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TOWARDS SCALING UP STUDENTS' PERFORMANCE AND RETENTION IN BASIC SCIENCE USING COMPUTER-AIDED INSTRUCTION IN TARABA STATE, NIGERIA.

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ABSTRACT

This study investigated the impact of Computer-aided instructional (CAI) strategy on the Performance and Retention of upper Basic II Science students in Taraba State, Nigeria. It adopted a non-randomized, pretest, posttest, post-posttest, control group quasi-experimental research design. Two null hypotheses were formulated in line with the research questions and purpose of the study. The population of the students comprised of 2511 and a total of 160 students were selected as sample using multi-stage sampling technique. The instrument known as Basic Science Performance and Retention Test (BSPRT) was adapted from BECE with a reliability of 0.81 obtained from the pilot testing using Kuder Richardson's (KR_{21}) formula for the data collected. Data were collected by the administration of the instrument during the pretest, posttest and post-posttest. Mean and standard deviation were used to answer the research questions; independent sample t-test was used to test the hypotheses at 0.05 level of significance. The results of the study showed that Computer-aided instructional pedagogical strategy in basic science enhanced the performance and retention of the basic science concepts among the upper basic II students. It was therefore recommended that STAN, NUT, NERDC among others should fund the development of computer-aided instructional package and train the manpower to produce software and hardware for science education teaching in order to enhance the performance and retention of the learnt concepts by the students in science.

Keywords; Basic Science, Performance, Retention, Computer-aided, Scaling, Guided-discovery

INTRODUCTION

Science and technology have 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. Every manufactured goods seen at home and 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. In the same way, the fruit juices and soft drinks consumed daily, the cars, the motorcycles and bicycles, the clothes and shoes are all products of science and technology. Ashiker (2012) opined that concrete steps should be taken to get the Nigerian citizens well-groomed in science and technology for the country's scientific and technological advancement.

Despite the more workshops, seminars and conferences being organized by professional bodies such as Science Teachers Association of Nigeria, Nigeria Educational Research and Development Council, Nigeria Union of Teachers, among others in order to improve the teaching and learning of science, there is still poor performance in science in the Upper Basic Education Schools, judging by the poor results in Basic Education Certificate Examination (BECE) taken by the students. The Ministery of Education Resource Centre Jallingo (2022) revealed that the percentage passed of students in BECE from 2018 – 2022 for the past five years indicate 20.25%, 18.10%, 15.00%, 14.10% and 18.90% passed respectively and 18.13%, 30.27%, 22.10%, 25.06% and 22.00% credit passed respectively. This is quite worrisome considering that none of the year has 50% passed. It is in connection with this, that researchers such as Onasanya, Shehu, Ogunlade and Adefuye (2011);

(Ncharam, 2008 cited in Benson 2016); and (Ash, 2005, as cited in Egbodo, 2016) have identified poor teaching strategies as one of the reasons for the low performance and retention of students in the sciences at the Upper Basic and Secondary Certificate Examinations.

Many factors contribute to the poor performance and retention of students in basic science examination including poor teaching methods, bad equipment's, absence of functional laboratories, the schools are also bedeviled by paucity of fund, instructional aids, lack of good libraries, absence of computers, internet connectivity, and inability of the basic science teachers to improvise and put across the basic science concepts as experienced by the researcher. Science subjects are only taught in theory and abstraction through Guided-Discovery Strategy (GDS) expository, among other strategies. The problem of ineffective teaching method facing the teaching and learning of basic science could be handled using computer-aided instruction which is motivational and students centered.

As the world is constantly changing and ways in which human beings' function at home, place of work and school are also changing. The speed at which technology is developing plays a major role in these changes. From offline to online virtual classes, computers are influential in human life, and can enhance the learning process in schools in various ways. This may be the reason why Achuonye, (2016) asserted that, with the increasing popularity of computer technology, it is essential for school administrators to support and encourage computer technology learning in our education system as it has become an important medium in instructional delivery. In recognition of the importance of computer in the teaching/learning process in Nigeria, the National Council on Education introduced computer education in 1987(Achuonye, 2016).

