Effect of Computer-Aided Instruction on Secondary School Students' Achievement and Retention in Basic Technology in Esan West L.G.A of Edo State

By

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Abstract
The study examined the effect of computer-aided instruction on junior secondary students' achievement and retention in basic technology. The study utilized a non-randomized quasi-experimental design. Multi-stage sampling technique was used in selecting samples of 110 from a population of 1050 JS II students in public secondary schools in Esan West local government area. The researcher developed CAI packages which were used as treatment for experimental group while control group was exposed to conventional method. BTART was the instrument for data collection. A reliability coefficient of 0.78 was obtained using Kuder Richardson's (KR_{21}) formula. The study was guided by four research questions and four null hypotheses. The research questions were answered using mean and standard deviation while ANCOVA was used to test hypotheses at .05 level of significance. The findings of the study show among others, that there was significant difference between the achievement scores of students exposed to computer aided instruction and conventional method (CAI = 35.84 and LM= 19.62).. The researcher therefore recommends that government and NGOs should fund development of computer-aided instructional packages and train manpower to produce software for technical education teaching to enhance achievement and retention.

Background of the Study and Problem

Education deals with passing of critical skills, aptitudes and knowledge from generations to generations to individuals. The late African icon, Nelson Mandela said "Education is the most powerful weapon with which man can change the world, and if they are still interested in the business of changing the world, then they need to revalue their weapons" (Duncan, 2013). More so, for education to be viable especially in our part of the world, the impacting of knowledge must cover several subjects and fields of learning which eventually lead to future vocations.

Technology has greatly contributed to the convenience and comfort of man. It is hard to get any single life in this world that is not affected by the development in science and technology (Oloyede, 2007). Every manufactured good seen at home or place of work is a product of science and technology. For instance, mobile phones, radio and television sets, PC tablets,

iPads, iPhones, iPods, laptops, desktops among other devices are products of science and technology (Tunde & Anthony, 2010). Government must take concrete steps to get the Nigerian citizens well groomed in science and technology.

According to Ibraheem (2004), that despite the workshops, seminars and conferences being organized by professional bodies in order to improve the teaching and learning of science, there is still poor achievement in the science and technology in the junior secondary schools, judging by the poor results in Junior Secondary Certificate Examination (JSCE) taken by the students. Onasanya, Shehu, Ogunlade and Adefuye (2011) identified defective teaching strategies as one of the reasons for the low achievement and retention of students in the sciences and basic technology at the junior and senior secondary certificate examinations.

Basic Technology is a subject introduced in the year 2007 for students at the upper Basic Education level. It objectives is to expose the students to rudiments of technology. At the inception of the 6-3-3-4 system of education, it was called Introductory Technology but currently in the 9-3-4 system of education it is called Basic Technology. The national policy on education (FRN, 2017) defined basic technology as the aspect of education which leads to acquisition of basic skills as well as basic scientific knowledge towards exploration of the world of work. It is also a subject that deals with the fundamentals of engineering and technology. Components of Basic Technology Woodwork, Metal Work, Building construction, Electrical/Electronics, Computer, Mechanics, Technical Drawing, and so on. Basic Technology as subject has been accorded a place in the school curriculum as a core subject like Mathematics and English Language. Objectives of teaching Basic Technology subject in Nigerian Basic Education Schools includes: i. to provide pre-vocational orientation for further training in technology; ii. to provide basic technology literacy for everyday life and iii. to stimulate creativity (FME, 2017). Looking critically at the objectives stated above, every student is expected to develop positive attitude towards the study of Basic Technology since it is the first-time students are introduced to technical subject. Basic Technology therefore, is defined as a pre-vocational subject designed for those in Basic Education Schools from Basic Education 7 to basic Education 9 to give learners the fundamental or elementary knowledge, skill, ideas etc of what technology is, which will help them for future development to solve or cope with modern technological problems and their solutions. Here, student achievement measures the amount of academic content a student learns in a determined amount of time. Student`s achievement will increase when quality instructional materials are used in teaching and learning of Basic Technology.The problem of ineffective teaching method facing the

teaching and learning of basic technology can be handled using computer-aided instruction (CAI).

