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EFFECTIVENESS OF COMPUTER-BASED CONSTRUCTIVIST INSTRUCTION ON STUDENTS' ACHIEVEMENT AND INTEREST IN BASIC SCIENCE AND TECHNOLOGY IN NIGER STATE

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ABSTRACT

This study investigated effectiveness of computer-based constructivist Instruction on students' achievement and Interest in basic science and technology in Niger State. Three objectives, three research questions and three hypotheses were set for the study. The population for the study was 1,552 students in Junior Secondary School II in Minna and Bida Local Government Areas of Niger State. The design for the study is Quasi-experimental using pretest posttest non-randomized control group with an intact class. The sample consisted of a total of 52 students, made up of 29 experimental group and 23 control group. Two instruments, Basic Science and Technology and Technology Achievement Test (BSTAT) and Basic Science and Technology Interest Inventory (BSTII) were used for collection of data. The instruments were subjected to validity and reliability test.The result obtained from trial testing was used to determine the reliability coefficient for BSTAT and BSTII using K-R20 (Kuder Richardson) and Cronbach alpha respectively. The reliability coefficient of BSTAT and BSTII is 0.73 and 0.77 respectively. The data collected were statistically analyzed using t-test. The results obtained showed that significant difference exists in the achievement and interest of subjects in Basic Science and Technology taught with web-based software teaching strategy. The application of Multiple Classification Analysis (MCA) showed that students taught with web-based learning strategy achieved and developed more interest significantly than those taught with lecture method. Based on the findings, web-based learning strategy is more effective in the enhancement of students' academic achievement and interest in Basic science and technology. The study recommended among others that the teaching of basic science and technology should be very flexible to incorporate new strategies.

Keywords: Computer-based constructivist instruction, achievement, interest, basic science and technology

Introduction

The main objectives of teaching and learning of Basic Science and Technology in Nigeria schools as stipulated by NERDC (2012) is that learners are expected to develop interest in science and technology; acquire basic knowledge and skills in science and technology; apply scientific and technological knowledge and skills to meet contemporary societal needs. Also take advantage of the numerous career opportunities provided by science and technology; become prepared for further studies in science and technology; avoid drug abuse and related vices; and to be safety and security conscious. In order to achieve the objectives of Basic Science Technology, the thematic approach to content organization was adopted by NERDC for the holistic presentation of scientific and technological concepts, knowledge and skills to learners for better achievement.

Achievement in opinion of Ogundukun

and Adeyemo (2010) is the exhibition of knowledge attained or skills developed by students in a subject as determined by test scores of students, assigned by teachers. Achievement according Abakpa (2011) is the measure of accomplishment in a specific field of study. The authors argued that achievement of students is the demonstration of their abilities to attain certain levels of instructional objectives outcome of their classroom instructions and experiences. The achievement of students in Basic Science and Technology cannot be compromised, because it is essential for the productive economic sector of our nation, for the production of labour force that is scientifically and technologically literate to bring about the desired changes for sustainable national development (Cyril, 2013).

Constructivism is a teaching strategy, which holds the view that scientific knowledge be personally constructed and reconstructed by the learner based on his or her experience. It is a model of instruction, which allows for interaction between students/students, students/teacher in the classroom. It is a problem-solving approach to learning that allows students to explore and work in groups, making meaning of tasks and setting out to solving problems that are perplexing to them (Hassan, 2016). There are several constructivist models, which are useful in helping learners reconstruct their knowledge based on their prior conception. They include: five phases of constructivist model (5E Model), five steps conceptual change model (PEDDA), four phases of constructivist model (IEPT), seven phases of constructivist model (7E Model),learning cycle model, Analogy and Negotiations.

Basic Science and technology Curriculum Study (BSTCS) cited in Mandor (2002) proposed that learning and teaching framework based on constructivism should consist of five phases namely engagement, exploration, explanation, elaboration and valuation.

Constructivism is an inquiry-based instructional approach that has been proven by many researchers such as Usman, Hassan, Maik& Musa (2015); Robert, Hassan and Nwankwu (2016); Ugwuanyi (2015); Mandor (2002); and Obeikwe (2008) to enhance achievement in science. It then becomes pertinent to explore its efficacy with the use of computer- based learning and ascertain whether or not learning can be done more effectively.

