Inquiry-based instructional approaches.

		Value	F	Hypothesis Df	Error Df	Sig
GENDER of Achievement Context-based * gender Inquiry based	Pillai's Trace	.023	1.687[b]	2.000	145.000	.189
	Wilks' Lambda	.977	1.687[b]	2.000	145.000	.189
	Hotelling's Trace	.023	1.687[b]	2.000	145.000	.189
	Roy's Largest Root	.023	1.687[b]	2.000	145.000	.189

Table 4 shows the Multivariate effect gender on pretest and posttest mean scores of male and female students taught Ecological Concepts with Context and Inquiry-based instructional approaches; Pretest as Covariate. The table reveals that when dependent variables (pretest and posttest score) were combined and pretest controlled, there was no significant difference in the mean achievement scores of male and female students taught Ecological Concepts with Context and Inquiry-based instructional approaches. $F(2, 145) = 0.97$, $p > 0.05$, Wilkis' $\lambda = 1.687$. The results of the analysis indicate that hypothesis two should be accepted on the basis that the multivariate effect of gender was not statistically significant on the combined pretest and posttest test mean scores of students taught Ecological Concepts with Context and Inquiry-based instructional approaches. There was no significant difference in the mean achievement scores of male and female students taught Ecological Concepts with Context and Inquiry based instructional approaches. Base on this, hypothesis two is retained.

Discussion of Findings

This study showed that there was significant difference in the achievement scores of students taught Ecological Concepts using Context and Inquiry based instructional approaches and those taught with the traditional method in favour of the two experimental groups . This is in support of the findings of Fikadu and Shimeles (2019) who investigated the effect of context-based instructional approaches on students' problem-solving skills using a quasi-experimental design. The study found that context-based instructional approaches are relatively better than traditional instruction in enhancing students' problem-solving skills. This study is also in support of the study of Esra and Figen (2015) who studied the effect of a "context-based learning approach" towards students' biology success and attitudes on biology courses where the result of the analysis shows that there is a meaningful difference between the context-based learning approach and traditional learning on students' success and attitudes towards biology in favour of context based group. The findings of this study also aligned with the study of Mwenda and Ndayambaje (2021) who examine the effect of inquiry-based teaching method on secondary students' academic achievement in Biology and the findings of the study showed that the use of inquiry-based teaching had a significant effect on the students' achievement in Biology. The findings of this study is also in agreement with the study of Oyovwi (2021) who examined the effects of concept mapping and inquiry method in teaching difficult curriculum in secondary school Biology on students' academic achievement in Delta State. The result of the study showed a significant difference between the performance of students exposed to the two experimental groups (Concept-Mapping and inquiry methods) and the control group (lecture method) in favour of the experimental groups.

This study showed that there was no significant difference in the mean achievement scores of male and female students taught Ecological Concepts with Context and Inquiry-based instructional approaches. This is in support of the study of Aransi (2018) who examined the impact of age and gender on High School students' academic performance in Economics and the findings indicated that there was no interactive influence of gender on the academic performance in Economics. It is also in line with the study of Oludipe (2012) who examined the influence of gender on Junior Secondary Students' Academic Achievement in Basic Science using Co-operative Teaching Strategy, findings of the study revealed that there was no significant difference in the academic achievement of male and female students in the pretest, post-test and delayed post-test levels. This result also supported the study of Nkok and Anietie (2022) who conducted a study on the interaction effect of gender on teaching methods and the result revealed that teaching method by gender interaction is not significant. On the other hand the finding of this study is not in support of the study of Vooren *et al.,* 2022 who compared success of female students to their male counterparts in the STEM fields, an empirical analysis from enrollment until graduation using longitudinal register data and discovered that females performed better than their male counterparts in their studies. Also, this study is not in support of Ibrahim (2016) work on the Effects of computer assisted instruction with animation and concept mapping on achievement and retention of secondary school Biology students who discovered in his research work that males performed better than the female academically.

Conclusions

The study investigated Context and Inquiry Based Instructional Approaches on Secondary School Students' Achievement in Biology in Niger State, Nigeria". From the findings of the study and discussions that followed, the following conclusions were made:

Context and Inquiry based instructional approaches were very effective in enhancing the academic achievement in Ecology concepts among senior secondary school biology students of Niger State, probably because the two methods were active methods of teaching that allowed the students to be actively involved in the teaching learning method.

Based on the findings of this research, it was found also that gender does not have any influence on the achievement of both male and female biology students taught Ecology concepts with context and Inquiry-based instructional approaches, indicating that the two experimental methods are gender friendly.

Recommendations

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

1) Science teachers should incorporate the idea of using Context and Inquiry-based instructional approaches in teaching science subjects in secondary schools since the study has shown that the students taught with the two experimental methods perform far better in achievement than those taught with the traditional method.
2) The two experimental methods are gender friendly, it is therefore recommended to be used as means of disseminating instructions in secondary schools to reduce the gap in the performance of male and female students.
3) Government and stakeholders of education at all levels should provide adequate funds to purchase instructional materials and for easy movement needed in this teaching method since it involves teaching students with real life situations.

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VIRTUAL REALITY (VR) FOR INSTRUCTIONAL PURPOSE; AWARENESS AND INTEREST OF COLLEGES OF EDUCATION LECTURERS IN YOBE STATE, NIGERIA

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Abstract
The study investigated lecturer's awareness and interest in using virtual reality for instructional purposes in colleges of education in Yobe State, Nigeria. Descriptive survey research design was used and the target population for the study was all lecturers of Federal College of Education (Tech) Potiskum. The total population was 369 lecturers as at 2021/2022 session. Therefore, 186 lecturers were randomly selected to serve as a sample size in consideration with Krejcie and Morgan table for determining sample size. A structured questionnaire titled (VR awareness questionnaire) was constructed and used for data collection. The questionnaire undergoes rigorous editing by experts by measurement and evaluation, English and educational technology experts. The questionnaire was arranged in conformity with modified likert scale. The questionnaire was tested and validated using Cronbach's Alpha correlation co-efficient test and 0.89 was obtained as a reliability co-efficient which indicated that the questions or instrument is valid and reliable. The instrument was administered using Google form. A total of one hundred and eighty six responds was collected from lecturers and filtered for data analysis. The collected data was transferred to excel and Statistical Package for Social Sciences (SPSS version 25.0) for analysis. Simple percentages was used to describing gender and answer the research questions while independent sample T-test was used in testing the only hypothesis at 0.05 level of significance. The study reveals that, colleges of education lecturers are aware of virtual reality technology going by 56.2% of the total populations (186). It was also reveal that, college's lecturers are interested in using virtual reality for instructional purposes by considering 63.0% are interested. Lastly, there is no significance difference between male and female lecturers in the awareness of virtual reality for instructional purposes in colleges of education in Yobe State, Nigeria. Finally, the researcher recommend that, School administrators should provide adequate virtual reality glasses and soft wares to the teachers. School administrators should encourage their staff to use virtual reality in their classes. Seminars workshops and training sessions should be organized for lecturers on the importance of VR in facilitating teaching and learning.

Keywords: Virtual reality, instruction, awareness, Interest.

Introduction

As the world is turning from analog mode to more advanced digital environment by introducing technology in to day today's activity to simplify and modify ways of performing duties. So also, our educational sectors most adjust to suit the changed environment in other to produce up to date learner's that can withstand the global challenges of innovative learning. As implies, "no education can rise above the quality of its teachers". Our teachers most also migrate from traditional or analog to more advanced, innovative and digital form of teaching and learning so that they can assist in producing relevant learner's that will face the global challenges. Virtual reality is a new innovation in the field of education that comes with everything teachers need to engage and improve students' performance. Although, no technology can totally replace human interaction in teaching learning process but all it can, is to enhance or improve students' performance. It is also a tool that gives students a dimensional perspective and firsthand experience about things understudy. VR help learner's to have experience of fast events by using various senses while they are within the classroom boundary. According to Musten (2021), The traditional methods of reading and learning the theory might not interest all the students but virtual reality setup is a comprehensive and

entertaining one where the students can easily and simply learn things by watching them, relating to them while they're in the classroom.

According to Mazuryk, T & Gervautz, M. (1999), Virtual reality is an interactive and immersive (with the feeling of presence) experience in a simulated (autonomous) world. Similarly, Smutný, Babiuch & Foltynek (2019), also defined VR as an artificial set of images and sounds, produced by a computer to create a simulated environment that incorporates auditory, visual, haptic, and other types of sensory feedback. This technological innovation in the field of education can be used to create artificial of simulated environment similar to the real world that is not possible for an individual to experience in a real or physical situation. It was affirm by Amos, Omotayo, Omotayo, Olanrewan & Micheal (2020), that, the major target of VR is involving the user in the artificial environment, in order to invent the fantasy of being in an environment that can be comprehended as a realistic place with sufficient interactivity to carry out tasks in a proficient and comfortable way. VR give learner's an advantage of acquiring skills and knowledge in the virtual environment while they are within the boundaries of their classrooms. The experience gained by using VR is easier to remember because it involved all senses (hearing, feeling and seeing).

An innovative teacher always exposed learners to technology that will help them to critically think ahead and acquire skill of delivering things in multidimensional approaches. Hu-Au and Lee (2017) lament that, educators who teach in the experience age, must embrace and leverage better methods to deliver the most effective learning experiences.

VR is described as a cutting-edge technology that allows learners to step through the computer screen into a 3-D interactive environment (Amos, Omotayo, Omotayo, Olanrewan & Micheal 2020). Lee & Wong, (2016) says that, It provides a different ways to see and experience information beside being used as a tool for model building and to enhance problem solving skills. Abdullahi (2020), examined the determinants of virtual labs adoption among physics teachers in Ilorin-west local government area of Kwara State and established that Physics teachers' perceived usefulness and ease of use of virtual laboratory have positive influence on the adoption of virtual laboratory. Educators have begun to embrace VR and its wide possibilities for learning as the technology rapidly moves to the mainstream and is especially useful for providing several opportunities: such as, increasing student engagement; providing constructivist, authentic experiences to impact student identity; allowing for new perspective taking and empathy; and supporting creativity and the ability to visualize difficult model (Hu-Au and Lee 2017).

According to Dewey, (1913), interest made a significant contribution to what people paid attention to and remembered. He mentioned that, interest facilitates learning, improves understanding and stimulates effort as well as personal involvement. In another view, interest involves an enduring predisposition of engagement with particular content or tasks over a period of time and is characterized by positive feelings, more stored knowledge and more stored value for the content. An individual with a well-developed interest for particular content will autonomously favor that content over other activity and the individual is likely to be not dependent on external factors such as the environment to sustain his interest (Hidi & Renninger, 2006). In a research conducted by Salihu, (2021), revealed that there is a significant difference in mean scores of interest in Physics between those exposed to virtual reality-based instruction and those taught using conventional teacher-based method. This implies that the use of virtual reality-based instructional strategy in teaching enhances students' interest. VR triggered learner's interest on the topic of discussion in the classroom during teaching and learning process (Huang, Richter, Kleickmann & Richter 2022).

Objectives/purpose

1. To investigate lecturers awareness of virtual reality for Instructional purpose
2. To find out lecturers interest on the use of virtual reality for Instructional purpose
3. To find out gender difference in the lecturers awareness of virtual reality for Instructional purpose

Research Questions

1. What is the level of lecturer's awareness of virtual reality for Instructional Purpose?
2. Does lecturers' have interest on the use of virtual reality for Instructional Purpose?
3. What is the gender difference in lecturer's awareness of virtual reality for Instructional purpose?

Hypothesis

There is no significance difference between male and female lecturers in the awareness of virtual reality for instructional purposes.

Methodology

Descriptive survey research design was used and the target population for the study was all lecturers of Federal College of Education (Tech) Potiskum. The total population was 369 lecturers as at 2021/2022 session. Therefore, 186 lecturers were randomly selected to serve as a sample size in consideration with Krejcie and Morgan table for determining sample size. A structured questionnaire titled (VR awareness questionnaire) was constructed and used for data collection. The questionnaire undergoes rigorous editing by experts by measurement and evaluation, English and educational technology experts. The questionnaire was arranged in conformity with modified likert scale. The questionnaire was tested and validated using Cronbach's Alpha correlation co-efficient test and 0.89 was obtained as a reliability co-efficient which indicated that the questions or instrument is valid and reliable. The instrument was administered using Google form. A total of one hundred and eighty six responds was collected from lecturers and filtered for data analysis. The collected data was transferred to excel and Statistical Package for Social Sciences (SPSS version 25.0) for analysis. Simple percentages was used to describing gender and answer the research questions while independent sample T-test was used in testing the only hypothesis at 0.05 level of significance.

Result and Discussion

This section present the result obtained from the collected data based on the questions presented to the lectures as well as discussing the result in detail.

Table 1- Demographic data of the respondents based on gender

Gender	Frequency	Percentage (%)
Male	120	64.5%
Female	66	35.5%
Total	186	100%

Table 2: What is the level of lecturer's awareness of virtual reality for Instructional Purpose?

S/N	QUESTIONS	Response			
		Strongly Agreed	Agreed	Strongly Disagreed	Disagreed
1	I am aware of virtual reality (VR) technology.	64 (34.4%)	79 (42.5%)	10 (5.4%)	33 (17.7%)
2	I am of the cognizant of the relevancy of VR for educational activities	12 (6.5%)	15 (8.1%)	81 (43.5%)	78 (41.9%)
3	I come across the concept of VR technology during my personal reading.	100 (53.8%)	74 (39.8%)	03 (1.6%)	09 (4.9%)
4	I am aware of the use of VR technology for instruction and it helps to reduce teacher barding and simplify learners understanding.	09 (4.8%)	20 (10.8%)	84 (45.2%)	73 (39.2%)

5	I have heard about VR technology application in to education but don't have any knowledge about it.	52 (27.9%)	91 (48.9%)	27 (14.6%)	16 (8.6%)
6	VR does not have any impact on learning, it is just for entertainment.	36 (19.4%)	104 (55.9%)	29 (15.6%)	17 (9.1%)
7	I have firsthand knowledge about VR and its application in to classroom activities.	22 (11.8%)	20 (10.8%)	98 (52.7%)	46 (24.7%)
8	VR technology does not encourage learning and retention.	77 (41.4%)	64 (34.4%)	33 (17.7%)	12 (6.5%)
9	VR takes learners to different learning environment that is not relevant to the present or current learning content.	62 (33.3%)	40 (21.5%)	56 (30.1%)	28 (15.1%)

The above table shows the number and percentage of each question respond by the respondents. In question one, 64 teachers which represent (34.4%) strongly agreed and 76 which represent (42.5%) agreed that they are aware of virtual reality technology while 10 out of 186 (5.4%) and 33 of 186 (17.7%) of teachers strongly disagreed and disagreed that they aware of VR technology.