Computer-aided instruction involves the use of computers pedagogy for classroom instruction. Computer-aided instruction does not fully replace the teacher in the 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 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. There are different types of computer-aided instruction software in science education which include drill and practice, tutorial software, instructional games, simulations, problem-solving software, discovery environment, among others.

Computer-Aided instructional strategy, in particular has become increasingly common household terms as evidenced by the wealth of references to them in the popular media and on television programs in the United States (US). The popularity of the CAI spread to the educational community as well. The Internet is increasingly being used as an educational tool in schools with access. There is a sharp increase in the number of schools connected to the Internet. Professional development opportunities for teachers to learn to use the Internet are ever increasing and the number of books that specialize in educational resources on the Internet are filling bookshelves. One can safely predict that in the short-term larger number of teachers are going to grapple with effective ways of integrating the Internet into the classroom. The Internet and the countless possibilities associated with the Internet are quickly reshaping the way we conduct business, the way we learn and redefining the way we relate to one another.

Computer-aided instruction involves the use of computers to supplement or assist classroom instruction. In its traditional form, Computer-aided instruction relies on software that presents information and guides a learner through a series of subject matter, objectives, quizzing the student periodically and assessing progress to a mastery level. Computer-aided instruction does not supplant or fully replace the teacher in a classroom environment. The computer has many purposes in the classroom that can be utilized to help a student in all areas of the curriculum. The computer-aided instructional program allows students to study science concepts while advancing at their own pace, enabling them to spend the necessary time on each subject lesson. The teacher role in this

environment is to provide targeted help to students when they need additional assistance. In addition, the computer program covers many administrative aspects such as lesson planning, grading and homework assignment so that teachers may spend more time on individual instruction with struggling students (Kirby, 2004) up to date.

Computer-aided instruction is of paramount importance in science education; as such it has a couple of advantages. A primary advantage that computer-aided instruction offers to the instructional process is that it permits students to proceed through curriculum objectives at a pace that they find comfortable. Classroom settings that move in lock-step at a pace determined by a teacher can either bore students by moving too slowly for them, or lose students by moving on to new material before mastery has been acquired on that which has already been covered (Nawarro & Shoemaker, 2004) up to date.

Computer-aided instruction software, however, permits students to dwell on material or return to it until they have reached a mastery level. It allows the student to do so in a more private context than a classroom, where students who learn more slowly may be subjected to embarrassment or ridicule from classmates. It also permits students who learn more rapidly and who have mastered a set of objectives to progress without waiting for new skills and concepts that they have not yet acquired. This individualization is crucial to understanding why computer-aided instruction is considered a powerful educational strategy. Computer-aided instruction has several other advantages. In general, as a supplement rather than a replacement for teacher-based instruction, it provides a blended approach to learning and thus a more diverse educational experience for students. Virtually all large scale studies that examine student attitudes find that computer-aided instruction can motivate students and improve attitudes towards learning. Some studies have shown that Computer-aided instruction improves school attendance. Computer-aided instruction can relieve a teacher of routine tasks that are associated with student practice, exercise, and drill, and do so at significantly lower cost than the teacher. Finally, one of the most important advantages involves what educational psychologists refer to as "locus of control," which is when students have a greater sense of control over their learning experience and how it is paced; they have less ambiguity about their performance because Computer-aided instruction systems furnish frequent feedback.
Interactions between instructors and students, as well as peer interactions between students are requisite to facilitate critical thinking and promoting enriched learning. A major advantage of computer-aided instruction is that, by necessity, it requires the student to be an active participant in the learning process. In order to progress from one screen of information to the next, in most cases, the student must respond using the computer's peripheral hardware (e.g. keyboard, mouse, joystick, or specially-designed devices) As a result, it is impossible for students to assume the role of a mere observer. Many classifications of computer-aided instruction are available in education. The six specific types seem to be most often utilized for educational purposes include drill and practice, tutorials, instructional games, simulations, problem-solving and discovery environment.