Owodunni, Igwe and Hassan (2014) advocated giving the students the maximum control over learning and creating curricula that foster growth and development of their minds. This can be achieved through the unique nature of new technologies such as computer and its accessories where it is intended to serve as a teaching, learning and problem-solving tool, with the ultimate objective of providing a level of instruction equivalent to or better than that of a human teacher (Ezeudu, 2011). The human ability to guide, encourage and reinforce positively is still a necessary component of teaching with computer-based learning because programme learning is critically dependent on its effectiveness on the design of the questions. However, some studies have been carried out by different authors such as Hassan, Kareem, Bala& Abba (2016), their study revealed that there was no significant difference in cognitive achievement of the students using computer-based learning strategy. Also, there is paucity of literature on the effects of computer-based constructivist instruction on students' achievement and interest in Basic Science and technology Curriculum Study (BSTCS) (Bani, 2010).Hence, the need for this study to determine whether the strategy would produce significant effect on the students' achievement and interest in Basic Science and technology.

In addition, Atadoga and Lakpini (2013) reported that persistent poor achievement of students and their lack of interest in science subjects could be attributed to their poor foundation created from poor instructional methods used by the science teachers from the beginning. Hassan, Gimba, Abdukadir, Umar and Adio (2016) agreed that instructional method used by science teachers has a significant influence on achievement and interest of students. That is why NERDC (2012) recommended child-centered and culturally oriented instructional approaches for the teaching and learning of Basic Science and Technology. One of the approaches for teaching and learning of Basic Science and Technology that relates to the cultural heritage of students environment and their culture is ethno-science. Ethno-science is the study of different students combined with a particular strategy and

geographical areas as relates to science oriented subject. In this study, the researcher investigates the effects of computer-based constructivist instruction on Upper Basic II (UBII) students' achievement and interest in Basic Science and Technology, as one of the cultural oriented approaches using demonstration teaching method as a control variable to determine its effectiveness.

Interest can be defined as persistent tendency to pay attention and enjoy some activities or contents (Nworgu, 2006). Interest in Basic Science and Technology refers to students' reactions, feeling and impression about Basic Science and Technology contents and concepts as well as related tasks. This implies that, if students have positive interest towards Basic Science and Technology they will not only enjoy studying it but would also derive satisfaction from the knowledge and skills acquire from it. Students' achievement and interest in science have direct link with instructional methods. This means that methods of instruction are functions of students' achievement and interest in science.

Statement of the Problem

The objectives of teaching and learning BST is for the students to develop interest in science and technology, acquire basic knowledge and skills in applied science and technology in order to solve contemporary societal problems. These objectives have hardly been achieved over the years. This has been attributed to methods of instruction used by the science teachers which do not take care of the cultural background and the needs of the students (Ezeudu, 2011). As a result, students have been viewing science taught to them in schools as foreign, abstract, unreal and meaningless. As a result, students merely memorize the contents and concepts taught, to pass their examinations with little or no interest which results in persistent poor achievement.

Research Studies revealed that the effective utilization of ethno-science instructional approach influences students' achievement and interest in science. Most of the researchers' works like Ugwuanyi (2015) focused on Biology while some other researchers focused in the areas of Woodwork, Electrical, Building, Metalwork, Technical Drawing, Chemistry, and Mathematics and Physics using computer-based constructivist instruction. Much is yet to be done on Basic Science and Technology which is considered as foundation for students' acquisition of scientific and technological knowledge and skills for sustainable national development. The foregoing in mind necessitated the researchers to investigate effectiveness of computer-based constructivist instruction on achievement and interest of Basic Science and Technology Students.