In question two, the number of teachers voted for each scale shown in the table above. 12 (6.5%) and 15 (8.1%) out of 186 strongly agreed and agreed that, they are of the cognizant of the relevancy of VR for educational activities. Furthermore, 81 (43.5%) and 78 (41.9%) out of the 186 teachers strongly disagreed and disagreed of the opinion of the cognizant of the relevancy of VR for educational activities.

Furthermore, in question three, 100 teachers out of 187 (53.8%) strongly agreed and 74 out of 186 (39.8%) agreed that, they come across the concept of VR technology during their personal research. However, only 3 (1.6%) and 9 (4.9%) out of 186 teachers strongly disagreed and disagreed with the statement.

The number of teachers responds to question four shows that, only 9 (4.8%) and 20 (10.8%) out of 186 teachers agreed that, they are aware of the use of VR technology for instruction and it helps to reduce teaching barding and simplify learners understanding. In parallel to the stated statement, 84 (45.2%) out of 186 teachers and 73 (39.2%) out of 186 teachers strongly disagreed and disagreed with the opinion.

Moreover, the number of teachers' votes for question five identifies that, 52 (27.9%) and 91 (48.9%) respectively strongly agreed and agreed with the view that, they have heard about VR application in to education but they don't have any knowledge about It. In contrary to their view, 27 (14.6%) out of 186 strongly disagreed and 16 (8.6%) of the total population 186 agreed with the opposite idea.
The responds of question six from the table shows that, 36 and 104 which represent (19.4%) and (55.4%) out of 186 teachers respectively strongly agreed and agreed that, VR does not has any impact on learning, it is purposely for entertainment while 29 (15.6%) out of 186 and 17 (9.1%) out of the same population of teachers strongly disagreed and disagreed that, VR does not has any impact on learning, it is purposely for entertainment.

From the table question seven was responded as, 22 teachers out of 186 (11.8%) and 20 out of 186 (10.8%) strongly agreed and agreed that, they has firsthand knowledge or information about VR and its application in the classroom. While 98 (52.7%) and 46 (24.7%) out of 186 teachers says that, they don't have firsthand knowledge about VR and its applications in the classroom environment.

The responds of question eight indicated that, 77 (41.4%) out of 186 teachers strongly agreed, 64 (34.4%) out of the total population of 186 teachers agreed, 33 (17.7%) teachers out of 186 strongly disagreed and only 12 representing (6.5%) out of 186 disagreed that, VR technology does not encourage student learning and knowledge retention.

Lastly, in the view of question nine which says that, VR takes learners to different learning environment that is not relevant to the current or present learning environment. 62 out of 186 (33.3%) teachers strongly agreed, 40 teachers representing (21.5%) agreed, 56 (30.1%) out of 186 strongly disagreed and finally, 28 out of 1`86 teachers disagreed by the saying.

The overall result of the table shows that, 56.2% of the total populations (186) are aware of the virtual reality technology for instructional purpose. The finding is similar to that of Soetan, Amos, Adenike, Omotayo, Olanrewaju and Micheal (2020), in a study titled Computer teachers awareness of virtual reality for Instructional purpose in kwara state, The findings established that, Virtual Bicycle and 3D Map world are the virtual reality facilities which most respondents are aware for instructional purpose. By virtue of the above statement, teachers are aware of virtual reality for instructional purpose. However, in contrary to the findings, ISSA, Onojah, Onojah, Adefuye & Boris (2020), investigates the awareness of Argumentative Reality (AR) among pre-service teachers and the results indicates that, 31.3% of the respondents have come across AR concept before while 68.7% claimed not to have come across AR concept before. This shows that, pre-service teachers are not aware of AR technology application in education.

Table 3: Does lecturers' have interest on the use of virtual reality for Instructional Purpose?
From the table above, teachers interest in using virtual reality for instructional purpose was highlighted and

S/N	QUESTIONS	Response			
		Strongly Agreed	**Agreed**	**Strongly Disagreed**	**Disagreed**
1	I am interested in using virtual reality for instructional purpose	94 (50.5%)	63 (33.9%)	20 (10.8%)	09 (4.8%)
2	I am motivated by using virtual reality in my class	68 (36.5%)	76 (40.9%)	23 (12.4%)	19 (10.9%)
3	Virtual reality encourages my students to come to class and encourage active participation during questioning session.	24 (12.9%)	33 (17.8%)	57 (30.6%)	72 (38.7%)
4	As a teacher, I want students to use virtual reality technology in my class.	82 (44.1%)	61 (32.8%)	20 (10.7%)	23 (12.4%)
5	I always encourage my students to learn by using virtual reality technology.	12 (6.4%)	19 (10.2%)	84 (45.2%)	71 (38.2%)
6	I want virtual reality application to be one of the topics to be taught in schools.	73 (39.3%)	60 (32.4%)	39 (20.9%)	14 (7.5%)
7	As a teacher, I want parents to help in using virtual reality technology.	81 (43.6%)	74 (39.8%)	20 (10.7%)	11 (5.9%)

the voted result of 94 (50.5%) teachers strongly agreed, 63 (33.9%) mark agreed, while 20 (10.8%) and 9 (4.8%) respectively selected strongly disagreed and agreed. Next to the number one question is question two which says, I am motivated by using VR in my class. 68 teachers out of 186 which represent (36.5%) strongly agreed, 76 (40.9%) of the 186 agreed. However, 23 (12.4%) and 19 (10.9%) strongly disagreed and disagreed respectively.

Virtual reality encourages learners to come to the class and increases active participation in the class. Going by the above question number three, the responds are as follows – 24 (12.9%) and 33 (17.8%) strongly

agreed and agreed while 57 (30.6%) and 72 (38.7%) strongly disagreed and disagreed with the above statement.

The responds of question four are shown in the above table in which 82 out of 186 (44.1%) of teachers voted strongly agreed, 61 out of 186 teachers agreed with the statement that says I want students to use VR technology in my class. While only 20 out 186 teachers strongly disagreed and 23 of 186 disagreed with the question. So also in question five, only 12 (6.4%) and 19 which represent (10.2%) out of 186 teachers honor the view that, I always encourage my students to learn using VR technology while 84 (45.2%) and 71 (38.2%) out of 186 teachers strongly disagreed and disagreed with the idea.

From the table, question six was responded by the respondents and the result reveled that, 73 of 186 (39.3%) teachers votes strongly agreed, 60 out of 186 (32.4%) teachers agreed with statement, however, 39 out of 186 (20.9%) teachers strongly disagreed while 14 (7.5%) of teachers disagreed with the question. Lastly, the data from question seven was collected according to teachers responds and the view was calculated in percentage as indicated. 81 out of the total population of 186 which represent (43.6%) of teachers strongly agreed with the view that, parents should help their children's to utilize virtual reality technology. 74 (39.8%) of teachers agreed while 20 (10.7%) and 11 (5.9%) out of 186 teachers strongly agreed and disagreed with the question. The overall result from table 3 shows that, 63.0% of college lecturers are interested in using virtual reality for instructional purposes. This finding was online with that of Karunanidhi and Raja (2015), his investigation revealed that, majority of the higher secondary school teachers, were found to have an average level of ICT interest.

Table 4: There is no significance difference between male and female lecturers in the awareness of virtual reality for instructional purposes.

S/n	Gender	N	M	SD	DF	T	Sig (2tailed)	Remark
	Male	120	1.56	0.77				
					311	0.58	0.72	Accepted
	Female	66	1.48	0.71				
	TOTAL	**186**						

From the above table, df value (311) = t-0.58, p = 72. This shows that, the stated null hypothesis which says that, there is no significance difference between male and female lecturers in the awareness of virtual reality for instructional purposes was accepted. This occurs as a result of the t-value (0.58) and the significance value of (0.72) was greater than the alpha value (0.05). The finding prove that of Soetan, Onojah, Aderogba, Obielodan, Ganiyu & Fakomogbon (2020) which says that, there was no significant difference between male and female teachers' awareness of virtual reality for instructional purpose. Meelissen, and Glas (2016) express the widespread gap in the attitude and (perceived) competency in information literacy between male and female teachers. However, Cuadrado-Garcia, Ruiz-Molina, and Montoro-Pos (2018) found little difference between genders which occurs as a result of females' teachers' frequent use of a virtual learning environment.

Conclusion

This study investigated virtual reality (VR) for Instructional Purpose; awareness and interest of Colleges of Education lecturers in Yobe State Nigeria. It was concluded that, colleges of education lecturers are aware of virtual reality technology going by 56.2% of the total populations (186) are aware of the virtual reality technology for instructional purpose. It was also concluded that, college's lecturers are interested in using virtual reality for instructional purposes by considering 63.0% are interested. Lastly, there is no significance difference between male and female lecturers in the awareness of virtual reality for instructional purposes.

Recommendation

School administrators should provide adequate virtual reality glasses and soft wares to the teachers.

School administrators should encourage their staff to use virtual reality in their classes
Seminars, workshops and training sessions should be organized for lecturers on the importance of VR in facilitating teaching and learning.

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PERCEPTION OF YOUTUBEAS A LEARNING TOOL AMONG PRE-SERVICE SCIENCE TEACHERS IN MINNA NIGER STATE

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Abstract
This study investigated the perception of YouTube as a learning tool among pre-service teachers in Minna, Niger state. Building on the Technology Acceptance Model (TAM) this study investigated student's perceived usefulness and ease of use of YouTube as a learning tool. The study adopted a cross-sectional survey design, the research population was 473 students from the Department of Science Education, Federal University of Technology Minna, Niger state, and 150 students which represent 30 percent of the research population, were randomly selected from the research population to serve as the research sample. A five-point rating scale Questionnaire was used as the instrument to collect data. The reliability coefficient was 0.84. The data collected was analyzed using mean and standard deviation. From the results of the study, students displayed a high level of perceived usefulness and perceived ease of use of YouTube as a learning tool. No significant difference was observed when the responses of male and female respondents were compared. Based on the results of the study it was recommendations that school administrators need to concentrate more on providing internet accessibility to students who would want to use YouTube for learning and tutorials, and lecturers should make available more educational content on YouTube since many students consider YouTube asa viable option for independent learning.

Keywords: Perception, YouTube, Pre-service Science Teachers.

Introduction

Generally, learning occurs inside the classroom, under the teachers' guidance and instruction. Nevertheless, learning is not only limited to just classroom experiences. It also happens outside the classroom where learners get to learn independently of a teacher. This independent learning outside the classroom offers a wide range of possible materials for learners to utilize. These resources include print materials (magazines, novels, newspapers among others), watching videos (visual materials), or listening to music (audio media). This has led to the incorporation of Information Communication Technology into the field of education.

The incorporation of technologies into the field of teaching and learning has recently become an area of great interest (Andrina & Nikola, 2019). Different types of technologies have been adopted in educational settings to support the process of teaching and learning. The development of video technology and the Internet, as well as the development of multimedia reproduction devices, using video as a web-based multimedia device has become more popular. Currently, several educational institutions produce online educational materials including videos. Students can have rapid access to these materials anywhere and anytime (Nagy, 2018). The development of the internet also brought about the development of social media channels (examples include *WeChat, Tumblr, WhatsApp, Snapchat, Facebook, YouTube, and Twitter*) which have also been adopted as means of transferring knowledge in the 21st century. These technological advancements have made various resources available for learners to learn different concepts within the classroom under the supervision of a teacher and independently outside the classroom (Mezhuyev, 2018).

Davis (1989), in his Technology Acceptance Model (TAM), asserted that when users are exposed to a new technology, their decision on how and when to use it is influenced by several factors, notable among them are:Perceived usefulness (PU): Fred Davis described this as the extent to which an individual believes that using particular technology would enhance his/her performance. It means whether or not an individual perceives that a particular technology will be beneficial for what they want to do.

Perceived ease-of-use (PEOU): Fred Davis described this as "the extent to which an individual believes that using a particular technology would be free from effort" (Davis 1989). It is most likely that a technology that has a simple interface will gain acceptance while complicated ones may not receive such acceptance. Mullen and Wedwick (2008), stated that YouTube founded in 2005, is the largest video-sharing social media platform which is considered to be relatively a new phenomenon, and teachers together with researchers have started to pay close attention to its possibilities within the educational setting. Mullen and Wedwick (2008), also suggested that videos have the potential to enhance almost any classroom lesson and that is are available on YouTube and other video-sharing websites such as TeacherTube, United Stream, worldTV, Yahoo Video,Google Video, and MSN soap box. YouTube provides free access to an appreciable amount of educational videos (Buzzetto-More, 2014) therefore making it a viable option for students to receive useful materials for learning purposes. According to Buzzetto-More (2014) YouTube EDU is a service for educators that contains short lesson from teachers, entire university courses, professional development materials and motivational videos from international leaders.

Berk (2010) in his research on the use of videos and the brain, stated that, the use of video in educational setting affected the students both hemispheres of the brain and emotional senses. He referred the use of videos educationally as "picture superiority effect" which explains that when concepts or ideas are presented in form of pictures, they are more likely to be remembered than in the form of words. The use of YouTube in an educational manner is beneficial for illustrating a concept, presenting an alternative viewpoint, stimulating a learning activity, and motivating the students.

Statement of the Problem

Teachers have a responsibility to teach learners according to the syllabus provided by the institution. Some aspects of the courses/subjects are however not covered by this syllabus. These aspects that are not covered by the syllabus could be very important for students in improving their understanding and mastery of such courses or subjects.

Learners require more experience and time to learn in a classroom. However, very limited time is usually allocated for each course/subject. This presents a great challenge for students to learn and practice concepts in the classroom. Limited time and practice in the classroom may result in a lack of confidence in using or applying such concepts or ideas by the students due to fear of making mistakes. This limitation to learning and practicing adequately in the classroom has made the need for the platforms to complement traditional classroom learning very paramount with YouTube being a viable option.

YouTube is fast becoming an outstanding platform for students to self-teach and enhance their learning skill for formal assessment in the classroom. However, there seem to be scarcity of literature on the subject of the effectiveness of YouTube as a learning tool, especially the influence that tutorial videos have on student learning. This study therefore aims to investigate the perceived effectiveness of YouTube among undergraduates in the Department of Science Education, Federal University of Technology Minna.

Research Questions

The following questions were proposed to guide the study.