Statement of the Problem

Studies have shown that students' performance and retention in basic science are unimpressive. Instructional strategies and cognitive factors have been identified majorly as being responsible for poor performance and retention in the sciences Factors such as absence of computers and software packages, fluctuating internet connectivity, arbitrary charges on data bundles, epileptic power supply, computer illiterate teachers among others are hindrances to the use of computer in schools. Researchers, educators, administrators, Science Teacher Association of Nigeria (STAN) and other relevant educational agents have tried to develop various innovative teaching strategies, yet schools have continually produced students with poor results in basic science as well as other related science subjects. These efforts have not yielded desired results in students' performance and retention as conventional teaching methods have been used in teaching sciences. This has been attributed to the use of inappropriate teaching strategy in teaching science subjects. The problem of this study

therefore, is to determine the impact of Computer-aided Instruction on the Performance and Retention on Students of Basic Science in Jalingo, Taraba State Nigeria. The study also explored the possibility of improving learning outcomes (performance and retention) using computer-aided instruction on Upper Basic Science Students.

Aim and Objectives

The purpose of the study was to investigate the Effect of Computer-Aided Instruction on the Performance and Retention of Students of Basic Science in Jalingo, Taraba State, Nigeria. It was aimed at the following objectives:

1. To find out if the use of Computer-Aided instruction in teaching basic science enhances students' performance in the subject better than the guided-discovery strategy.
2. To determine whether students' retention in basic science is improved by the use of computer-aided instruction when compared with guided-discovery strategy.

Research Question

The following research questions guided the study:

1. What is the difference in the mean performance scores of the students taught Basic Science using computer-aided instruction and those taught using guided-discovery strategy?
2. What is the difference in the mean retention scores of the students taught Basic Science using computer-aided instruction and those taught using guided-discovery strategy?

Hypotheses

The study was guided by the following null hypotheses which was tested at $P<0.05$ level of significance:

Ho1. There is no significant difference in the mean performance scores of students taught Basic science using computer-aided instruction and those taught the same concepts using guided-discovery strategy.

Ho2. There is no significant difference in the mean retention scores of students taught Basic Science using computer-aided instruction and those taught using guided-discovery strategy.

Review of Empirical Literature

Onasanya et al (2011) investigated teacher's awareness and extent of utilization of information communication technologies for effective science and health education in Nigeria. The authors also examined the relationship between awareness, extent of utilization and teachers' gender. The research subjects were 240 science and health education teachers drawn from 40 secondary schools, randomly selected from 10 Local Government Areas of Oyo State. Two instruments were designed by the researcher and used for this study. These are 40 item computer literacy test (with reliability coefficient measure of 0.77) and the 20-item questionnaire on teachers' level of utilization of ICTs (with Cronbach alpha measure of 0.82). Data were analyzed using weighed means scores standard deviation and t-test. The analysis shown that the level of computer literacy of the science teachers examined is low. Their level of utilization of ICT resources was also found to be very low. From the 2 hypotheses tested, the result showed that there was significant difference between the mean scores for male and female science teachers in their level of computer literacy (knowledge, $t = 6.48$; application, $t = 3.62$, and communication, $t = 2.63$) and (2) utilization of ICTs ($t = 4.00$). It also indicated that the males outperformed their female counterparts in both instances, although, their level is very low. Therefore, all science teachers (especially the females) need to be motivated and provided with relevant ICT training experience (at pre-service and in-service levels) in order to enhance their instructional delivery productivity. In Onasanya et Al's study, the use of computers and their accessories were the major focus. This study also centered on the application of computers in classroom instruction. The study was carried out in science and health education to find out the teachers' awareness of ICT utilization in Oyo state while this was carried out to find out the effect of computer-aided instruction on upper basic II students' performance and retention in basic science

in Jalingo, Taraba State. Consequently, there is need for this study in Taraba State as a result of the variance in subject areas and locations. Also, the variables in the researchers' study were different from the ones in this study.