Purpose of the Study

The purpose of this study is to determine the effectiveness of computer-based constructivist instruction on achievement and interest of JSS II Basic Science and Technology Students in Niger State. Specifically, the study sought to determine:

1. The difference between the mean Basic Science and Technology achievement scores of students exposed to computer-based constructivist instruction and those not exposed to it as measured by the Basic Science and Technology Achievement Test (BSTAT).
2. The gender difference between the mean Basic Science and Technology achievement scores of Students exposed to Computer-Based Constructivist instruction and those not exposed to it as measured by Basic Science and Technology Achievement Test (BSTAT).
3. The difference between the mean Basic Science and Technology interest scores of Students exposed to Computer-Based Constructivist instruction and those not exposed to it as measured by Basic Science and Technology Interest Inventory (BSTII).

Hypotheses

This study was guided by the following hypotheses and tested at 0.05 level of significance.

HO_1: There is no significant difference between the mean Basic Science and Technology achievement scores of Students exposed to Computer-Based Constructivist instruction and those not exposed to it as measured in the Achievement Test (BSTAT).

HO_2: Gender has no significant influence on the mean Basic Science and Technology achievement scores of Students exposed to Computer-Based Constructivist instruction and those not exposed to it as measured by Basic

Science and Technology Achievement Test (BSTAT).

$H0_3$: There is no significant difference between the mean Basic Science and Technology interest scores of Students exposed to Computer-Based Constructivist instruction and those not exposed to it as measured by Basic Science and Technology Interest Inventory (BSTII).

Research Method

This study adopted a quasi-experimental research design which is a non-equivalent pre-test post-test control group design. This is considered appropriate because, according to Hassan, Kareem, Bala and Abba (2016), there will be no randomization of the subjects into treatment and control groups. Intact classes were used to avoid disturbing the normal classes in terms of classroom schedule.

The study was carried out in Bida and Minna in Niger State, the target population for this study consists of all the 1,552 JSS II Students in the Junior Secondary schools in Bida and Minna Niger State, the sample for this study was made up of 52 Students. The study adopted multi-stage sampling technique to select the sample for the study. Multi- stage sampling technique was used- first, by sampling of the educational zone: purposive sampling was used to select two out of seven educational zones in the state (Bida and Minna zones). Secondly, purposive sampling technique was also used to select two co-educational JSS schools from Bida and Minna Niger State. The technique was used based on the criteria that:

- The school was a public school
- The teachers possessed the same professional qualifications.

Thirdly , simple random sampling technique was used to assign the schools to either the experimental group or the control group. Two instruments were used in collecting data for the study: 'Basic Science and Technology Achievement Test (BSTAT) and the Basic Science and Technology Interest Inventory (BSTII). The instruments were used for the pre-test and the post-test. However, the items used for the post-test were reshuffled.

BSTAT is a teacher made achievement test constructed from the Basic Science and Technology curriculum for JSS II. The test items were generated by the researcher. The BSTAT is a Thirty (30) item multiple choice .

Face and content validity was established for BSTAT by presenting it to five experts in Science Education Department and industrial and Technology Education Department Federal University of Technology Minna. After validation, trial testing was carried out and the result obtained was used to determine the reliability coefficient for BSTAT. The reliability coefficient of BSTAT was calculated to be 0.73 using the K-20 (Kuder Richardson) method. In order to establish the coefficient of stability, the instrument was re-administered to the same 20 Students, Scores from the two tests were correlated using Pearson Product Moment Correlation Coefficient technique. The coefficient of stability computed was 0.69. This was considered good enough. The test of stability became necessary since the BSTAT would be used for both pre-test and post-test in view of the research design.

For the Basic Science and Technology Interest Inventory (BSTII), Cronbach Alpha reliability method was used to test the internal consistency. An internal consistency reliability of 0.77 was obtained. This was considered high enough. Pre-test on both BSTAT and BSTII was administered to the students in the experimental and the control groups prior to the commencement of treatment. That was done by the class teachers in charge. The scores of the pre-test served as a covariate to the students' post-test scores. The Post-test on BSTAT and the post-test on BSTII were administered to the experimental and control groups immediately after the teaching exercise.

The data collected from the administration of the tests were analyzed in line with the research questions and hypotheses using Mean, Standard Deviation and Analysis of Covariance. The Mean and Standard Deviation were used in answering the research questions while Analysis of Covariance (ANCOVA) was used to test the hypotheses at $P < 0.05$ level of significance.