1. What is the perceived usefulness of YouTube as learning tool among male science pre-service teachers?
2. What is the perceived ease of use of YouTube as a learning tool among science pre-service teachers?
3. What is the perceived usefulness of YouTube as a learning tool among science pre-service teachers based on gender?

Null Hypothesis

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

HO_1: There is no significant difference between male and female pre-service teachers' perceived usefulness of YouTube as a learning tool.

Literature Review

The latest innovations in recent technology have produced a variety of electronic devices and e-platforms that are accessible to teachers and learners at all levels of education (Jackman, 2019). The adoption and utilization of YouTube in academia has received enormous interest principally in the medical academic field as pointed out by different publications (Clifton & Mann, 2011; Green, *et al.*, 2018; Schaper*et al.*, 2014). Su and Kuo (2010) argued that YouTube is frequently used by university students and posting information literacy videos on YouTube increases visibility but does not easily achieve a comparable accomplishment of an extensive and well-structured tutorial. Numerous librarians not only build information literacy tutorials on their library websites but also post instructional short films on video-sharing sites for easy access and high visibility (Su &Kuo, 2010).

The use of YouTube in the teaching and learning process offers both students and teachers many benefits (Alkhudaydi, 2018). These benefits include: drawing learners' attention, focusing learners' attention, examining hard-to-examine experiences, creating interest in the subject, improving content attitudes, establishing a link with learners, encouraging resourcefulness, increasing teamwork, inspiring students, making learning pleasurable, reducing nervousness about intimidating topics, increasing general understanding of concepts.

It has been found through studies that YouTube is the best fit for students raised since the introduction of the World Wide Web (Net generation) and a viable means of tapping their multiple intelligences and learning styles (Lui, 2020) which has been widely accepted (Buzzetto-More, 2014; Donoker, 2011; Kelly *et al.*, 2010). The utilization of e-learning programs and blended learning has been discovered to improve discussion, collaboration, and engagement (Buzzetto-More, 2014; Greenberg & Zanetis, 2012; Revoir, 2012). Additionally, YouTube Videos can be incorporated into most learning systems and integrated into courses, assignments, quizzes, and tutorials (Snelson, 2010), in addition, they can be used to support autonomous learning and tutoring (Berk, 2010 and Kelly*et al.*, 2010). Whereas some researchers have found YouTube to be principally effective in facilitating full online courses (Jones & Graham, 2012), others have argued that the utilization of online video-sharing services like YouTube is primarily valuable when used to accompany rather than completely substitute hybrid or blended model of learning (Kelly *et al.*, 2010).

The term Technology Acceptance Model (TAM) was first introduced by Fred Davis in 1986. It explains the relationship between perceived ease of use and perceived usefulness and their connection with the external variables and the actual use of a particular technology. The Technology Acceptance Model (TAM) is the most prominent framework for measuring user acceptance of a system (Zhou*et al.*, 2019). Al-Gahtani, (2016) defined Technology acceptance as the learner's willingness to use technology for "the tasks it is designed to support". Additionally, the Technology Acceptance Model (TAM) is particularly adapted for examining user acceptance of a technology. In the Technology Acceptance Model, a user's behavioral intention to use a particular technology shows the user's acceptance of the technology (Lee & Lehto 2013).

The Technology Acceptance Model was built on two factors (perceived usefulness and perceived ease of use) which were used to determine whether or not an individual will adopt a particular technology (Chen*et al.*, 2012). Perceived usefulness measures the degree to which an individual believes that using a particular technology would enhance his or her job or life performance while perceived ease of use the measure of the extent to which an individual believes that using a particular technology would be free of effort (Chen*et al.*, 2012).

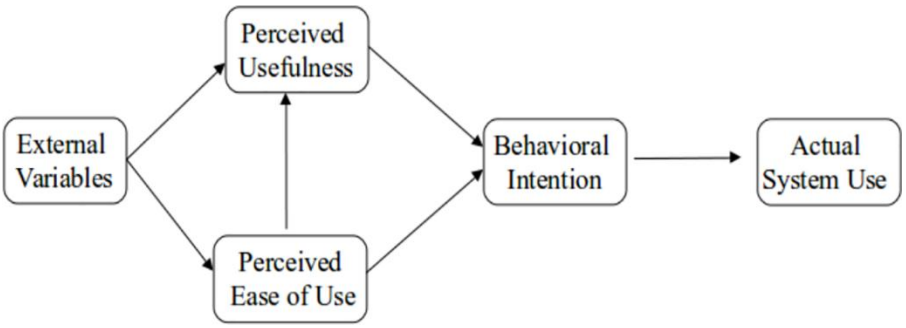

Figure 2.2: Technology Acceptance Model (Davis *et al.*, 1989)

Chen *et al.*, (2011) stated in their study that "perceived ease of use and perceived usefulness positively affect the attitudes toward an information system; and further, positively affect the individuals' intentions to use and the acceptance of the device or technology. In addition, perceived ease of use positively affects the perceived usefulness, and both of perceived ease of use and perceived usefulness are influenced by external variable."

Research Methodology

The study adopted a survey research design. The population of this study consists of the pre-service teachers in public Universities in Niger State while the target population was composed of 473 pre-service teachers in Department of Science Education Federal University of Technology Minna, Niger State.

A simple random sampling technique was used to randomly select a sample composed of 150 students (100-500 level) from the Department of Science Education, Federal University of Technology Minna, Niger State for the purpose of this study.

The researcher adopted questionnaire as instrument for collecting data. The questionnaire has three sections: A, B and C. Section "A" is on Demographic information of the respondents which includes sex, age, department and level. Section "B" is on the perceived usefulness of YouTube as a learning tool. It has a total of 15 items. Section "C" contains questions on the perceived ease of use of YouTube as a learning tool. It has 13 items; The research instrument was prepared using a 4 – point scale, ranging from "strongly agree" (SA), through "agree" (A), "disagree" (D) to "strongly disagree" (SD) which was scaled 4, 3 2 and 1 respectively.

The questionnaire was validated by experts in Educational Technology and Science Education department who evaluated the instrument to ascertain its appropriateness and also make recommendations. After the recommendations and corrections from the experts were effected the instrument was used for the purpose of data collection

The reliability coefficient of the instrument was obtained using Cronbach's Alpha, the most popular coefficient of reliability measure. Based on the result obtained on analysis using SPSS the value of Cronbach's alpha was 0.84 which is higher than the 0.70 minimum value (Nunnally1978). The data collected were analyzed using descriptive statistics (Mean and deviation). The mean and standard deviation was used in answering the posed research questions and the decision mean of 2.5 was used to determine student's perception.

Results

Research Question one

What is the perceived usefulness of YouTube as learning tool among science pre-service teachers? To answer this research question, mean and standard deviation were used and the results is presented in Table 1

Table 1: perceived usefulness of YouTube among Pre-service teachers

Items	N	Mean	S.D	Remark
Using YouTube in my own learning time gives me greater control over my studies.	146	3.08	.74	Positive
Using YouTube in my own learning time improves my learning productivity.	146	3.28	.81	Positive
Using YouTube in my own learning time enhances the effectiveness of my study activities.	146	3.25	.79	Positive
Using YouTube videos makes it easier to study/learn at my own pace.	146	3.30	.73	Positive
Using YouTube videos in my own learning tine improves the quality of assignments I do.	146	3.31	.69	Positive
Using YouTube videos in my own learning time enables me to accomplish study task more quickly.	146	3.20	.74	Positive
Using YouTube videos is another way for me to learn science	146	3.34	.71	Positive
YouTube exposes me with variety of videos for academic purposes.	146	3.40	.66	Positive
I learn new concepts from YouTube videos.	146	3.43	.65	Positive
I learn correct solutions to scientific problems from YouTube videos.	146	3.12	.67	Positive
Watching YouTube videos help in improving my listening skill.	146	3.27	.75	Positive
Watching YouTube videos help in improving my speaking skills.	146	3.01	.84	Positive
Watching YouTube videos help in improving my reading skill.	146	2.86	.88	Positive
Watching YouTube videos help in improving my writing skills.	146	2.56	.90	Positive
YouTube helps me share my science knowledge with others.	146	3.19	.76	Positive
Grand Mean		**3.17**	**0.75**	**Positive**

Table 1; all of the variables are classified as positive, since their mean values are greater than "2.44". This indicates that the Pre-service Teachers consider YouTube to useful academically and is utilized by the same for their academic work. They utilize YouTube for independent studies and as compliment for traditional classroom learning. They access videos that help them accomplish learning tasks faster and easier. The

grand mean from Table 4.2 is 3.17 which is greater than 2.5 criterion mean indicating that students perceive YouTube to be useful.

Research Question two

What is the perceived ease of use of YouTube as a learning tool among science pre-service teachers? To answer this research question, mean and standard deviation were used and the results is presented in Table 2

Table 2: Perceived Ease of Use of YouTube among Pre-service Teachers

Items	N	Mean	SD	Remarks
Using YouTube to learn science independently is easy	146	3.05	.60	Positive
Becoming skillful at using YouTube to learn science is easy	146	3.04	.77	Positive
Getting information using YouTube videos is easy	146	3.35	.57	Positive
I have easy access to the YouTube website	146	3.29	.70	Positive
It is easy for me to find materials in science learning on YouTube	146	3.29	.63	Positive
I am able to watch videos on YouTube as many times as I want	146	3.42	.67	Positive
YouTube provides an attractive learning environment	146	3.03	.83	Positive
I like using YouTube in learning science	146	3.07	.74	Positive
I am confident in using YouTube to learn science	146	3.04	.78	Positive
I enjoy choosing materials on YouTube in learning science	146	3.02	.78	Positive
Using YouTube videos independently enhances my confidence to learn science	146	3.16	.73	Positive
Using YouTube videos independently enhances my confidence to practice science	146	3.16	.70	Positive
Using YouTube enables me to control my own learning	146	3.20	.71	Positive
Grand Mean		**3.16**	**0.71**	**Positive**

From Table 2; all the variables have been classified to be positive because their mean is above "2.5". This indicates that Pre-service teachers perceive YouTube to be easy to use. They find variety of academic videos on YouTube which aid their learning and accessing such videos is quite easy. And accessing such videos is quite easy since the YouTube website can be accessed anywhere, at anytime and by anyone. The grand mean from Table 2 is 3.16 which is greater than 2.5 criterion mean indicating that students perceive YouTube to be easy to use.

Null Hypothesis One

There is no significant difference in the perceived usefulness of YouTube as a learning tool between male and female science pre-service teachers. To test this formulated hypothesis, an independent t-testwas employed and the results is presented in Table 3

Table 3: t-test result of Perceived usefulness of YouTube among Pre-service Teachers based on Gender.

Gender	N	X	SD	t	df	P-value	Remark
Male	76	61.65	8.00				
Female	70	64.19	9.54	-2.059	143	0.29	Not significant

From Table 3 the Mean of both male and female Pre-service teachers when compared using the independent t-test, the result shows no significant difference between the male and female students because the P-value was found to be greater than0.05level of significance. According to Tinner (2017), whenever P- the value is greater than the 0.05 significance level the null hypothesis is not rejected. This indicates that there is no significant difference in the perceived usefulness of YouTube as a learning tool between male and female Pre-service teachers.

Discussion of Results

Based on the results on the analysis above, the respondents showed high level of perceived usefulness of YouTube as a learning tool. This implies that the respondents consider YouTube to be useful for academic purposes as many of them have utilize it as a compliment for traditional classroom learning also as a tool for independent learning.

However, the respondents showed a relatively higher level of perceived usefulness of YouTube than that of Ease of Use of YouTube when both are compared. This means that even though the respondents consider YouTube to be useful for academic purpose, some of them also have slight challenges when it comes to ease of accessing and navigating YouTube for academic purpose.

Additionally, when the responses of the respondents were analyzed and compared based on gender, it was found that there was no significant difference in the level of perceived Usefulness and Perceived Ease of Use of male and female respondents. This indicates that both male and female pre-service teachers consider YouTube to be both useful and easy to use for academic purposes.

Finally, in terms of perceived Usefulness and Perceived Ease of Use, majority of the respondents from the population provided positive responses which suggested that they had high level of belief that using YouTube videos was useful and easy and did not require much effort or expertise. This suggests that, they did not encounter many problems in using YouTube as one of the medium of independent learning. The feedbacks from the respondents implied that the majority of the students in the Department of Science Education, Federal University of Technology Minna, Niger state belief that YouTube videos are useful medium to enhance their learning and this they can do with ease.

The findings in this study agree with the results of a study carried out at University of Kebangsaan, Malaysia in 2014 by Nabila Shamsuddin. Where she found that majority of the students in University of Kebangsaan displayed high levels of Perceived Usefulness and Perceived Ease of Use of YouTube as a learning tool. Additionally, it was also discovered in the same study that majority of the students from each faculty used YouTube as one of the medium learning.

Recommendations

Based on the findings of the study the following recommendations were made: school administrators such as vice chancellors and principals need to concentrate more on providing internet accessibility to students who would want to use YouTube for learning and tutorials. Additionally, lecturers and educators at all levels of education must begin to make available more educational contents on YouTube since many students consider YouTube for viable option independent learning and as a perfect complement of traditional classroom learning.

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EFFECTS OF MASSIVE OPEN ONLINE COURSE ON SECONDARY SCHOOL STUDENTS' RETENTION IN CHEMISTRY IN NORTH-CENTRAL, NIGERIA

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Abstract
The study investigated the effects of massive open online course on secondary school students' retention in chemistry in North-Central, Nigeria. A quasi-experimental- pre-test post-test non-randomized non-equivalent control research design was adopted. A multistage sampling technique was used to select 276 students who were randomly assigned to experimental groups I, II and control group from Federal Government College within the study area of 2023/2024 academic session. Three research questions and three corresponding were formulated and tested at 0.05 alpha level. The instrument used for data collection was Chemistry Achievement Test (CAT) which was validated and its reliability coefficient of 0.75 was obtained when analyzed using Pearson Product Moment Correlation (PPMC). The data collected were analyzed using Mean and standard were to answer the research questions while ANOVA was used to test the hypotheses. The findings of the study revealed a significant difference in the retention scores of students taught chemistry using MOOCs online, Hybrid MOOCs, and the conventional lecture method. Hybrid MOOCs had a significant difference positively as it influences students' ability to retain knowledge. When it was observed that significant difference occurred, Sidak pairwise comparisons was used to locate the direction of the differences. Students taught Chemistry using MOOCs online and Hybrid MOOCs achieved higher than those taught with conventional lecture method. Based on the finding, it was recommended among others that Federal government colleges should consider integrating MOOCs online and Hybrid MOOCs into chemistry instruction to enhance academic performance and retention.