Nnaobi (2013) investigated enhancing students' performance using computer-aided instruction (CAI) in tertiary institutions in Rivers State. The study used two groups of non- randomized pretest-posttest design. The guided-discovery method was carried out among the two groups with instructional materials such as models, pictures and flow charts. The experimental group (Chemistry/Computer science students) was exposed to chemistry lesson packages in computer drill and practice software on organic for a period of 4 weeks while the control group (Agricultural science students) was taught with instructional material.

The period for the Nnaobi's study was considered to be short. It would have been better if the researcher used 6-7 weeks for treatment and administration of the instrument. The study was conducted among the tertiary institutions' students while this present study was carried out among the secondary school students. The variables are not the same in that of Nnaobi's and this study. For these reasons, there is need for this study.

Nnaobi (2013) compared the effects of Computer Assisted Instruction on the achievement of Junior High School (JHS II) students in Pre-Technical skills after exposing them to computer-assisted instruction and the guided-discovery methods of instruction. The theoretical framework for the study is that people learn most things better through construction of computer games or multimedia composition rather than through guided-discovery methods of directly teaching content. The study involved 59 out of 386 students from two schools in Kumasi Metropolis in Ghana. Twenty-eight of the students formed the computer-assisted instruction group while 31 formed the guided-discovery group.

Quasi-experimental design was used for the study. Structured pre-test and post-test achievement test with a reliability co-efficient = 0.74 and 0.75 respectively were used to collect data. The study utilized 4 hypotheses which were analyzed using Predictive Analysis Software (PAS) version 18. The study revealed that the computer-assisted instruction group performed better than the guided-discovery method of instruction group. However, there was no statistically significant difference between the performance levels of the two groups. It was recommended that computer-assisted instruction should be introduced in the teaching of pre-technical skills throughout the country.

The study of Nnaobi compared computer-assisted instruction and guided-discovery Strategy which were also compared in this study. The study covered only one learning outcome variable, performance but the present study covered performance and retention. The study was carried out in Ghana while this study was carried out in Nigeria. Hence, there is need for this study.

Oka and Nwafor (2016) investigate the effects of computer-assisted instruction as a teaching strategy on junior secondary school students' achievement in Basic Science. Quasi-experimental design was used for the study. The study was conducted in Abakaliki Education Zone. Two co-educational school were drawn for the study through simple random sampling technique. One school was assigned to the treatment group while the other was assigned to the control group through a simple toss of the coin. Due to the large population at the junior secondary level data for study were collected from only four intact classes in JSS II from each of the two coeducational schools that were used for the study. In all therefore a total of four intact classes were used for the study (two intact classes for treatment group and two intact classes for the control group) Basic Science Achievement Test (BSAT) with a reliability score of 0.75 was the instruments used to collect data. Three research questions and three null hypotheses guided the study. The data for the research questions were answered using mean and standard deviation, while the hypotheses were tested using the analysis of covariance (ANCOVA) at an alpha level of 0.05. the findings of the study revealed that computer-assisted instruction as a method of teaching enhanced higher students' achievement in Basic Science than the conventional method. Based on the findings the researcher made some recommendations.

The study of Oka and Nwafor (2016) compared computer-assisted instruction and conventional method which were also compared in this study, the study covered achievement as learning outcome

variable, while the present study covered performance and retention. The study was carried out in Abakaliki, Ebonyi state while this study was carried out in Jalingo, Taraba State. Hence there is need for this study.