RESULTS

The results of the study are presented in line with the research questions and hypotheses that guided the study.

Research Question One

What is the difference between the mean Basic Science and Technology achievement scores of Students exposed to Computer-Based Constructivist Instruction and those not exposed to it as measured by the Basic Science and Technology Achievement Test (BSTAT)?

Table 1: Students' Basic Science and Technology Achievement Pre-test and Post-test Mean Scores and StandardDeviation

Experimental Condition	N	Pre-Text $\bar{X}$	SD	Post-Test $\bar{X}$	SD	Mean Gain Score
Experimental Group	27	23.37	12.57	43.04	21.77	19.67
Control Group	25	12.36	6.26	17.44	10.69	5.08
Total	52	18.08	11.40	30.73	21.40	12.65

Table 1 shows that students exposed to Computer-Based Constructivist instruction had a pre-test mean score of 23.37, with a standard deviation of 12.57 while the post-test mean score was 43.04 and a standard deviation of 21.77. The mean gain score between the pre-test and the post-test in experimental group was 19.67.

The students in the control group had a pre-test mean score of 12.36 with a standard deviation of 6.26 and a post-test mean score of 17.44 with a standard deviation of 10.69. The mean gain score for the control group was 5.08. The difference of the mean gain scores of the experimental and control groups was 12.65. This suggests that the students who were exposed to computer-based constructivist instruction achieved more than those who were not exposed to it.

Hypothesis One

HO_1: There is no significant difference between the mean Basic Science and Technology achievement scores of Students exposed to Computer-Based Constructivist instruction and of those not exposed to it as measured in BSTAT.

Table 2: Summary of the 2 Way Analysis of Covariance (ANCOVA) of Students'Post_test mean Basic Science and Technology Achievement Scores

Source	TypeIIIsum Of squares	df	Mean square	F	Sig.	Decision at 0.05 level
Correlated model	14848.747[a]	4	3712.187	20.532	.000	
Intercept	080.933	1	808.933	4.474	.040	
Pre-test.	5575.851	1	5575.851	30.840	.000	
Treatment	1691.231	1	1691.231	9.354	.004	S
Gender	47.525	1	47.525	.263	.611	NS
Treatment* Gender	99.520	1	99.520	.550	.462	NS
Error	8497.483	47	180.798			
Total	72454.000	52				
Correlated Total	23346.231	51				

a. R squared = .636 (Adjusted R Squared =.605)

The data in Table 2 indicate that Computer-Based Constructivist instruction, which is treatment, as a main factor has a significant effect on students' achievement in Basic Science and Technology. The calculated F-value of 9.354 is significant at 0.004 at 0.05 levels of significance. This implies that Computer-Based Constructivist instruction significantly enhanced students' achievement in Basic Science and Technology. The null hypothesis of no significant difference in the mean achievement scores of the experimental and control groups is, therefore, rejected.

Research Question Two

What is the influence of gender on the mean Basic Science and Technology achievement scores of Students exposed to Computer-Based Constructivist Instruction as measured by BSTAT

Table 3: Means and Standard Deviation of Students' Pre-test and Post-test Scores in Basic Science and Technology Achievement Test byGender

Genderof	N	Pre-test $\bar{X}$	SD	Post-test $\bar{X}$	SD	Mean gain score
Males	16	18.21	11.84	29.72	22.51	11.52
Females	11	17.91	11.08	32.00	20.33	14.09
Total	27	18.08	11.40	30.73	21.40	12.65

Results in Table 3 indicates that male students had a pre-test mean Basic score of 18.21 and a post-test mean score of 29.72. The mean gain score of male students is 11.52. The female students had pre-test and post-test mean scores of 17.91 and 32.00 respectively. The females have a mean gain score of 14.09. Also at pre-test, male and female students' standard deviations were 11.84 and 11.08 respectively while at post-test, male and female Students 'standard deviations were 22.51 and 20.33 respectively. However, the female Students had a higher mean gain score than the males.

A corresponding hypothesis formulated to further address research question two is Ho_2.

This hypothesis stated that Gender has no significant influence on the mean Basic Science and Technology achievementscores of Students exposed to Computer-Based Constructivist Instruction and those not exposed to it as measured by Basic Science and Technology Achievement Test(BSTAT). Hence the result here conform with the hypothesis.