Keywords: Massive Open Online Course, Retention, Chemistry, Hybrid MOOC

Introduction

Technological innovations in the 21st-century education system have brought about radical changes in how Information and Communication Technology (ICT) is applied in education. ICT as an enabler of online learning has greatly changed the learning spaces of teaching and learning in any institution, making it possible to access massive courses to support teachers and students' learning interactions (Ali, 2020).

This mean that ICT provides models of educational delivery platforms through the use of the internet to deliver courses typically known as online learning which has sprung up in different formats and forms to facilitate active learning, aid innovative teaching, motivate students and tutors (Diep et al., 2019). One of the specific initiative technological platforms that are fast growing in popularity with educational researchers, tutors and learners is the Massive Open Online Courses (MOOCs).

MOOCs are platforms that use web-based tools in the form of providing education opportunities to a large number of participants to attend free online courses across the globe from anywhere without restrictions or time zones (Bogart, 2023). MOOCs have been utilised in diverse ways regularly in the form of a flipped classroom to supplement traditional classroom teaching through the integration of an entire course or definite parts of a course at various levels of education. A more practical approach to MOOCs in its two distinct, aims at bringing in face-to-face interactions and online learning components together is known as a hybrid MOOC.

MOOC pedagogy appeals to educators due to its key assumption that blended learning provides an opportunity to take advantage of both the technological experiences provided by online learning and participation in traditional learning (Schettino & Capone, 2022). Therefore, using MOOCs as platform of learning can increase and stimulate students' curiosity in subjects such as Chemistry for a better understanding.

Chemistry is one of the essential science subjects that provides a foundation for understanding basic and applied scientific disciplines in general. Chemistry has been recognised as a very significant subject in science education, and its importance in the technological development of any nation has been extensively reported (Nja et al., 2022).

Conversely, the academic performance of students has not been satisfactory for many years (Umate et al., 2021) equally in Chemistry. Despite the numerous researches and instructional intensity over the years students' performance in the West African Senior Secondary School Certificate Examinations (WASSCE) is still on a steady rise and fall as students' performance is fluctuating in Chemistry.

Various factors have been attributed to the students' undulating academic performance in Chemistry. Several researchers avow that Chemistry contents are difficult to comprehend fully as work out of problems compel students to calculation which serves as a mental concern (Schmidt-Rohr, 2020). Specifically, the WAEC Chief Examiners Report from 2017–2021 stated that students' knowledge of periodic Table, organic Chemistry and acid-base reactions in Chemistry was poor, in spite of the numerous significant efforts made consistently over the years to improve the yearly performance. As highlighted in the WAEC (2018) chief examiners' reports, candidates' are weak in their inability to determine the choice of an indicator for an acid-base titration and their basic understanding of simple concepts in acid-base titration related concepts. Despite the laudable objectives of Chemistry in the school curriculum, the majority of its lessons are still taught using conventional methods. Many of the conventional mean of imparting knowledge have been somehow comparatively ineffective on the students' ability to master and then retain imperative concepts (Kooloos et al., 2020).

Students' retention is of key importance to their academic growth. Salem (2019) describes retention as the ability of students to recall the acquired knowledge from a particular subject. Retention is further exhibited by the learners through successful performance in the test organized to measure their achievement. Shikku and Mwangi (2023) opined that the retention of learned materials depends upon the type of instruction received. With access to massive open online courses, it will make students learn at their own pace, foster a strong community relationship among students and provide better experiences in increasing their retention capability. Therefore, the need for integrating instructional strategies could suit all those factors that are needed for improving students' academic retention irrespective of their gender.

Research on gender differences in academic achievement in science continues to result in indefinite conclusions and this can be attributed to the uneven exposure of males and females to learning instructional strategies applicable to the learning of Chemistry. Various studies show male students perform better than females (Oladejo et al., 2023); some revealed that female students are better off than their male counterparts (Bush et al., 2023) and to some, there is no influence of gender on their performance (Makarova et al., 2019).

However, the teaching and learning of Chemistry at the senior secondary school level in Nigeria have yet to explore learning on MOOCs, and its effect on academic retention have not received much experimental research attention. On this basis, this study investigate the effects of massive open online courses (MOOCs) on secondary school students' chemistry retention in North-Central Nigeria.

Research Question

The following research questions were raised to guide the study:

1. What is the difference in the mean achievement scores of students taught with MOOCs online, Hybrid MOOCs and those taught with conventional lecture method in Chemistry?
2. What is the difference in the mean retention scores of students taught Chemistry with MOOCs online, Hybrid MOOCs and those taught with conventional lecture method in Chemistry?
3. What is the difference in the mean retention scores of students taught with MOOCs online, Hybrid MOOCs and those taught with conventional lecture method in Chemistry based on gender?

Research Hypotheses

The hypothesis was formulated and tested at 0.05 level of significance:

HO_1: There is no significant difference in the mean achievement scores of students taught with MOOCs online, Hybrid MOOCs and those taught with conventional lecture method in Chemistry.

HO_2: There is no significant difference in the mean retention scores of students taught with MOOCs online, Hybrid MOOCs and those taught with conventional lecture method in Chemistry.

HO_3: There is no significant difference in the mean retention scores of students taught with MOOCs online, Hybrid MOOCs and those taught with conventional lecture method in Chemistry based on gender.

Research Methodology

The research design that was employed for this study is a quasi-experimental design which involves a pretest posttest non-randomized, non-equivalent, control group design. It involves three levels of independent variables, (three treatments – MOOCs online platform, Hybrid MOOCs and Conventional lecture method-CLM), two level of dependent variable, which is the achievement and retention and a moderating variable of gender (male & female). The three participating schools were assigned to MOOCs-only (without teacher interference), Hybrid MOOCs (with face-to-face tutor) and the conventional lecture method respectively. The population of this study comprised of the entire 7,783 Senior Secondary Schools Chemistry students in all Federal Government Colleges in North-Central Nigeria, namely; Benue, Kogi, Kwara, Nassarawa, Niger, Plateau and FCT Abuja. The target population of this study comprised all the 1,578 of Senior Secondary Schools (SSII) chemistry students as at 2023/2024 academic session. (Federal Ministry of Education). The sample for this study comprised of 276 Chemistry students from three senior secondary schools two (SSII) in all Federal Government Colleges in North-Central Nigeria. The research design layout is shown in table 1

Table 1: Research Design Layout

Groups	Pretest	Treatment	Posttest	Retention test
Experimental Group I	O1	X1	O2	O3
Experimental Group II	O1	X2	O2	O3
Control Group	O1	X3	O2	O3

O1 = represents pretest scores for all the groups.
O2 = represents post-test scores for all the groups.
O3 = represents retention scores for all the groups.
X1 = represents treatment for experimental group I on MOOCs-only platform.
X2 = represents treatment for experimental group II on Hybrid MOOCs.
X3 = represents treatment for represents control group without treatment

Multistage sampling techniques were employed in this study. Firstly, purposive sampling procedure was adopted to select three Federal Government Colleges in North-Central Nigeria. The schools were selected

based on the following criteria (i) gender composition (co-educational schools), (ii) availability of manpower and (iii) schools that have facilities and functional instructional learning resources. Secondly, the selected three equivalent co-educational schools were randomly assigned to each of the two experimental and a control group using simple random sampling technique. An intact class was used in this study where all students in the classroom was engaged in the teaching and evaluation processes. Table 2 shows the summary of the sampled schools.

S/N	Name of School	Male	Female	Total
1	FGC Ilorin (MOOCs platform)	37	54	91
2	FGC Kwali (Hybrid MOOCs)	39	49	88
3	FGC Ugwolawo (CLM)	42	55	97
	Total	**118**	**158**	**276**

Two research instruments were used in this study: (i) MOOCs platform, (ii) Chemistry Achievement Test (CAT). The MOOCs platform for teaching Chemistry at senior secondary school class II (SSSII) in Federal Government Colleges operated at two distinct modes: MOOCs-only (without teacher interference) and Hybrid MOOCs (with face-to-face tutor. The MOOCs platform was developed by the researcher and computer programmer. The concept of Chemistry (Periodic Table, Acid-base Reaction and Organic Compound) selected for this study are culled from the Nigeria Senior Secondary School curriculum. The instructional contents of the lesson plan of Chemistry concepts were prepared by the researcher. Chemistry Achievement Test (CAT) was constructed by the researcher based on the content of the topic. The CAT made up of two sections; section A and B. Section A was for collection of demographic data of the students such as state, class, name of school and gender while Section B contains of 50 multiple choice items on the concepts; Periodic Table, Acid-base Reaction and Organic Compound. It contains four options (A-D) having one correct option answer among the four options. All multiple-choice items are of parallel standard to those developed, validated and used for the conduct of West African Examination Council. The section B was allotted two marks per correct option. The total mark obtainable was converted to percentage (100%). The CAT was used to collect data on students' achievement was administered to the experimental and control groups as pretest and later as posttest and finally reshuffled to get the retention test. The face and content validation of the treatment was done by three senior lecturers from Chemistry Department, Federal University of Technology, Minna, three senior Chemistry teachers from Federal Government College, three experts from Test and Measurement Department of National Examination Council (NECO), Minna. Expert validation was done by three computer specialists, chemistry experts, and Educational Technology experts. All the observations and suggestions pointed out were effected, to make sure the instruments met the required standard and suitably covered the contents in the chosen topics. Field trial validation was conducted on 32 senior secondary chemistry students from Federal Government College in Minna.

To establish the degree of the reliability of CAT, a pilot test was conducted on thirty (30) randomly selected SS II Chemistry students of Federal Government College, using test-retest method in an interval of two weeks. This school was not be part of the sampled schools but part of the population that was used for the real study. The scores obtained were converted into percentage and analyzed using Pearson Product Moment Correlation (PPMC). The reliability coefficient of 0.75 was obtained from CAT indicating that the test instruments were reliable acceptable in accordance with Edmonds et al. (2017) suggesting that reliability should be 0.70 or probably higher. Prior to the treatments, CAT was administered as a pretest to the students in the groups to ascertain their level of ability. Thereafter, the MOOCs platform, Hybrid MOOCs and the Conventional lecture method were used to teach the Chemistry concepts for four weeks. Immediately at the end of the treatment period, administration of posttest to all the groups was done. Retention test was administered two weeks after the posttest. The chemistry acquisition of science process skills test was marked according to the marking scheme and the results were subjected to data analysis. The research questions were answered using Mean and Standard Deviation while the hypotheses were analyzed

using Analysis of Variance (ANOVA) at 0.05 alpha levels with the aid of SPSS version 25.0. was used to analyze the pre-test to ascertain the equivalence of the groups. Sidak pairwise comparison was employed to determine the direction of the significance.

Results

Research question 1: What is the difference in the mean achievement scores of students taught with MOOCs online, Hybrid MOOCs and those taught with conventional lecture method in Chemistry?

In answering research question one, the mean achievement scores of students taught with MOOCs online, Hybrid MOOCs and those taught with conventional lecture method in Chemistry was answered using Mean and standard deviation as presented in Table 3

Table 3: Mean and Standard Deviation of Pretest and Posttest Achievement Scores of Experimental Group I and II and the Control Group

Groups	**N**	**Pretest**		**Posttest**		**Mean Gains**
		$\bar{X}$	SD	$\bar{X}$	SD	
Experimental Group 1	91	40.18	17.02	79.04	14.26	38.86
Experimental Group 2	88	39.31	17.22	68.24	22.66	28.93
Control Group	97	43.39	18.75	53.56	20.25	10.17

Table 3 displays the mean and standard deviation of experimental group one treated with MOOCs online, and experimental group two treated with Hybrid MOOCs and the control group exposed to conventional lecture method at pretest and posttest. The mean achievement scores of experimental group one at posttest were higher (M = 79.04, SD = 14.26) than the pretest mean scores (M = 40.18, SD = 17.02), with a mean gain of 38.86. For experimental group two, the mean achievement scores on the posttest were higher (M = 68.24, SD = 22.66) than the pretest scores (M = 39.31, SD = 17.22), with a mean gain of 28.95. However, in the control group, the mean achievement scores on the posttest were lower (M = 53.56, SD = 20.25) than the pretest scores (M = 43.39, SD = 18.75), with a mean gain of 10.17. This implies that the changes that occur at pretest and posttest are attributed to the intervention given to the experimental group I and II. Therefore, students taught Chemistry using MOOCs online and Hybrid MOOCs achievedhigher than those taught with conventional lecture method respectively.

Research question 2: What is the difference in the mean retention scores of students taught Chemistry with MOOCs online, Hybrid MOOCs and those taught with conventional lecture method in Chemistry?
In answering research question three, the mean retention scores of students taught with MOOCs online, Hybrid MOOCs and those taught with conventional lecture method in Chemistry was answered using Mean and standard deviation as presented in Table 4

Table 4: Mean and Standard Deviation of Posttest and Retention Test Scores ofExperimental Group I and II and the Control Group

Groups	N	Posttest		Retention		Mean Losses
			SD		SD	
Experimental Group 1	91	79.04	14.26	65.64	17.45	-13.4
Experimental Group 2	88	68.24	22.66	54.74	19.27	-13.5
Control Group	97	53.56	20.25	49.22	14.24	-4.34

Table 4 displays the mean and standard deviation of experimental group one treated with MOOCs online and experimental group two treated with Hybrid MOOCs and the control group exposed to conventional lecture method at posttest and retention test. The mean retention scores of students for experimental group one was lower (M = 65.64, SD = 17.45) than the posttest scores (M = 79.04, SD = 14.26). The mean loss was -13.4 indicating a substantial loss in their retention. For experimental group two, the mean retention scores of the posttest were also lower (M = 54.74, SD = 19.27) than the posttest scores (M = 68.24, SD = 22.66). The mean loss was - 13.5 indicating a substantial loss in their retention. Nevertheless, in the control group, the mean retention scores were the lowest (M = 49.22, SD = 14.24) than the posttest scores (M = 53.56, SD = 20.25), with a mean loss of -4.34 which signifies a negligible loss. The mean losses for the experimental groups were less than 15% implying that students taught Chemistry with MOOCs online and Hybrid MOOCs, on average retained the concepts learnt. For students in the control group taught the same concepts with conventional lecture method indicated that their posttest scores were at the lower bound and had therefore retained close to 95.66% thus, losing only 4.34%.

Research question 3: What is the difference in the mean retention scores of studentstaught with MOOCs online, Hybrid MOOCs and those taught with conventional lecture method in Chemistry based on gender?