Computer-aided instruction involves the use of computers to supplement classroom instruction. Computer-aided instruction does not fully replace the teacher in a classroom environment. The computer is simply an electronic device or machine that accepts data, processes data and gives out output with great speed and accuracy. Computer-aided instruction uses a combination of texts, graphics, sound and videos in the learning process**.**

Computer-aided instruction system is designed to automate certain forms of drill and practice instruction in delivering basic skills (Tinto, 2007). There are different types of computer-aided instruction software in science education including drill and practice, tutorial software, instructional games, simulations, problem-solving software and discovery environment.

However, this study was anchored on drill and practice software. This software provides opportunities for students to work on problems or examples one at a time and then receive feedback on performance. It is used as a mean to learn or review new content. It is made up of flashcard activities, branching drills and extensive feedback activities. Many of these programs are smartphone friendly so students can access the activities anywhere.

According to Federal Republic of Nigeria (FRN, 2004), in release of educational objectives for secondary schools, emphasis is laid on the need to equip students to live effectively in this modern age of science and technology. The major goal of technology education is to develop scientifically and technologically literate individuals that are concerned with high competence for rational thoughts and actions. The objectives of technology education in Nigeria, according to FRN (2004) include the need to prepare students to observe and explore the environment; explain simple natural phenomena; develop technological attitudes including curiosity, critical reflection and objectivity; apply the skills and knowledge gained through science to solve everyday problems in the environment; and develop self-confidence and self-reliance through problem-solving activities in technology.

Achievement is the performance of students in a test or examination. In determining the students' achievement using computer-aided instruction, Ash (2005) found that computer-aided instruction packages enhanced students' academic achievement in an aspect of mathematics in middle schools. Study conducted by Kingsley and Boone (2008), revealed that students who used computers in addition to textbooks in instruction scored higher on a standardized State test. Computer-aided strategy could expose technology in active data-based form and allow students and teachers to fully participate in the teaching-learning process. This may help to

reduce the long-time stigma of the chalk-and-talk approach to technology teaching. As the growth of educational programs continues to rapidly accelerate, concern over the retention of the students' knowledge is increasing.

Retention is the ability of a student to hold and bring to mind a memory of the previously learned skills, knowledge and experience during and after examination. Retention is significantly important, not just for student success, but also for the success of academic institutions. Nnaobi (2013) found that computer-aided instruction has the ability to sustain students' interest, encourage them to participate actively in the lesson and retain concepts learnt for a long time.

The conventional lecture method is the control variable to expose its ineffectiveness in delivering basic technology concepts; and to provide a way forward that suggests the use of computer-aided instruction that combines activity-based and inquiry approaches to science teaching. Another reason for the choice of computer-aided instruction and lecture methods is not just for mere comparison of the two methods but to create awareness among the junior secondary school teachers that there is a paradigm shift from conventional lecture method to an enhanced teaching strategy referred to as computer-aided instruction that may minimize the achievement and retention gaps in Vocational and technology education.

Statement of the Problem

Studies have shown that students' achievement and retention in basic technology are unimpressive (Ibraheem, 2004; &Ncharam, 2008). Instructional strategies and cognitive factors have been identified majorly as being responsible for poor achievement and retention in the technologies. Factors such as absence of computers and software packages, fluctuating internet connectivity, arbitrary charges on data bundles, epileptic power supply, computer illiterate teachers and students and gender are hindrances to the use of computer in schools.

Researchers, educators, administrators, TVET and other relevant educational agents have tried to develop various teaching strategies, yet schools have continually produced students with poor results in basic technology as well as other science subjects. These efforts have not yielded desired results in students' achievement and retention as conventional teaching methods have been used in teaching technologies. This has been attributed to the use of inappropriate teaching strategy in teaching science subjects (NECO Examiner,2022).