In addition, result in Table 2 indicates that there is no significant differences in the post-test mean Basic Science and Technology achievement scores of male and female Students. This is shown by the F-value of .263 in respect of gender as a factor in the study which is significant at .611 levels. This indicated that at 0.05 levels, the F-value of .611 was not significant. The null hypothesis of no significant influence of gender on the mean Basic Science and Technology achievement score of Students exposed to Computer-Based Constructivist Instruction still stands. This implies that the female Students did not achieve significantly better than the male Students in BSTAT. Therefore, gender is not a significant factor in Basic Science and Technology achievement of Students. The null hypothesis is therefore not rejected.

Research Question Three

What is the difference between the mean Basic Science and Technology interest scores of Students exposed to Computer-Based Constructivist instruction and of those not exposed to it as measured by Basic Science and Technology Interest Inventory (BSTII)?

Table 4: Students' Basic Science and Technology Interest Pre-test and Post-test Mean Scores and Standard Deviation

Experimental Condition	N	Pre-Test $\bar{X}$	SD	Post-Test $\bar{X}$	SD	Mean Gain Score
Experimental Group	27	18.52	8.38	53.48	7.19	34.96
Control Group	25	15.80	3.95	49.20	6.06	23.40
Total	52	17.21	6.71	51.42	6.95	34.21

Table 4 indicate that the pre-test and post-test interest mean scores of Students exposed to Computer-Based Constructivist instruction were 18.52 and 53.48 respectively with the standard deviation of 8.38 and 7.19 respectively. The mean interest gain score for the experimental group is 34.96. The pre-test' score and post-test interest mean scores of Students in the control group were of 15.80 and 49.20 respectively with standard deviation of 3.95 and 6.06 respectively. The mean interest gain score for the control group is 23.40. This, therefore, suggests that Students exposed to self- instruction strategy had more interest in Basic Science and Technology than those not exposed.

HO_2: There is no significant difference between the mean Basic Science and Technology interest scores of Students exposed to Computer-Based Constructivist Instruction and of those not exposed to it as measured by Basic Science and Technology Interest Inventory (BSTII).

Table 5: Summary of 2-Way Analysis of Covariance (ANCOVA) of Students' Post-test mean Basic Science and Technology Interest Scores

Source	Type III sum of squares	Df	Mean square	F	Sig	Decision at 0.05 Level
Correlated Model	435.030[a]	4	108.757	2.521	.053	
Intercept	17106.047	1	17106.047	396.508	.000	
Pre-Test	54.194	1	54.194	1.256	.268	
Treatment	390.396	1	390.396	9.049	.004	S
Gender	149.201	1	149.201	3.458	.069	NS
Treatment* Gender	11.439	1	11.439	265	.609	NS
Error	2027.662	47	43.142			
Total	139968.000	52				
Correlated Total	2462.692	51				

Results in Table 5 indicate that Computer-Based Constructivist Instruction, which is the treatment, as a main factor has a significant effect on students' interest in Basic Science and Technology. This is shown by the F-value of 9.049 which is significant at .004 and 0.05 levels. This implies that the null hypothesis of no significant difference in the mean interest score of students exposed to computer-based constructivist instruction in Basic Science and Technology and those not exposed is rejected. This suggests that there is a significant difference in the mean interest scores of students exposed to self- instruction strategy in Basic Science and Technology and those not exposed.

Discussion of the Findings

The result of the study indicates that Computer-Based Constructivist Instruction has a significant effect on students' achievement in Basic Science and Technology. Students who were taught Basic Science and Technology using Computer-Based Constructivist instruction achieved significantly higher than those taught without using the strategy. The finding of this study is in line with the findings of some earlier studies on the positive effect of different learning strategies with respect to Students'achievement in Basic Science and Technology. The studies conducted by Obiekwe (2008), Usman, Hassan, Maik and Musa (2015); Mandor (2002); Cyril (2013) provide credence for the present study. These studies showed that there is a significant difference in the Basic Science and Technology achievement of Students in the treatment group that used self-instruction strategies than in the achievement of Students in the control group. The enhancement in Students' achievement in Basic Science and Technology could be due to the Students' understanding of the self- instruction strategy. The finding of this study suggests that Computer-Based Constructivist instruction help Students to actively be in-charge of the learning process and to monitor the progress in

learning exercise. As students are deeply involved in active learning, they are able to learn the processes involved in solving BSTAT problems.