In answering research question four, the mean retention scores of students taught with MOOCs online, Hybrid MOOCs and those taught with conventional lecture method in Chemistry based on gender was answered using Mean and standard deviation as presented in Table 5

Table 5: Mean and Standard Deviation of Posttest and Retention Test Scores of Male and Female Students Taught Chemistry MOOCs online, Hybrid MOOCs and those taught with Conventional Lecture Method

Groups	N	Posttest		Retention		Mean Losses
		$\bar{x}$	SD	$\bar{x}$	SD	
Experimental 1 Males	37	81.03	6.55	71.19	16.15	-9.84
Experimental 1 Females	54	77.69	17.64	61.83	17.43	-15.86
Experimental 2 Males	39	83.49	8.767	65.85	12.02	-17.64
Experimental 2 Females	49	56.10	23.03	45.90	19.46	-10.2
Control Group Males	42	45.00	15.35	43.26	12.66	-1.74
Control Group Females	55	60.09	21.19	53.76	13.79	-6.33

Table 5 displays the mean and standard deviation of male and female students in experimental group one treated with MOOCs online at posttest and retention test indicated that the mean retention scores for male group was lower (M = 71.19, SD = 16.15) than their posttest scores (M = 81.03, SD = 6.55). The mean loss was -9.84 indicating a marginal loss in their retention. Forthe female group, the mean retention scores were also lower (M = 61.83, SD = 17.43) than the posttest scores (M = 77.69, SD = 17.64). The mean loss was -15.86 indicating a substantial lossof knowledge. This implies that male students retained up to 90.16% of knowledge, while the female students retained 84.14 % of Chemistry knowledge in the experimental group I.

Similarly, the mean and standard deviation of male and female students in experimental group two treated with Hybrid MOOCs at posttest indicated that the mean retention scores of the male group was lower (M = 65.85, SD = 12.02) than the posttest scores (M = 83.49, SD = 8.767). The mean loss was 17.64 indicating a substantial loss of knowledge. For the female group, the mean retention scores were also lower (M = 45.90, SD = 19.46) than the posttest scores (M = 56.10, SD= 23.03). The mean loss was -10.2 indicating a loss of knowledge. This implies that male students retained up to 82.36% of knowledge, while the female students retained 89.8% of Chemistry knowledge in the experimental group II.

Furthermore, the mean and standard deviation of male and female students in the control group exposed to conventional lecture method in Chemistry at posttest indicated that the mean retention scores for male group was lower (M = 43.26, SD = 12.66) than the posttest scores (M = 45.00, SD = 15.35). The mean loss was -1.74 indicating a minimal loss. For the female group, the mean retention scores were also lower (M = 53.76, SD = 13.79) than the posttest scores (M = 60.09, SD = 21.19). The mean loss was -6.33 indicating a minor loss. This implies that male students retained up to 98.26% of knowledge, while the female students retained 93.67% of Chemistry knowledge in the control group.

Hypotheses Teseting

An initial examination was carried out to assess potential distinctions among the groups, comprising Experimental Groups I and II and the Control Group. This preliminary testing aimed to establish the baseline disparities in students' achievement levels and their academic backgrounds before commencing the experiment. The scores collected from the three groups were subjected to ANOVA analysis, and the outcomes of these analyses are detailed in Table 6.

Table 6: ANOVA Comparison of the Pretest Mean Achievement Scores of Experimental Group I and II and the Control Groups

Source of Variation	Sum of Squares	Df	Mean Square	F-value	p-value
Between Groups	868.752	2	434.376	1.385	.252
Within Groups	85619.016	273	313.623		
Total	86487.768	275			

S = Significant at 0.05 level

Table 6 shows the ANOVA statistical analysis conducted to examine the differences between the three levels of students' achievement in experimental groups I, II and the control group atpretest. The between group analysis revealed that there was no statistically significant difference F (3, 273) = 1.385, p-value = .252 at p > 0.05, indicating that the mean differences acrossconditions were the same. This implies that the groups are equivalent considering their prior academic experiences and exposure to certain learning conditions. The null hypotheses are subjected to statistical analysis of One-way Analysis of Variance (ANOVA). The selection of ANOVA is predicated on the preliminary findings of the pretest, indicating group equivalence. Similarly, fundamental assumptions of ANOVA including the normality of data distribution, the linearity of relationships, and the homogeneity of variances across groups were verified. The scrutiny and satisfaction of these assumptions provided a robust foundation for the application ofthe ANOVA statistical analysis.

Hypothesis One: There is no significant difference in the mean achievement scores of students taught with MOOCs online, Hybrid MOOCs and those taught with conventional lecture method in Chemistry.

Table 7: Summary of ANOVA Result of Mean Achievement Scores of Students taught Chemistry using MOOCS Online, Hybrid MOOCS and those taught with Conventional Lecture Method

Source of Variation	Sum of Squares	df	Mean Square	F-value	p-value	Eta Squared
Between Groups	30829.738	2	15414.869	41.133	.000	.232
Within Groups	102307.751	273	374.754			
Total	133137.489	275				

S = Significant at 0.05 level

Table 7 shows the ANOVA statistical analysis was conducted to examine the difference between three levels of achievement in experimental groups I, II and the control group at posttest in Federal Government Colleges in North-Central Nigeria. The Table revealed that F (3,273) = 41.133, P- value = .000 at $P < 0.05$, indicating a significant difference in the mean achievement of students taught MOOCs online, Hybrid MOOCs and those taught with conventional lecture method. Consequently, hypothesis one was rejected. The effect size, as gauged by partial eta squared ($\eta^2 = .23$), denoted a substantial effect size. This implies that approximately 23% of the variance in the outcome can be attributed to the independent variables, specifically MOOCs online and Hybrid MOOCs. In practical terms, this substantial effect size signifies that the implementation of MOOCs online and Hybrid MOOCs in Chemistry instruction for Federal government college students significantly impacts their mean achievement scores. The finding implies that students taught MOOCs online, Hybrid MOOCs and those taught with conventional lecture method differ significantly in their mean achievements. To determine the significant difference between the groups, Sidak

pairwise comparisons was computed to detect the direction of the difference as presented in Table 7 (b).

Table 7(b): Sidak Pairwise Comparison of the Posttest Mean Achievement Scores ofStudents in the three Groups (Experimental Groups I, II and the Control Group)

(I) Method	(J) Method	Mean Difference (I-J)	Std. Error	Sig.[b]
EXP 1 MOOCs online	EXP 2 Hybrid MOOCs	10.805*	2.894	.001
	CONTROL GROUP	25.487*	2.825	.000
EXP 2 Hybrid MOOCs	EXP 1 MOOCs online	-10.805*	2.894	.001
	CONTROL GROUP	14.682*	2.850	.000
CONTROL GROUP	EXP 1 MOOCs online	-25.487*	2.825	.000
	EXP 2 Hybrid MOOCs	-14.682*	2.850	.000

*. The mean difference is significant at the .05 level.

Table 7(b) presents the results of Sidak pairwise comparisons, which revealed statistically significant differences between Experimental Group I, Experimental Group II, and the Control Group ($p < .000$). Likewise, a statistically significant difference was observed between Experimental Group II, Experimental Group I, and the Control Group ($p < .000$). Consequently,a statistically significant difference was observed between the Control Group and both Experimental Groups ($p < .000$). These findings collectively suggest that each group made a significant contribution, signifying the effectiveness of the experimental intervention.

Hypothesis Two: There is no significant difference in the mean retention scores of students taught with MOOCs online, Hybrid MOOCs and those taught with conventional lecture method in Chemistry.

In testing hypothesis three, ANOVA was used to analyse the significant difference in the mean retention scores of students taught with MOOCs online, Hybrid MOOCs and those taught with conventional lecture method in Chemistry as presented in Table 8

Table 8: Summary of ANOVA Result of Mean Retention Scores of Students taught Chemistry using MOOCS Online, Hybrid MOOCS and those taught with Conventional Lecture Method

Source of Variation	Sum of Squares	Df	Mean Square	F-value	p-value	Eta Squared
Between Groups	13013.264	2	6506.632	22.420	.000	.14
Within Groups	79230.475	273	290.222			
Total	92243.739	275				

S = Significant at 0.05 level

Table 8 presents ANOVA statistical analysis was conducted to examine the difference between three levels of retention in experimental groups I, II and the control group at posttest in Federal Government Colleges in North-Central Nigeria. The Table revealed that $F(3,273) = 22.420$, P-value = .000 at $P < 0.05$, indicating a significant difference in the mean retention of students taught MOOCs online, Hybrid MOOCs and those taught with conventional lecture method. Consequently, hypothesis three was rejected. The effect size was

assessed using partial eta squared (η^2 = .14) which denoted a large effect size. This suggests that approximately 14% of the variance in the outcome can be attributed to the independent variables; MOOCs online andHybrid MOOCs. In practical terms, this large effect size signifies that the implementation of MOOCs online and Hybrid MOOCs in Chemistry instruction for Federal government college students significantly impacts their mean retention scores. The finding implies that students taught MOOCs online, Hybrid MOOCs and those taught with conventional lecture method differsignificantly in their mean retention. To determine the direction of the difference, the Sidak pairwise comparisons was computed to detect the direction of the difference as presented inTable 8(b).

Table 8(b): Sidak Pairwise Comparison of the Posttest Mean Retention Scores of Students in the three Groups (Experimental Groups I, II and the Control Group)

(I) METHOD	(J) METHOD	Mean Difference (I-J)	Std. Error	Sig.
EXP 1 MOOCS Online	EXP 2 Hybrid MOOCS	10.899*	2.547	.000
	CONTROL GROUP	16.421*	2.486	.000
EXP 2 Hybrid MOOCS	EXP 1 MOOCS Online	-10.899*	2.547	.000
	CONTROL GROUP	5.522	2.508	.083
Control Group	Exp 1 MOOCS Online	-16.421*	2.486	.000
	EXP 2 Hybrid MOOCS	-5.522	2.508	.083

*. The mean difference is significant at the .05 level.

Table 8(b) presents the results of Sidak pairwise comparisons, which revealed statisticallysignificant differences between Experimental Group I and Experimental Group II with theControl Group ($p < .000$). Similarly, a statistically significant difference was observed between Experimental Group II, and Experimental Group I ($p < .000$) while that of the Control Group indicates no statistically significant difference ($p > .000$). Consequently, a statistically significantdifference was observed between the Control Group and the experimental groups I ($p < .000$), however, no statistically significant difference was observed between the control group and experimental group II. These findings collectively suggest that each group made a significant contribution, signifying the effectiveness of the experimental intervention.

Hypothesis Four: There is no significant difference in the mean retention scores of students taught with MOOCs online, Hybrid MOOCs and those taught with conventional lecture method in Chemistry based on gender.

In testing hypothesis one, ANOVA was used to analyse the significant difference in the mean retention scores of students taught with MOOCs online, Hybrid MOOCs and those taught with conventional lecture method in Chemistry as presented in Table 9

Table 9: Summary of ANOVA Result of Mean Retention Scores of Male and Female Students taught Chemistry with MOOCs Online, Hybrid MOOCs and those taught with Conventional Lecture Method

Source of Variation	Sum of Squares	Df	Mean Square	F-value	p-value	Eta Squared
Between Groups	26202.950	5	5240.590	21.426	.000	.28
Within Groups	66040.789	270	244.596			
Total	92243.739	275				

S = Significant at 0.05 level

Table 9 shows the ANOVA statistical analysis conducted to examine the difference between male and female students' retention in experimental groups I, II and the control group at posttest in Federal Government Colleges in North-Central Nigeria. The Table revealed that F (6,270) =21.426, P-value = .000 at $P < 0.05$, indicating a significant difference in the mean retention of male and female students taught MOOCs online, Hybrid MOOCs and those taught with conventional lecture method. Consequently, hypothesis four was rejected. The effect size, computed by partial eta squared ($\eta^2 = .28$), indicated a large effect size. This implies that around 28% of the variance in the outcome can be attributed to the independent variables, specifically MOOCs online and Hybrid MOOCs. In practical terms, this large effect size highlights the impact of implementing MOOCs online and Hybrid MOOCs in Chemistry instruction for Federal government college students, particularly in terms of their mean retention scores. The results suggest that male and female students taught using MOOCs online, Hybrid MOOCs, and the conventional lecture method exhibit significant variations in their mean retention. To further determine the direction of these differences, Sidak pairwise comparisons were conducted, providing a detailed overview of the distinctions, as presented in Table 9(b).

Table 4.15: Sidak Pairwise Comparison of the Posttest Mean Retention Scores of Male and Female Students taught Chemistry with MOOCs Online, Hybrid MOOCs and those taught with Conventional Lecture Method

(I) Gender	(J) Gender	Mean Difference (I-J)	Std. Error	Sig.
Exp 1 Males	Exp 1 Females	9.356	3.338	.078
	Exp 2 Males	5.343	3.589	.892
	Exp 2 Females	25.291*	3.406	.000
	Control Grp Males	27.927*	3.526	.000
	Control Grp Females	17.426*	3.325	.000
Exp 1 Females	Exp 1 Males	-9.356	3.338	.078
	Exp 2 Males	-4.013	3.287	.977
	Exp 2 Females	15.935*	3.086	.000
	Control Grp Males	18.571*	3.218	.000
	Control Grp Females	8.070	2.996	.107
	Exp 1 Males	-5.343	3.589	.892
Exp 2 Males				
	Exp 1 Females	4.013	3.287	.977
	Exp 2 Females	19.948*	3.356	.000
	Control Grp Males	22.584*	3.478	.000
	Control Grp Females	12.083*	3.274	.004
Exp 2 Females	Exp 1 Males	-25.291*	3.406	.000
	Exp 1 Females	-15.935*	3.086	.000
	Exp 2 Males	-19.948*	3.356	.000

	Control Grp Males	2.636	3.289	1.000
	Control Grp Females	-7.866	3.072	.153
Control Grp Males	Exp 1 Males	-27.927*	3.526	.000
	Exp 1 Females	-18.571*	3.218	.000
	Exp 2 Males	-22.584*	3.478	.000
	Exp 2 Females	-2.636	3.289	1.000
	Control Grp Females	-10.502*	3.205	.018
Control Grp Females	Exp 1 Males	-17.426*	3.325	.000
	Exp 1 Females	-8.070	2.996	.107
	Exp 2 Males	-12.083*	3.274	.004
	Exp 2 Females	7.866	3.072	.153
	Control Grp Males	10.502*	3.205	.018

*. The mean difference is significant at the .05 level.