Egbodo (2016) investigated the effect of computer-aided instruction on junior secondary students' achievement and retention in basic science, the study utilized a non-randomized quasi-experimental design. Multi-stage sampling technique was used in selecting samples of 120 from a population of 1050 JS II students in Oju local government area. A reliability coefficient of 0.78 was obtained using Kuder Richardson's (KR21) 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 0.05 level of significance. The findings of the study showed that there was significant difference between the achievement scores of students exposed to computer- aided instruction and conventional method ($p = 0.00$ and $a = 0.05$; $p < a$). Also, students in the experimental group retained better than their control method counterparts ($p = 0.00$ and $a = 0.05$; $p < a$). However, no significant difference existed in the achievement ($p = 0.58$ and $a = 0.05$; $p > a$) and retention ($p = 0.46$ and $a = 0.05$; $p > a$) of the male and female students exposed to CAI. It was therefore, recommended that government and NGOs should fund development of computer-aided instructional packages and train manpower to produce software for science education teaching to enhance achievement and retention. The study of Egbodo (2016) investigated the effect of computer-aided instruction on junior secondary students' achievement and retention in basic science, the study covered achievement and retention as learning outcome variable, while the present study covered performance and retention. The study was carried out in Oju local government of Benue state while this study was carried out in Jalingo, Taraba State. Hence there is need for this study.

Jackson et al (2019) study investigated effect of Computer-Assisted Instruction (CAI) on upper-basic students' achievement in Basic Science using pre-test post-test quasi-experimental design. Two research questions and two null hypotheses guided the study. The sample used for the study was 74 upper-basic II students (intact classes of 40 for CAI and 34 for conventional instruction) purposively drawn from the population of 3,807 students in the 55 secondary schools in Makurdi Local Government Area of Benue State. Data was collected using Basic Science Achievement Test (BSAT). BSAT was validated and pilot tested with the reliability coefficient of 0.89 using Kuder Richardson formula 21. The research questions were answered using mean and standard deviation while the hypotheses were tested at 0.05 alpha level of significance using t-test statistic. It was found that the achievement of students exposed to CAI were better than those in conventional instruction. Also, there was
no gender disparity in the achievement of students exposed to CAI. This means CAI is gender friendly and can effectively minimize students' failure if government/proprietors provide functional computer laboratories in all basic schools for the application of CAI packages in the teaching and learning of Basic Science; and if teachers are students are acquainted with the use of CAI packages. The study of Jackson et al (2019) investigated effect of Computer-Assisted Instruction (CAI) on upper-basic students' achievement in Basic Science while this study investigated the effect of computer-aided instruction, the study covered achievement as learning outcome variable, while the present study covered performance and retention. The study was carried out in Makurdi local government of Benue state while this study was carried out in Jalingo, Taraba State. Hence there is need for this study.

Chimaobi (2016) carried out to determine the effect of computer assisted instruction on secondary school students" academic achievement. The sample of the study consisted of 117 students. The sample consisted of the intact classes, one experimental group with 68 students and the other one as control group had 49 students. A random sampling technique using balloting method was used in selecting the two schools out of the 65 public secondary schools in Nassarawa Education Zone. A pre-test-post-test quasi experimental design was used. The instrument used was Chemistry Achievement Test (CAT) and Chemistry Interest Rating Scale (CIRS) which were both validated and

with reliability coefficients of 0.75 and 0.78 respectively. The hypotheses stated were tested using t-test statistics at P ≤0.05 level of significance. Major findings of the study revealed that there is significance difference in the academic achievement and interest rating among secondary school students exposed to computer assisted instruction. But there is no significance difference in the academic achievement and interest in Chemistry rating scale between male and female students exposed to computer assisted instruction. In the light of the findings from this study, the following recommendation was made among others. School authorities and government agency in charge of managing the affairs of secondary schools should make provision of computers and education softwares and train teachers with the current development in the methodology of teaching and learning chemistry.