This seems to be a worry to find out the appropriate teaching method in basic technology in Junior secondary schools in Esan West Local Government Area of Edo State. Mofeed (2011) opined that computer-aided instruction has the ability to empower teachers and learners, and

transform teaching and learning processes from being highly teacher-dominated to student-centered. This transformation will result in increased students' performance; create opportunities for learners to develop their creativity, problem-solving abilities, informational reasoning and communication skills. Consequently, computer-aided instruction could be a satisfactory strategy in teaching and learning of basic technology in Junior Secondary Schools. The problem of this study therefore, is to explore the possibility of improving learning outcomes (achievement and retention) using computer-aided instruction.

Research Design

The study utilized a non-randomized pretest posttest quasi-experimental design. Hence, only one of the groups will receive treatment. The selection of the design for this study is due to the fact that random assignment of subjects to the treatment groups is not possible. This is because the research will be conducted in a school setting.

Population

The population for this study consisted of 1050 JS II students in the 35 approved secondary schools in Esan West Local Government Area. This was arrived at by summing the number of the JS II students in the 35 approved junior secondary schools in the study LGA. The choice of JS II students is based on the fact that they are not preparing for an external examination at this level. The students are also expected to have been exposed to basic technology topics at the JS I and II levels to give them a rich knowledge of the subject.

Another consideration for the choice of JS II students is that, at this stage the students are expected to have reached the formal level of reasoning, cognition and interpretation. Other criteria for selecting the population of the study are schools that have facilities for teaching basic technology and had presented students for Junior Secondary Certificate Examination (JSCE) for at least five years.

Sample and Sampling Technique

The sample for this study was made up of 120 JS II basic technology students drawn from the four sampled junior secondary schools. The breakdown revealed that experimental group consisted of equal gender balance of 30 boys and 30 girls, while the control group comprised of equal gender balance of 30 boys and girls 30 respectively. The sample size of 120 was considered adequate since it is an experimental type where emphasis is not on large sample size but the treatment and control of extraneous variables.

Multi-stage sampling technique was used in selecting sample for this study. In this type of sampling according to Emaikwu (2013), different sampling techniques are applied at several stages of the research study. This was used because stratification was done along more than one variable at a time. For instance, purposive sampling was used in selecting schools, random sampling was used in selecting students and proportionate stratified random sampling was used in selecting gender for the study.

Instrumentation

Basic technology Achievement and Retention Test (BTART) developed by the researcher was the instrument for data collection.

Validation of Instrument

Forty multiple-choice items were initially constructed by the researcher but only 35 items survived the validation. The items were reduced to 35 in respect of the comments by the validators that there were too many calculations for the level of the learners used for the study; and also on the ground that 40 items constructed were too many. On the whole, only 30 items survived the item analysis and validation; and were used to measure the students' achievement and retention. The instrument, BTART was validated by 3 specialists in Vocational and technical education in Ambrose Alli University, Ekpoma.

Method of Data Collection

The method of data collection is organized in three sections, the first deals with the procedure for data collection, the second deals with the training of research assistants, and the third deals with instructional packages.

Method of Data Analysis

The data obtained through BTART were analyzed with respect to each research question and hypothesis. The data collected were classified into pretest, posttest and post-posttest for both the experimental and control groups. The data generated were then analyzed using appropriate statistical tools; the research questions were answered using mean and standard deviation, and the four stated hypotheses were analyzed using Analysis of Covariance (ANCOVA) in Statistical Package for Social Science (SPSS) software version 21 at 0.05 level of significance.

Results

Research Question 1: What is the difference in achievement scores of the students taught using computer aided instruction and those taught using lecture method in basic technology?

Table 1: Mean Achievement and Standard Deviation of Students' Scores in ComputerAided instruction (CAI) and Lecture Method (LM)

Group	N	Pretest		Posttest		Mean Gain
		Mean	SD	Mean	SD	
Exp. (CAI)	55	30.864.01		40.83	5.19	35.84
Control (LM)	55	20.75	2.17	28.48	3.16	19.62
Mean Diff.		51.61		69.31		55.46

Table 1 shows the mean and standard deviation of students' scores in experimental and control groups. The table revealed that the pretest mean achievement score of students in experimental group was 30.86 with a standard deviation of 4.01 while students in the control group had mean achievement score of 20.75 and a standard deviation of 2.17. The mean difference between the two groups was 0.10 which implies that the groups were of close cognitive abilities before the treatment since the mean difference was considered small.