Table 9(b) presents the results of Sidak pairwise comparisons, which revealed statistically significant differences between Experimental Group I males and Experimental Group I males, experimental group II females with (p > .000) signifying no statistically significant difference between the groups.

Summary of Findings of the Study

Based on the results presented, the following findings were obtained;

1. There was a significant difference in the achievement scores of students taught Chemistryusing MOOCs online, Hybrid MOOCs, and the conventional lecture method.
2. There was a significant difference in the mean retention scores of students instructed withMOOCs online, Hybrid MOOCs, and the conventional lecture method.
3. There was a significant difference in the mean retention of male and female students taught with MOOCs online, Hybrid MOOCs, and the conventional lecture method.

Discussion of Findings

The finding from this study revealed a difference in the achievement scores of students taught Chemistry using MOOCs online, Hybrid MOOCs and those taught with conventional lecture method. This finding aligns with Nagasampige and Nagasampige (2017) research whose study affirmed the effectiveness of Massive Open Online Courses (MOOCs) from platforms like edX, Coursera, Udacity, and Udemy within the Indian university system. The finding also concurs with that of Bonafini *et al.* (2017) whose quantitative analysis further supports the pedagogical assumptions of MOOCs, revealing that students' engagement in forums and video interactions significantly enhances the likelihood of course achievement. Similarly, Wang and Zhu (2019) research indicates that students in MOOC-based flipped classrooms generally outperform their counterparts in traditional classrooms.

However, the finding disagrees with the finding of Cimermanová (2018) whose study revealed no significant difference in academic achievement across various forms of e-learning, including computer-assisted learning, blended learning, and Massive Open Online Courses (MOOCs). Similarly, Israel (2015) study revealed comparable or slightly better performance by students in blended MOOCs within traditional classrooms compared to those exclusively in face-to-face environments.

Finding emanating from this study also revealed a significant difference in the mean retention scores of

students taught Chemistry with MOOCs online, Hybrid MOOCs and those taught with conventional lecture method in Chemistry. This finding corresponds with that of Tahiru and Kamaludeen's (2018) whose finding indicated a substantial disparity in the intentions to use Massive Open Online Courses (MOOCs) for academic purposes, with MOOCs users exhibiting ahigher retention level compared to non-users. Similarly, Hakami (2019) research demonstrated the supportive role of MOOC platforms in teaching and learning within hybrid and traditional learning environments.

Another finding of the study revealed that there is a significant difference in the mean retention scores of students taught with MOOCs online, Hybrid MOOCs and those taught with conventional lecture method in Chemistry based on gender. The finding of the study agrees with that of Bayeck (2016) whose research revealed a higher enrollment of women compared to men, with students often joining courses due to peer influence. Kizilcec *et al.* (2017) finding indicated that men exhibited higher gender sensitivity and performed less effectively than women in retention tests within an English language learning MOOC. These collective findings underscore the nuanced dynamics of gender and performance in the context of MOOC enrollment and outcomes.

Conclusion

From the findings that emanated from this study, the following conclusion were drawn;

It was established that the utilization of MOOCs online and Hybrid MOOCs in Chemistry instruction leads to a significant difference in the achievement scores of students. This means that the efficacy of these instructional method enhanced student achievement in the subject. It was established that the observed difference in retention rates among students taught with MOOCs online, Hybrid MOOCs, and the conventional lecture method supports the conclusion that MOOCs, especially in hybrid formats, positively influence students' ability to retain knowledge. This suggests the potential for improved long-term learning outcomes. The gender- specific variation in mean retention further solidifies the conclusion that MOOCs online and Hybrid MOOCs have a pronounced effect on both male and female students. These findings highlight the importance of considering gender-specific learning dynamics when implementing innovative instructional approaches

Recommendations

In light of the significant findings derived from this study, the following are recommended:

1. Federal Government Colleges and administrators should consider integrating MOOCs online and Hybrid MOOCs into Chemistry instruction to enhance students' academic achievement.
2. Governments in conjunction with other professional bodies should sponsor further researcher on the use of MOOCs online and Hybrid MOOCs.
3. Federal government colleges should design MOOC-based interventions that account for and cater to the unique learning dynamics of both male and female students. This tailored approach can contribute to more equitable skill development outcomes.

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PERCEIVED INFLUENCE OF LESSON STUDY AND TEAM TEACHING ON PROFESSIONAL DEVELOPMENT OF PHYSICS TEACHERS IN NIGER STATE, NIGERIA

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Abstract
The study was carried out to examine the perceived influence of Lesson study and Team teaching on the professional development of physics teachers in Niger State. The study adopted a survey design and was guided by two research questions. The population was made up of all Physics Teachers in the State Science and Technical colleges. Fifteen physics teachers (15) in the six purposively sampled science and technical colleges were used for the study. Data was collected on professional development of participating teachers using two separate 5-likert scale questionnaires. The reliability coefficient for each of the two elements of professional development (Classroom management skill and Learning community) considered in this study was calculated using Cronbach alpha. For classroom management skill using lesson study and team teaching, the reliability coefficient was 0.80 and 0.74 respectively. For learning community using lesson study and team teaching, the reliability coefficient was 0.78 and 0.93 respectively. The mean was used to answer the research questions. Findings revealed that the participating physics teachers in the lesson study and team teachinggroups improved in the two elements of professional development considered in this study. It was therefore recommended among others that the school administrators should implement lesson study and or team teaching in schools as a form of capacity building for teachers.

Keywords: Professional development, Lesson study, Team teaching, Classroom management, Learning community

Introduction

Physics is a branch of science that deals with nature and properties of matter and energy. Physics is a popular subject among students but due to its relationship with Mathematics a large number of students perceived it as a tough subject compared to other science subjects. Also, Physics has been perceived as a difficult subject across all levels of learning (Chala et al., 2020). Hence, the need to encourage students to gravitate towards the learning of Physics in schools so as to reduce the number of students who do not find the learning of Physics interesting drastically to the barest minimal (Veloo *et al.*, 2015).

King'aru (2014) opined that giving priority to teachers' quality, good classroom management, good teacher-learner relation, and professional development and support will help to improve the state of science teaching in schools. King'aru further stressed that the poor state of teaching is the cause of low literacy of learners in science, low participation in innovative science activities and poor students' achievement in examinations.

Efforts are being made to improve both in-service and pre-service teachers' professional development by stakeholders, such as the policy makers, educators, parents, community leaders and researchers in Nigeria education sector. The Stakeholders are aware that if this is achieved, only then can our educational quality be improved since teachers' professional development is key to improve educational quality, leading to improved students' achievement and even economic growth of the societyAyeni (2011), all in an attempt to close the gap between theory and practice of teaching.

The aim of any professional development programs is to ensure a viable professional community in schools so that the effect of the programs on classroom practices may be enhanced. For this reason, stakeholders in education periodically organize capacity building programs for in-field teachers. One of the shortcomings of these programs is the inability to bridge the theory-practice gap (Burns & Lawrie, 2015). The theory-practice gap can be bridged by Lesson Study and Team Teaching.

Lesson Study is a model which foster collaborative professional development process where an individual lesson is indepthly explored, thereby enhancing their learning and that of their students (Fernandez & Yoshida, 2004). This method involves a group of teachers coming together as a team to plan, teach, observe, analyze and also refine individual class lessons known as research lessons. It also creates a suitable learning atmosphere for teachers to collaboratively discuss and analyze students learning progress and to enhance their learning (Ball & Cohen, 1999).

Murata et al, (2004) suggested three specific areas that develop and interact through the lesson study process to support teacher learning. The three broad areas are; Teachers' knowledge, Teachers' commitment and community, and Learning resources.

Another Strategy that possesses inherent professional lubricant capable of reducing professional friction among the interacting components of teachers' professional development and Students Learning is Team teaching.

Team Teaching is a form of cooperative teaching where two or more teachers collaborate together and share work to achieve more than what one teacher can achieve (Wenzlaff et al., 2002). This is why (Courtney, 2016) opined that for teachers to achieve a successful collaboration, they must be able to share resources, jointly make decisions, also understand and have respect for one another's role and beliefs within the educational setting. These synergized efforts avail new opportunities for various ways to participate in the designing, planning, and teaching of curriculum. This also, sustains the pedagogical and professional development of the potential of a strong learning community for learners and teachers (Ferguson & Wilson, 2011).

Team Teaching has been used at all levels of education, from elementary level to tertiary institution. According to (Bleiler, 2012) the main purpose of team-teaching is to combine the expertise of several different individuals with the underlying assumption that multiple perspectives will enhance instruction.In order to ensure successful implementation of these approaches, the participating teachers must understand its effectiveness and make sure that they truly collaborate for the betterment of the students (Courtney, 2016). Overall, literatures abound on how lesson study has developed teachers' competency in teaching and learners' academic performance in mathematics (Boz & Belge-Can, n.d; Lucenario *et al.*, 2016, Fredrick, 2019). Furthermore, also investigated was the effect of team teaching on students' academic achievement (Besharati & Mazdayasna, 2017; Hooda & Sharma, 2016).

In Nigeria, there have been few researches on teaching strategies that enhance sustained professional development and improve Students' learning outcomes (Shuaibu, 2019, Gana et al., 2018). For this reason, the researcher intends to examine teachers' professional development usinglesson study and team teaching since policy makers are now interested in studies that can provide guardian on how to design programs that will result in significant and sustained improvement and students' opportunities to learn (Ingvarson *et al.*, 2005).

Purpose of the Study

The main purpose of this study was to investigate the perceived influence of lesson study and team teaching on professional development of Physics teachers in Niger State. Specifically, the study sought toinvestigate the;

(i) level of perceived influence of lesson study and team teaching on physics teachers' classroom managementskills.

(ii) level of perceived influence of lesson study and team teaching on physics teachers' learning community.

Research Questions

The following research questions were answered in this study;

(i) What is the level of perceived influence of lesson study and team teaching on Physics teachers' classroom management skills?

(ii) What is the level of perceived influence of lesson study and team teaching on Physics teachers' learning community?

Methodology

The study adopted a survey design. The population of the study consist of all the three hundred and one (301) Physics Teachers (203 Male; 98 Female) in all the four hundred and six (406) Senior Secondary Schools in Niger State in the 2020/2021 academic session.Multistage sampling technique was adopted for the study. A cluster sampling technique was used to cluster Niger state into three Senatorial zones, namely; Zone "A" Zone "B" and Zone "C". The simple randomsampling technique was used to select two out of the three Senatorial zones.Also, the purposive sampling technique was used to select two schools from each of theselectedsenatorial zones because they all have well equipped Physics laboratory. Two schools were assigned to lesson study group and two schools to team teaching group. Also, in other not to disrupt the schools' program, one intact class each from the four selected schools and a total of fifteen (15) Physics teachers, eight (8) for lesson study and seven (7) for team teaching.

Data was collected on professional development of participating teachers using two separate 5-likert scale questionnaires. The first was on the professional development for teachers using lesson study and the other on the professional development for teachers using team teaching. The two questionnaires were validated by experts in the Department of Science Education of Federal University of Technology, Minna and an expert in the field of professional development in Niger State College of Education, Minna. In order to calculate the reliability coefficient of the instruments, the questionnaire on the professional development for teachers using Lesson Study was pilot tested on 30 teachers in Minna who have been trained on lesson study under the Strengthening of Mathematics and Science Education in Nigeria, a Japan International Cooperation Agency (JICA). In like manner, the questionnaire on the professional development for teachers using Team Teaching was also administered to 20 randomly selected teachers at Mariam Babangida Girls Secondary School, Minna, state public school where Team Teaching has been implemented.

The reliability coefficient for each of the two elements of professional development (Teachers'classroom management skill and Learning community) considered in this study was calculated using Cronbach alpha. For classroom management skill using Lesson Study and Team Teaching, the reliability coefficient was 0.80 and 0.74 respectively. For learning community using Lesson Study and Team Teaching, the reliability coefficient was 0.78 and 0.93 respectively.

A five-point rating scale of Strongly Agreed (SA, =5), Agreed (A, =4), Undecided (U, =3), Disagreed (D, =2) and Strongly Disagreed (SD, =1) was used in weighing respondents' responses. Data gathered from the administration of the questionnaire on participants were analyzed using mean to answer the research questions.

Results
The results were analyzed and presented based on the raised research questions.

Research Question One
What is the level of perceived influence of Lesson Study and Team Teaching on physics teachers' classroom management skills?

Table 1: Mean Responsesof Physics Teachers on theperceived influence of Lesson Study and Team Teaching on Classroom Management Skills

S/N	ITEMS	X_{LS}	X_{TT}	Remark
1	Established rules and regulations contributed to having a conducive learning environment	4.25	3.57	Agree
2	I learnt the importance of documenting and reviewing rules and regulations with the students	4.13	4.43	Agree
3	I learnt how to get students interest by previewing exciting parts of the lesson	4.50	3.29	Agree
4	Encourages good behavior to be rewarded with incentives	4.75	3.86	Agree
5	Teachers were consistent and impartial with the way they rebuke inappropriate behavior	4.38	4.14	Agree
6	Encourages teachers-parents' partnership to reinforce good behavior in the classroom	4.00	3.71	Agree
7	Encourages the use of non-verbal communication such as physical objects to improve content delivery	3.75	3.43	Agree
8	Lesson Study enhances my ability to know students by name	3.88	4.00	Agree
9	My time management skill greatly improved	4.00	3.43	Agree
10	There is a great improvement in my overall classroom practices after experience	4.63	4.57	Agree
	Cumulative Mean	**4.23**	**3.84**	

NB: X_{LS}- Mean response of Lesson Study**X_{TT}-** Mean response of Team Teaching
Table 1 shows that all items were rated above the agreeable mean of 3.00. This implies that the physics teachers in both groups perceivedan improvedclassroom management skills after exposure to Lesson Study or Team Teaching.

Research Question two
What is the level of perceived influence of Lesson Study and Team Teaching on Physics teachers' learning community?

Table 2: Mean Responses of Physics Teachers on the influence of Lesson Study and Team Teaching onTeachers' Learning Community

S/N	ITEMS	X_{LS}	X_{TT}	Remark
1	Working with other colleagues exciting	4.25	4.00	Agree
2	Meaningful relationships with fellow colleagues are built	4.38	3.86	Agree
3	The integrative nature of is a panacea to teachers' Isolation	4.13	4.43	Agree
4	My tolerant level has increased since my involvement	3.38	3.43	Agree
5	Everyone to participate democratically	4.50	4.29	Agree
6	There is mutual respect for each other during implementation	3.50	4.86	Agree
7	Members share interests and beliefs within the group	4.00	4.14	Agree
8	Encourage interdependency of members	4.13	3.57	Agree
9	Interaction and participation of members strengthen learning Community	4.38	4.57	Agree
10	No teacher is left behind within the community	4.75	3.71	Agree
	Cumulative Mean	**4.14**	**4.09**	

NB: X_{LS}- Mean response of Lesson Study**X_{TT}-** Mean response of Team Teaching

Table 2 shows that all items were rated above the agreeable mean of 3.00. This implies that the physics teachers in both groups perceived an improvedteachers' learning community after exposure to Lesson Study or Team Teaching.