The study of Chimaobi (2016) was carried out to determine the effect of computer assisted instruction on secondary schools students" academic achievement in chemistry while this study investigated the effect of computer-aided instruction in Basic Science, the study covered academic achievement as learning outcome variable, while the present study covered performance and retention. The study was carried out in Nassarawa educational zone of Kano state while this study was carried out in Jalingo, Taraba State. Hence there is need for this study. Samuel & Uchenna (2020) examined the impact of computer-assisted and field trip instruction on the educating and learning of fundamental science and innovation in upper basic education (Junior Secondary School 1-3). The study employed quasi-experimental design, which is the pre and post-test for control and experimental group design performed at three selected public schools in Gwagwalada Area Council, Abuja. Three research questions and hypotheses guided the study. Two hundred ten (210) junior secondary students (JSS) were randomly selected by a simple ballot method from three secondary schools in Gwagwalada area council of Abuja. A 50 – item questions test called Basic Technology Performance Test (BTPT) developed by the researcher was employed to gather information for the investigation. Scores generated from pre-test and post-test were analyzed using Pearson Product Moment Correlation Coefficient (PPMCC), and the test had a reliability of 0.92. The paired sample and independent-sample t-test were used to analyze the data through the Statistical Package for Social Science (SPSS) version 25. The result showed that the use of Computer-Assisted Instruction (CAI) has a better effect on students' achievement in basic science and technology. It was additionally uncovered from the outcome that there was a significant difference between pre- and post-lesson assessments. Recommendations were made to the teachers that they should always apply Computer-Assisted Instruction (CAI) materials for effective lesson delivery. The study Samuel & Uchenna (2020) examined the impact of computer-assisted and field trip instruction on the educating and learning of fundamental science and innovation in upper basic education (Junior Secondary School 1-3) while this study investigated the effect of computer-aided instruction in Basic Science, the study covered academic achievement as learning outcome variable, while the present study covered performance and retention. The study was carried out in Gwagwalada area council of Abuja while this study was carried out in Jalingo, Taraba State. Hence there is need for this study.

Chibuzo (2012) Impact of computer-assisted instructions on the academic performance of students in social studies in Enugu State, Nigeria. To carry out the study, six research questions were posed in line with the purpose of the study. Also, six hypotheses guided the study and were tested at 0.05 level of significance. Three hypotheses were rejected and the other three were accepted. The design of the study was quasi-experimental design. Specifically, pre-test, post-test, non-equivalent group design was used. The population of the study was all the JSSI students in Public Junior Secondary Schools in Enugu State, Nigeria. The students' population stood at 6383. From this population, eight co-educational Junior Secondary Schools with a population of 806 female students and 676 male students were purposively sampled for the study. Four schools were randomly selected and assigned for experimental group while the remaining four schools were randomly selected and assigned for control group. The total sample used was 1,482 students. Data collection was carried out using Social Studies Achievement Test (SSAT) after exposing the students to the treatments. The instrument was developed by Examination Development Centres, Enugu, Awka, Abakaliki and Umuahia 2004-2007 and the questions relating to physical environment were

lifted from them on permission. The reliability of the instrument was 0.73. The data collected were analyzed using mean, standard deviation, T-test and ANOVA which were tested at 0.05 level of significance. Among the findings of the study are: students taught Social Studies with CAI performed better than those taught using conventional method, and that boys and girl alike taught Social Studies with CAI performed well equally. Based on the findings, CAI is indispensable if the teaching and learning of Social Studies is to be effective and meaningful. Recommendations were made which included that Teachers should be computer literate, and that Enugu State Government should encourage and liaise with stakeholders in the state to provide well equipped computer laboratories in all secondary schools in the state among others.

The study of Chibuzo (2012) was carried out to find out the Impact of computer-assisted instructions on the academic performance of students in social studies in Enugu State, Nigeria while this study investigated the effect of computer-aided instruction in Basic Science, the study covered academic performance as learning outcome variable, while the present study covered performance and retention. The study was carried out in Enugu State while this study was carried out in Jalingo, Taraba State. Hence there is need for this study.

Atif (2014) Effect of computer-assisted learning on the achievement and problem solving skills of the educational statistic students, The basic aimed of this study is to investigate the effects of Computer Assisted Learning on the achievements of the educational statistic students the measurements related to the experimental and control groups. The result showed that, the difference is on behalf of the experiment group. This fact shows that the computer-assisted learning method and traditional education methods have a clear different effect on the student's educational statistics achievements. This result leads that experiment group's students with computer-assisted learning methods increase their achievement level and show a higher performance more than the control group students. The study of Atif (2014) was carried out to find the Effect of computer-assisted learning on the achievement and problem-solving skills of the educational statistic students while this study investigated the effect of computer-aided instruction in Basic Science, the study covered academic achievement as learning outcome variable, while the present study covered performance and retention. The study was carried out in the University of Jordan while this study was carried out in Jalingo, Taraba State. Hence there is need for this study.