Table 1 also reveals that the posttest mean achievement scores of students in experimental group was 40.83 with a standard deviation of 5.19 while students in the control group had mean achievement score of 28.48 and a standard deviation of 3.16 with an achievement mean gain of 55.46.

The mean difference between the two groups was 35.84 in favour of experimental group. Thus, the experimental group achieved higher than the control group because the use of CAI stimulated and encouraged the students to participate actively in the lessons. The mean difference at the posttest was observed to be higher than that of the pretest suggesting the groups were no longer of the same cognitive abilities. Nevertheless, the students in the control group increased their achievement from 20.75 to 28.48 with a mean gain of 19.62.

Research Question 2: What is the difference in the mean retention scores of the students taught using computer-aided instruction and those taught using lecture method in basic technology?

Table 2: Mean Retention and Standard Deviation of Students' Scores Taught by Computer-Aided Instruction and Lecture Method

Group	N	Posttest		Post-Posttest		Mean Gain
		Mean	SD	Mean	SD	
Exp. (CAI)	55	30.86	4.10	40.83	5.19	35.84
Control (LM)	55	20.75	3.14	28.48	3.16	19.62
Mean Diff.		51.61		69.31		55.46

Table 2 shows the mean retention and standard deviation of students' scores in experimental group and lecture method. The table revealed that the pretest mean retention score of students in experimental group was 30.86 with a standard deviation of 4.10 while the students in the control group had mean retention score of 20.75 and a standard deviation of 3.14. The mean difference between the two groups was 51.61 which suggest that the groups were of different cognitive aptitude at the posttest since the mean difference was considered high. Table 2 equally revealed that the post-posttest mean retention score of students in experimental group was 40.83 and a standard deviation of 5.19 with a mean gain of 35.84 while students in the control group had mean retention score of 19.62 and a standard deviation of 3.16 with a mean retention gain of 19.62. The mean difference between the two groups was 55.46 in favour of the experimental method. The difference at the post-posttest was higher than that of the posttest suggesting that the students in the experimental group retained better than those in the control group.

The result from table 2 revealed that the students in the experimental group had higher mean retention score in basic technology. The implication of this result is that the method employed in the experimental group encouraged the students to assimilate and retrieve basic technology concepts learnt easily.

Hypothesis 1: There is no significant difference in the mean achievement scores of students taught using computer-aided instruction and those taught by traditional lecture method.

Table 3: ANCOVA Test of Students' Achievement Scores in CAI and LM

Source	Type III Sumof Squares	Df	Mean Square	F	Sig.
Corrected Model	866.16	2	433.08	43.31	.00
Intercept	2182.76	1	2182.76	218.37	.00
Pretest	7.48	1	7.48	.75	.39
Method	**863.07**	**1**	**863.07**	**86.32**	**.00**
Error	1169.84	112	9.99		
Total	55757.00	110			
Corrected Total	2035.99	109			

a. R Squared = .43 (Adjusted R Squared = .42)
* denotes F is significant at 0.05 alpha level.

Table 3 showed one-way ANCOVA test of basic technology students' achievement scores in computer-aided instruction and lecture method. Pretest scores were used as covariate to control the initial difference in the two methods. The result from the table 3 revealed that $F_{1,119} = 86.32$, and $p = 0.00$ for the main treatment. The significant value p-value (0.00) was less than the set significant value of the study ($p < 0.05$). Therefore, the null hypothesis that stated that there is no significant difference in the mean achievement scores of students taught using computer-aided instruction and those taught by conventional method was rejected.

The conclusion drawn was that there exists a significant difference in the achievement of basic technoogy students exposed to computer-aided instruction and lecture method. This indicates that there is statistically significant difference between the mean achievement scores of the experimental and the control methods. The experimental group exposed to CAI achieved better than the control group taught using modified lecture method since the estimated effect size of ANCOVA test was considered significant. This suggests the need to deviate from conventional method to computer-aided instruction in order to adjust in line with the paradigm shift in science education pedagogy.