Discussion of Results

The sole reason for professional development program for teachers is to optimize their efficiency which in turn should lead to improved students learning outcomes. An effective professional program is expected to continuously enhance the ethical practices of teachers. Bothlesson study and team-teaching models have been used as an approach to teachers' professional development (Goldshaft, 2016; Španović, *et al.* 2015; Carlgren, 2012).The findings of this study showed that Physics teachers who participated in both Lesson Study and Team Teaching agreed that they recorded an improved classroom management skill and learnt from each other within the learning community.

One of the outcomes of effective classroom management, is effective lesson delivery. Shuaibu (2019) found out thatteachers improved significantly in their lesson delivery skills, teachers' quality. Also, Murchú and Conway (2017)result showed teachers who participated in Team Teaching experienced several visibilities of a range of good teaching practices, and they noted and stopped in effective practices.

Furthermore, on learning community, Tonya (2017) revealed that Lesson study is an avenue for physics teachers in secondary schools to engage in inquiry on their students so as to better understandstudent thinking and learning. The study conducted by Rosenfeld et al.(2013),also revealed that during Team Teaching, teachers had a good learning experience, collaborated together in order to facilitate good teaching and learning, gained self-confidence, exposed to new ideas and teaching techniques, commended the guidance received from more the experiencedteachers. Generally, the results of several other studies revealed and affirmed thatboth LessonStudy and Team Teaching effectively enhanced teachers' quality and has a positive influence on the professional development of teachers (Dave & Takuya, 2019; Gana etal., 2018; Lomibao, 2016).

Conclusion

The findings of the study revealed that Physics teachers' classroom management skills and learningcommunitywere enhanced after the implementationof both Lesson Study and Team Teaching. It wastherefore, concluded thatthePhysics teachers who participated in the Lesson Study and Team Teaching improved in the two elements of professional development considered in this study.

Recommendations

(i) Implementation of school-level Lesson Study and or Team Teaching should be encouraged by school administrators as a form of capacity building for teachers. This would enhance teachers' community of learners.

(ii) School administrators should leverage on both Lesson Study and Team Teaching to mentor inexperienced teachers.

(iii) Government should ensure sustained professional development of teachers across all levels of education. The use of Lesson Study and Team Teaching models might be cost effective and will ensure continuity, bridge gap between theory and practice.

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SYNTHESIS, SPECTROSCOPIC CHARACTERIZATION AND QUANTUM CHEMICAL CALCULATIONS OF (E)-4-BROMO-2-(((3-METHOXYPHENYL) IMINO) METHYL) PHENOL

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Abstract
The Schiff base compound (E)-4-bromo-2-(((3-methoxyphenyl) imino) methyl) phenol ($C_{14}H_{12}BrNO_2$) *was synthesized and characterized by the flash elemental analysis, infrared, ultraviolet, proton and carbon-13 spectroscopic methods. Quantum chemical calculations were also performed on the modelled and optimized compound using Density Functional Theory (DFT) with Becke's three-parameter hybrid functional employing the Lee-Yang-Parr correlation functional (B3LYP) and the Empirical Density Functional 1 methods (EDF1) with 6-31G** basis set. The infrared, ultraviolet, proton and carbon-13 nuclear magnetic resonance spectra of the compound were calculated and the results compared with the corresponding experimental spectra to enhance the structural elucidation. The comparison between the calculated and experimental results provided a very good agreement.*

Keywords: (E)-4-bromo-2-(((3-methoxyphenyl) imino) methyl) phenol, computational modelling, substituents.

Introduction

(E)-4-bromo-2-(((3-methoxyphenyl) imino) methyl) phenol is a Schiff base derived from the reaction between 5-bromosalicyalaldehyde and *m*-anisidine. Schiff base is like aldehyde or ketone except that the carbonyl group (C=O) is being replaced with imine or azomethine (HC=N) group. Schiff base was discovered by a German chemist, Hugo Schiff in 1864 (Kalaivani, Priya, and Arumachalam, 2013; Moosavi-Tekyeh and Dastani, 2015; More *et al*., 2017). The ensuing C=N in Schiff bases take part in bonding with metal ions through nitrogen lone pair electrons. Schiff bases can also be called imines or azomethines (Grivani *et al*., 2013; Hossain *et al*., 2019). The azomethine moieties are vital for biological activities. They are of beneficial active centres for many biological systems (Ejiah *et al*., 2013; Zayed and Zayed, 2015). The nitrogen atom of the C=N in Schiff bases may participate in the formation of hydrogen bonds with the active centres of cell constituents and affect the normal cell processes (Khan *et al*., 2013). Schiff bases are among the most widely used organic compounds. They play essential roles in living systems as well as in coordination chemistry. They act as exceptional chelating ligands with wide range of properties, which can be changed by introducing several substituents on either the carbonyl or amine rings. They are of vital roles in living systems in combination with enzymes such as transaminases and tryptophan synthase (Ananda, *et al*., 2014; Ikram *et al*., 2015; Khan *et al*., 2013; Muhammad *et al*., 2013; Oloyede-Akinsulere *et al*., 2016).

Literatures revealed that Schiff bases derived from 2-hydroxybenzaldehyde and derivatives showed extensive range of biological properties. Some of the reported biological properties are anti-inflammatory (Sathe *et al*., 2011), analgesic (Sondhi *et al*., 2006), antimicrobial (Biswas, Pramanik, and Mondal, 2015; Ghosh *et al*., 2016; Hasi *et al*., 2016; Ikram *et al*., 2015; Mounika *et al*., 2010; Naik, Selvaraj, and Naik, 2014; Salehi *et al*., 2016; Yildiz *et al*., 2015; Zayed and Zayed, 2015), anticonvulsant (Chaubey and Pandeya, 2012), antitubercular (Hasan *et al*., 2016; Mazlan *et a*l., 2014; Saha *et al*., 2016), anticancer (Kasumov, Sahin, and Aktas, 2016), antioxidant (Ghosh *et al*., 2016; Hasi *et al*., 2016; Ikram *et al*., 2015; Temel *et al*., 2015), anthelmintic and antimalarial (Devi and Batra, 2015) which make them gain significance in medicinal and pharmaceutical fields.

Currently, with the improvement of computational methods, it is possible to reliably modelled and determine the molecular properties of different compounds which help augment experimental observations.

Therefore, in order to correlate between the theoretical and experimental results, the molecular structures of the compounds were modelled and theoretical calculations using DFT were carried out on the optimized structures. These were employed for the electronic, IR and NMR spectra. A comparison of the resemblances between the theoretical and experimental spectra of the compound could further be used for structural identification. Hence, this study which investigated the synthesis, spectroscopic characterization and quantum chemical calculations of (E)-4-bromo-2-(((3-methoxyphenyl) imino) methyl)phenol.

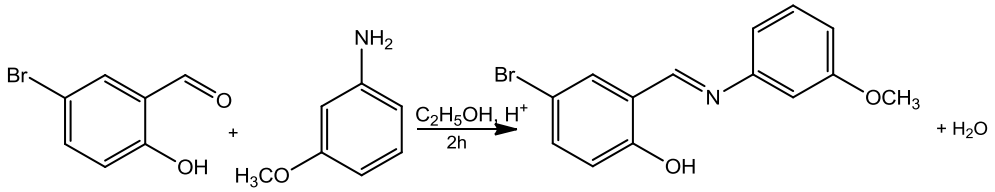
Material and Methods

Reagents and Instruments

5-Bromosalicylaldehyde, *m*-anisidine and methanoic acid were purchased from Merck and used as supplied. The solvent DMSO (dimethylsulfoxide) and absolute ethanol were of analytical grade and were used without further purification. The infrared spectrum was recorded on a Perkin-Elmer 400 FT-IR/FT-FIR and NMR spectrum was obtained using a Bruker Avance 111 600 in solution with deuterated DMSO using tetramethylsilane (TMS) as internal standard at 600 MHz. The elemental analysis was carried out with Finnigan Flash EA 1112 series. Additionally, the electronic spectrum was recorded on Shimadzu UV-2600 series in DMSO. Melting point was taken on Stuart Melting point apparatus SMP-3 but was not correct.

Synthesis of the Compound

0.015 mole of 5-bromosalicylaldehyde in 10 mL absolute ethanol was added in drops to 0.015 mole of *m*-anisidine in 15 mL of the same solvent. The resulting solution was stirred for 2 hours on addition of three drops of methanoic acid. The brownish precipitate was filtered and washed with cold ethanol, recrystallized from ethanol and dried in a desiccator over silica gel for two days.



Scheme 1. Synthetic route of the compound.

Details of Computational Method

The compound was modelled and optimized using Gaussian 09 and Spartan '14 computational software packages. Density Functional Theory was employed for the geometry optimization, chemical shifts, electronic transitions and frequency calculations of the compound based on preliminary conformational search of the molecule with molecular mechanics force field. The DFT calculations were performed on the most stable conformer in the ground state using Becke's three-parameter hybrid functional employing the Lee-Yang-Parr correlation functional (B3LYP) and the Empirical Density Functional 1 methods (EDF1) with 6-31G** basis set (Demehin, 2021a, 2021b).

Results and Discussions

Characterization of the Compound

The (E)-4-bromo-2-(((3-methoxyphenyl)imino)methyl)phenol, ($C_{14}H_{12}BrNO_2$), has a Molecular weight: 306.15 g/mol, Yield 73.14%.

Elemental analysis, % (Found) C: 59.92, H: 3.95, N: 4.58. Calculated, C: 59.90, H: 3.96, N: 4.57. FT-IR (ATR, cm^{-1}): 3000,2939, 2832, 2441, 2247,1593, 1581, 1565, 1480, 1456, 1430, 1352, 1286, 1260, 1210, 1187, 1174, 1138, 1096, 1075, 1047, 967, 909, 875, 859, 812, 798, 766, 730, 677, 629, 577, 566, 548.
^{1}H NMR (DMSO-d_6, δ, ppm): 13.03 (s, 1H, OH), 8.70 (s, 1H, −HC=N), 7.83-6.80 (m, 7H, aromatic), 3.72 (s, 3H, −OCH_3).

^{13}C NMR (DMSO-d_6, ppm): 161.57, 160.40, 153.13, 136.45, 134.51, 129.30, 121.74, 121.44, 119.80, 112.98, 112.77, 109.91, 56.47. UV: 290 (n−π*), 360 (π−π*).

A good yield of the compound was obtained as a solid. It was stable in air and soluble in most organic solvents but insoluble in water. It was brownish in colour. The FT-IR spectrum data of the compound revealed the formation of the azomethine bond (−HC=N) and the absorption band was displayed at 1593 cm^{-1}. The compound exhibited the phenolic (C−O) stretching vibration at 1286 cm^{-1} and the hydroxyl (O−H) absorption band around 3000-2400 cm^{-1}. The aromatic (C=C) absorption bands were displayed in the range 1581-1430 cm^{-1} (Aziz *et al*., 2015; Demehin *et al*., 2017; Farid, Rosan, and Refat, 2015; Kianfar *et al*., 2015; Kiran *et al*., 2015; Mahmoud *et al*., 2015; Saha *et al*., 2016; Salehi *et al*., 2016; Shabbir *et al*., 2016).

The ^{1}H NMR result (Fig. 1) of the compound showed a singlet signal at δ 13.03 ppm to the phenolic –OH protons and a singlet signal at δ 8.70 ppm attributed to the azomethine (−HC=N) protons which confirmed the formation of the Schiff bases. The aromatic protons appeared as multiplets at δ 7.83-6.80 ppm. Furthermore, a sharp singlet signal attributed to the methoxy group protons appeared at δ 3.72 ppm in the spectrum of the compound (Ananda *et al*., 2014; Demehin, 2021a; 2021b; Saha *et al*., 2016; Salehi *et al*., 2016). Signals at δ 3.33 ppm and δ 2.45-2.50 ppm in the spectrum are for H_2O/DMSO and DMSO respectively.

The ^{13}C NMR result of the compound was consistent with the ^{1}H NMR. The ^{13}C NMR spectrum (Fig. 2) showed peak at 161.57 ppm assigned to the azomethine carbon which further confirmed the formation of the Schiff base compound and the aromatic carbon around 160.40-109.91 ppm. Moreover, the signal for the methoxy (–OCH_3) group carbon appeared at δ 56.47 ppm (Abo-Aly *et al*., 2015; Ananda *et al*., 2014; Demehin, 2021a, 2021b; Saha *et al*., 2016; Salehi *et al*., 2016; Shabbir *et al*., 2016).

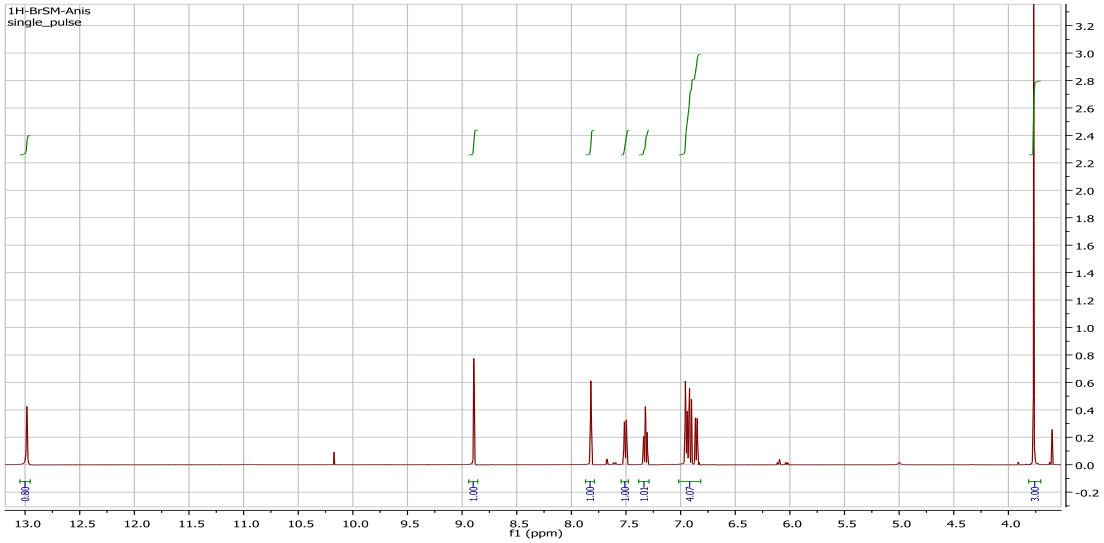


Fig. 1: ^{1}H NMR spectrum of the Compound.