The result of this study showed that male and female students in the experimental group performed better than their counterparts in the control group in Basic Science and Technology achievement. An important finding is that the female students in the experimental group had higher mean achievement scores than their male counterparts. However, the analysis of covariance (ANCOVA) for gender as main effect indicates that gender has no significant influence on the Basic Science and Technology achievement of students. This means that gender is not a significant factor in the use of the learning strategy. The finding is in consonance with the studies conducted by Atadogaand Lakpini (2013), Ezeudu (2011) and Mandor (2002) which also showed that there is no significant difference in the performance of males and females in Basic Science and Technology achievement using learning strategies.

These findings, however, contradict some earlier findings which portray gender as a significant factor in Basic Science and Technology achievement (Akalonu, 2001; Etukudo, 2002; Eraikhuemen, 2003; and Ongundokun&Adeyemo, 2010). The results obtained indicate that male students had higher mean scores than the females in Basic Science and Technology Achievement Test. The findings of this study could be explained in line with the view of Ezeudu (2011) who stated that gender has no direct effect on Basic Science and Technology achievement. Exposing students to computer-based constructivist instruction may have removed the differences that existed between the two genders. This implies that both male and female students benefited significantly from the strategy. However, the non-significant difference in Basic Science and Technology achievement of male and female students could also be attributed to effective use of Computer-Based Constructivist Instruction which ensured students' active participation in the learning process.

The results of this study show that Computer-Based Constructivist Instruction significantly enhanced the interest of students in Basic Science and Technology. Those in the treatment group had a significantly higher mean interest rating in Basic Science and Technology interest inventory than those in the control group. The finding of this study is in line with the findings of some earlier studies which indicated that interest determines the level of learning outcomes. Harbour- Hassan (2016), Ezeudu (2011), OgundokunandAdeyemo (2016) found that students develop more competence in subjects they are interested. In effect, the interest students show in an activity or in an area of knowledge predicts how much they will attend to it and how well they process, comprehend and remember it (Atadoga&Lakpini, 2013;,Stipek, 2002). As the students practice and realize some positive outcomes and success, they gain greater confidence in their ability to succeed in Basic Science and Technology. Their interest and urge to do more also increases. This could be the reason for the higher interest in learning Basic Science and Technology as demonstrated by students in the experimental group.

Conclusion

This study indicated that using computer-based constructivist instruction for teaching basic concepts in Basic Science and Technology enhanced students' achievement and at the same time increase their level of interest in the subject. Male and female students taught Basic Science and Technology content with computer-based constructivist instruction achieved equally and exhibited the same level of interest in the subject. This implies that gender has no significant influence in the achievement and interest of students exposed to Computer-Based Constructivist Instruction in Basic Science and Technology. Equally, the interaction effect of teaching Basic Science and Technology content with Computer-Based Constructivist Instruction and gender was not significant in the achievement and interest of Students.

Recommendations

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

- Teachers should be encouraged to adopt pupil-centred strategy like Computer-Based

Constructivist Instruction rather than teacher-centred way of teaching. This will go a long way to help improving the students' achievement and interest.

- Students on the other hand should be well exposed to Computer-Based Constructivist Instruction since the findings of this study indicate that it has a facilitative effect on their achievement and interest in Basic Science and Technology irrespective of gender.
- Evidence from the study indicates that the Computer-Based Constructivist Instruction remains the best strategy that can be used to facilitate effective teaching of Basic Science and Technology students for easy and timely coverage of the syllabus.
- Conferences, workshops, seminars and enlightenment programmes should be constantly organized by the federal, state and local government for their teachers in order to improve their knowledge and skills on the use of Computer-Based Constructivist Instruction. If this is done, students of Basic Science and Technology would have their performance well improved.
- Teachers should ensure that Students are actively involved in the learning activity by allowing them to take active participation in every learning situation.