Hypothesis 2: There is no significant difference in the mean retention scores of students taught using computer-aided instruction and those taught using lecture method.

Table 4: ANCOVA Test of Students' Retention Scores in CAI and LM

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	1320.62	2	660.31	49.07	.00
Intercept	497.22	1	497.22	36.95	.00
Posttest	173.61	1	173.61	12.90	.00
Treatment	**295.74**	**1**	**295.74**	**21.98**	**.00**
Error	1574.31	112	13.46		
Total	61107.00	110			
Corrected Total	2894.93	109			

a.R Squared = .46 (Adjusted R Squared = .45)

* denotes F is significant at 0.05 alpha level.

Table 4 showed ANCOVA test of students' retention scores in experimental and lecture methods. Posttest scores were used as covariate to control initial difference in the two groups. Results from the table 4 revealed that $F_{1,119} = 21.98$ and $p = 0.00$. Since $p < 0.05$, the observed difference in students' mean retention score in experimental and lecture methods was judged to be significant.

Thus, the null hypothesis that there is no significant difference in the mean retention scores of students taught using computer-aided instruction and those taught by Lecture Method was rejected. Students in the experimental method retained better than their control method counterparts because the use of computer motivated them to assimilate and recall the learnt concepts of work, energy, power and kinetic energy.

Discussion of Findings

The finding from table 1 showed that students in the experimental group had a higher mean achievement score (35.84) in BTART than the control (19.62) counterparts. This result is further confirmed by the finding from table 5 which indicates that the treatment is a significant factor in the achievement of basic technology students. This indicates that students taught using computer-aided instruction achieved better than those taught by lecture method. The result of this study is in agreement with the findings of Ada et al (2012); and Salem (2011). who found and reported that there was significant difference in the performance of students taught by CAI and LM. Contrary to the above finding, the result is

in contrast to the previous finding of Bayraktar (2008) who could not found any significant difference between the students exposed to CAI and those exposed to lecture method.

Result from table 2 revealed that the students exposed to computer-aided instruction, retained and retrieved basic technology concepts learnt better than those in control group. This was shown by mean retention score of 30.86 for experimental group which was higher than that of 20.75 for control group. The ANCOVA test in table 4 also indicated that the CAI method is a significant factor in students' retention abilities in basic technology. This was shown by the rejection of the null hypothesis that there is no significant difference between the mean retention scores of students exposed to computer-aided instruction and conventional lecture method.

It thus seems that computer-aided instruction is one of the valuable strategies of impacting basic technology concepts to the students in Nigerian secondary schools. This showed by the comparison of mean retention score of the experimental group with control group. There was significant difference between the retention scores of student taught basic technology by CAI and those taught by convention method. The result is in agreement with the findings of Tabassum (2004); and Gbodi and Laleye (2006) who found significant difference in the retention scores of students taught with CAI and conventional lecture method.

Conclusion

Based on the findings of this research, it was concluded that computer-aided instruction in basic technology enhances achievement and retention of the junior secondary students. Computer-aided instruction did not favour one gender more than the other in terms of achievement and retention in basic technology. The male and female students in the experimental group had no significant difference in their achievement and retention tests. This means that the achievement and retention of basic technology students did not depend on gender but on cognitive abilities and teaching strategy used by the teacher. From the foregoing, CAI may be a valuable tool for enhancing individualized instruction, achievement, retention and learning motivation.

Recommendations

On the basis of findings from this study, it is recommended that:

1. Government, Non-Governmental Organization and Parents Teacher Associations should fund development of CAI packages in the schools, equip the

schools with necessary ICT facilities and train manpower to produce software for science and technology education in Nigerian schools.

2. Schools should train science and technology teachers on the use of ICT resources for science and basic technology teaching and learning particularly, the use of different software packages, DVDs, CD ROMs, videotapes, overhead projectors on science concepts and processes to encourage the potentials of ICT in Nigerian schools.

3. Computer literacy programme should be provided for both students and teachers for full integration of ICT resources in Vocational and Technical Education Programme.

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