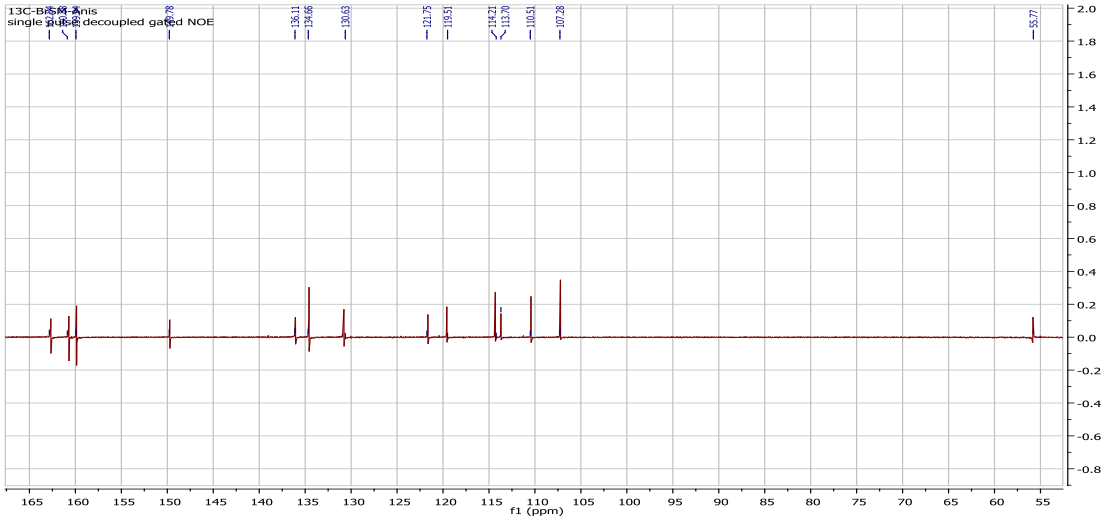


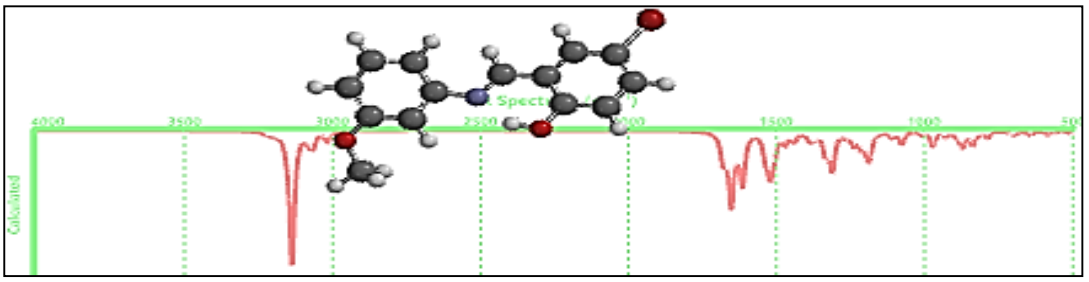
Fig. 2: ^{13}C NMR spectrum of the Compound.

Computational Studies

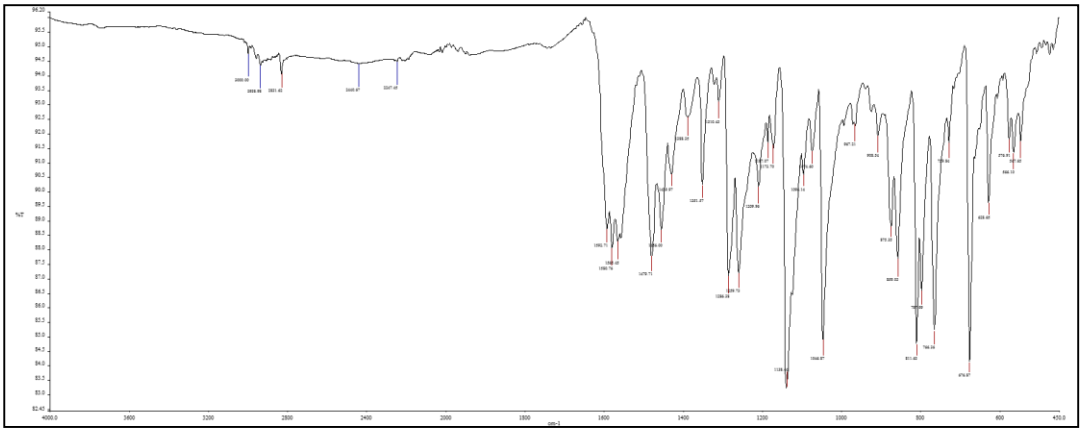
Theoretical IR Spectrum

The absorption bands of the theoretical IR vibrational frequency data of the compound at B3LYP/6-31G** level were observed at: 3233, 3325, 3219, 3212, 3210, 3201, 3189, 3154, 3137,3081, 3066, 3047, 3018, 1681, 1671, 1652, 1632, 1615, 1538,1524, 1518, 1506, 1504, 1493, 1471, 1440, 1388, 1373, 1361, 1335, 1324, 1311, 1265, 1239, 1215, 1195, 1186, 1178, 1156, 1148, 1108, 1077, 1011, 1004, 973, 971, 964, 930, 894, 887, 873, 867, 837, 820, 787, 781, 728, 703, 694, 646, 634, 583, 560, 556 cm^{-1} while absorption bands at EDF1/6-31G** level appeared at: 3195, 3185, 3180, 3173, 3170, 3164, 3149, 3111, 3066, 3047, 3031, 2978, 2787,1641,1632, 1613, 1594,1578, 1504, 1501, 1486, 1472, 1460, 1438, 1418, 1376, 1373, 1363, 1345, 1314, 1298, 1281, 1236, 1221, 1189, 1175, 1162, 1148, 1135, 1094, 1050, 987, 967, 950, 942, 940, 909, 859, 854, 838, 811, 800, 766, 761, 684, 676, 632, 616, 571, 547, 540 cm^{-1}

The theoretical IR vibrational frequency values of the compound were in good agreement with the experimental values (Fig. 3). The azomethine (−HC=N) absorption bands of the compound appeared at 1615 cm^{-1} at B3LYP/6-31G** level, while it was observed at 1601 cm^{-1} experimentally. The phenolic C−O stretching vibrations were observed around 1335-1311 cm^{-1} in the theoretical data and the experimental value appeared at 1286 cm^{-1}. The theoretical □(O−H) stretching vibration in the compound appeared around 3137 cm^{-1} while the experimental stretching vibration was observed around 3000-2440 cm^{-1}. The aromatic (C=C) absorption bands appeared in the range 1652-1440 cm^{-1} theoretically, however, the band was observed around 1581-1430 cm^{-1} experimentally.



A



B

Fig. 3: IR spectra of the compound, theoretical (A) and experimental (B)**.**

Theoretical NMR Spectrum

The theoretical chemical shifts of the compound (Table 1) were in good agreement with the experimental values. The data obtained at B3LYP/6-31G** level revealed that the compound's aromatic hydrogen peaks: H1, H2, H3, H12, H4, H5, H6, H7, H9, H11, H13, H15, H16, H17 appeared at 7.95, 4.73, 9.28,14.18, 8.20, 7.44, 8.42, 8.38, 7.98, 7.63 ppm respectively in the theoretical spectrum, these appeared in the range 7.83-6.80 ppm in the experimental study. The hydrogen of the azomethine (−HC=N) and −OH groups appeared at 9.28 ppm and 14.18 ppm in the theoretical calculation while they were experimentally observed at 8.70 ppm and 13.03 ppm respectively. The chemical shift of the three hydrogen in the $-OCH_3$ group was observed at 4.73 ppm in the theoretical calculation and at 3.72 ppm in the experimental spectrum. Moreover, the peaks for the aromatic carbon appeared theoretically in the range 154.90-104.48 ppm and were experimentally observed in the range 160.40-109.91 ppm. Furthermore, the carbon in the azomethine and $-OCH_3$ groups appeared at 156.43 ppm and 52.50 ppm respectively in the theoretical calculation while the peaks were experimentally observed at 161.57 ppm and 56.47 ppm respectively.

Table 1: Theoretical NMR data of the compound

Positions of H & C	δ (ppm) B3LYP	EDF1	Positions of H & C	δ (ppm) B3LYP	EDF1
H1	7.95	7.95	H10	-	8.40
C1	114.11	113.27	C10	154.15	122.47
H2	4.73	4.92	H11	8.42	8.34
C2	156.43	154.40	C11	111.99	110.58
H3	4.73	4.92	H12	-	-
C3	116.17	115.81	C12	124.82	151.91
H4	9.28	9.39	H13	8.38	-
C4	130.69	127.53	C13	104.48	101.51
H5	14.18	15.93	H14	-	-
C5	124.76	124.14	C14	52.50	54.57
H6	8.20	8.23	H15	7.98	7.94
C6	131.33	128.64	C15	-	-
H7	4.73	4.92	H16	-	-
C7	154.90	150.79	C16	-	-
H8	-	-	H17	7.63	7.57
C8	145.59	142.54	C17	-	-
H9	7.44	7.79			
C9	102.75	103.32			

Theoretical Electronic Spectrum

The theoretical electronic spectrum data of the compound were comparable to the experimental values. The agreement between the theoretical and experimental electronic spectra data corroborated the suggested structures. The theoretical spectrum of the compound as calculated at B3LYP/6-31G** level showed five absorption bands at 246, 259, 302, 328, 344 nm, these bands were related to the promotion of electrons from HOMO → LUMO+1, HOMO-3 → LUMO, HOMO-2 → LUMO, HOMO-1 → LUMO, HOMO → LUMO respectively. Similarly, at EDF1/6-31G** level displayed five absorption bands at 289, 292, 294, 347, 394 nm.

Frontier Molecular Orbitals

The frontier molecular orbitals are the highest occupied molecular orbital (HOMO) and the lowest unoccupied molecular orbital (LUMO). They determine the way molecules interact with other species. The HOMO is the orbital energy that donates electron, meanwhile, it is the orbital of highest energy containing electrons, On the other hand, the LUMO is the orbital of lowest energy. The energy gap between the HOMO and LUMO is expected to play significant roles in the intra- and inter- charge transfers according to the frontier molecular orbital theory (Temel *et al*., 2015). The energy band gaps between the HOMO and LUMO is more significant in considering electronic transitions than individual orbital component of a molecule. Since the difference between the LUMO and HOMO displayed the reactivities and stabilities of molecules in chemical reactions, consequently, the lower the energy gap, the more reactive and less stable the molecule. Thus, Fig. 4 indicated the suggested structure, optimized structure, HOMO and LUMO of the synthesized Schiff base. The energies of the HOMO and LUMO are -5.9 eV and -2.0 eV respectively while the calculated energy band gap is 3.9 eV.

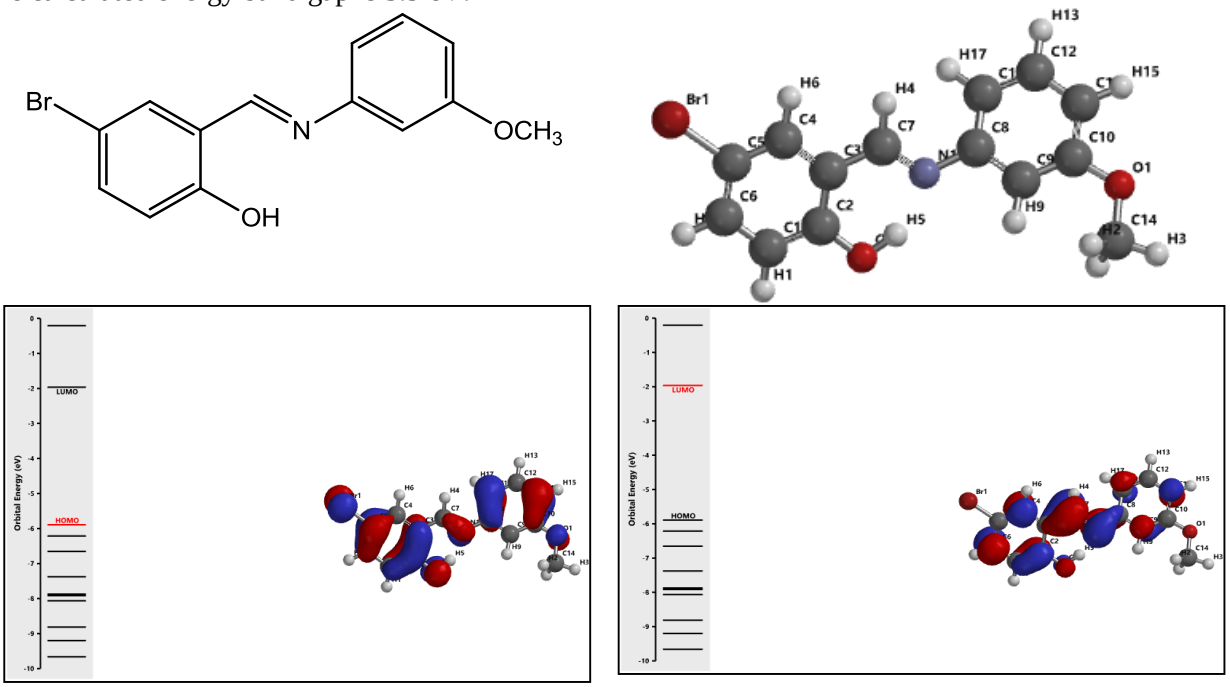


Fig. 4: Proposed structure, Optimized structure, HOMO and LUMO of the compound at B3LYP/6-31G level.**

Conclusion

A Schiff base, (E)-4-bromo-2-(((3-methoxyphenyl)imino)methyl)phenol was synthesized and characterized by different spectroscopic techniques. The elemental analyses, IR, ^{1}H NMR, ^{13}C NMR and electronic spectra confirmed the formation of the compound. A comparison of the experimental and

theoretical results showed that the theoretical data were in very good agreement with the experimental values, thus, corroborating the proposed structure.

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