REFERENCES

Abakpa, B. O. (2011). Effects of mastery learning approach on senior secondary schoolstudents' achievement and interest in geometry. Unpublished PhD thesis; University of Agriculture, Makurdi, Nigeria.Ahmadu Bello University, Zaria, 11th – 15th June, 2013.

Akalonu, G. C. (2001). Effects of Female Gender Friendly Curriculum Materials on Students' Achievement and Interest in Integrated Science. Unpublished M.E'd thesis, Faculty of Education, University of Nigeria, Nsukka.

Atadoga, M. M., &Lakpini, M. A. (2013). A comparison of numeracy achievement of primary school pupils taught using whole class and varied classroom organization instructions. Proceedings of Multicultural African Conference, Held at Faculty of Education,

Cyril, M. U. (2013). Effects of individualized, demonstration and discovery methods of teaching mechanical craft practice in technical colleges in Adamawa state. *Nigerian Vocational Association Journal, 18(2)*, 79-86.

Ezeudu, F. O. (2011). *Fundamentals of science education for colleges and universities*. Enugu: City and Company.

Federal Government of Nigeria (2013).*National policy on education*. Lagos: NERDC Press,

Hassan, A.M. (2016). Effects of e-learning on students achievement and interest in science and technology for sustainable development in Niger State. National conference for institute of education, University of Nigeria, Nsukka.

Hassan, A.M, Gimba R.W, Abdulkadir, M, Umar, B.K &Adi, T.A. (2016) Effect of blended Information and Communication Technology on the interest of junior secondary school students in basic science and technology for sustainable development. 4th International conference proceedings. 21st century global changes in education: implication for sustainable development 4th – 7th October, 2016 pp. 94 – 102

Hassan, A.M, Kareem, W.B, Bala, M.M & Abba, U. (2016). Effects of Information and Communication Technology (ICT) on achievement and interest of junior secondary school students in basic science and technology. Pp 363-368. 57 annual conference of science teachers association of Nigeria

Mandor AK (2002). Effects of constructivist-based instructional model on acquisition of science process skills among junior secondary students. Unpublished M.ed thesis, Faculty of education, University of Nigeria, Nsukka.

Nigerian Educational Research and Development Council, (2012). 9-year basic education curriculum: Basic Science for Upper Basic Education 7-9: NERDC PLC.

Obiekwe, C. L. (2008). Effects of constructivist instructional approach on students' achievement and interest in basic-ecologgical concepts in biology. Unpublished masterthesis: University of Nigeria Nsukka.

Ogundokun M. O.,&Adeyemo D. A. (2010). Emotional intelligence and academicachievement: the moderating influence of age, intrinsic and extrinsic motivation. *The African symposium, 10(2),* 127-141.

Owodunni, A.S, Igwe, C.O & Hassan, A.M (2014) Assessment of the metacognitive awareness and its implication on technical college students academic achievement in Niger State. *Journal of Information, Education, Science and Technology (JIEST)* Vol. 1 No.1. incomplete details

Robert, O.O, Hassan, A.M &Nwankwo, F.C (2016) Requisite for workshop equipment and materials management in technology education workshops in Higher Institution of learning in Minna metropolis, Niger State. *Journal of Information, Education, Science and Technology (JIEST)* Vol. 3 No.1 incomplete details

Ugwuanyi, E. C. (2015). Effects of an ethno-science based instructional model on students' academic achievement and interest in the senior secondary school biology. Unpublished master thesis: University of Nigeria Nsukka.

Umar, I.Y, Idris, A.M & Hassan, A.M (2016) Enhancing School-to-work transition of technology education graduates for industrial development in Niger State, Nigeria.*Indian Journal of Vocational Education.*India Central Institute of Vocational Education. Incomplete details

Usman G.A, Hassan, A.M, Maik, B. M & Musa, S.A (2015) Effects of cooperative learning and peer-teaching on secondary school students achievement in basic science and technology in Minna, Niger State. *Journal of Information, Education Science and Technology (JIEST)* 2 (2), pages not included?