Lawal (2020) investigated the effect of Computer-Aided Instruction (CAI) on the performance of Senior Secondary School Students in Geometry in Katsina, Katsina State, Nigeria. The study examined the significance of retention achievement scores of students taught using computer-aided instruction and those taught using the traditional method. The sample consisted of twenty senior secondary school students drawn from two secondary schools in Katsina. Stratified random sampling was used to select the 20 students (10 males and 10 females). Three research questions and three hypotheses were formulated, and tested at 0.05 level significance. Geometry Achievement Test (GAT) made up of 40 items of multiple-choice objective type, developed and validated by the researcher was used as an instrument for data collection. The Geometry Achievement Test (GAT) was administered to students as pre-test and post-test. The results of students were analyzed using t-test statistic to test the hypotheses. The results indicated that students taught using (CAI) performed significantly better than their counterparts taught using the traditional method of instruction. Similarly, students taught using CAI performed better than the control group in retention test. It was also found that there was no significant difference in the post-test performance scores of male and female students taught using CAI package. Based on the findings it was recommended that Computer-Aided Instructions be encouraged for teaching and learning of Geometry and mathematics in our schools. The study of Lawal (2020) investigated the effect of Computer-Aided Instruction (CAI) on the performance of Senior Secondary School Students in Geometry in Katsina, Katsina State, Nigeria while this study investigated the effect of computer-aided instruction in Basic Science, the study covered academic performance as learning outcome variable, while the present study covered performance and retention. The study was carried out in Katsina state while this study was carried out in Jalingo, Taraba State. Hence there is need for this study.

Leann (2020) carried out a study to determine the effect of implementing a Computer-Assisted Instruction on secondary physics students' academic achievement. The research utilized the quasi-experimental pretest-posttest control group design that is participated by 157 Grade 10 students of a private school in the Philippines. The experimental group was taught using the computer-Assisted Instruction while the control group was instructed using the conventional method of teaching Physics. Mann-Whitney test with a significance level of 0.05 was used in comparing the difference between pretest scores of the control and experimental groups, the difference between the pretest and posttest scores of the control group and experimental group, and Z test with a significance level of 0.05 was utilized in comparing the mean gain scores of both groups to determine the effect of the CAI. The findings of the study show that both CAI and conventional methods of teaching improve the level of performance of students in physics significantly. However, when the effectiveness of the two methods is compared, there is no significant difference between their effects on academic achievement. Therefore, CAI could be used as an alternative teaching method. The study of Leann (2020) was carried out a study to determine the effect of implementing a Computer-Assisted Instruction on secondary physics students' academic achievement while this study investigated the effect of computer-aided instruction in Basic Science, the study covered academic achievement as learning outcome variable, while the present study covered performance and retention. The study was carried out in Philippines while this study was carried out in Jalingo, Taraba State. Hence there is need for this study.

Although most of the studies reviewed covered the variables, Computer-aided, performance and retention, which are also variables in this present study but there are in the areas of Mathematics, Biology, introductory technology, Chemistry, which may not be generalized to basic science. Hence, there is a need for the study, effects of computer-aided instruction on Upper Basic II students' performance and retention. Gender as a moderating variable is also added in this study.

Instrument and Method of Data Collection

Basic science Performance and Retention Test (BSPRT) adopted from BECE\JSCE past question papers was the instrument for data collection. The Basic Science Performance and Retention Test (BSPRT) was used for pretest, posttest and post-posttest in basic science. The test was attempted based on the concepts of work, power and energy taught. The BSPRT contains 40 multiple choice items with four options per question. The multiple-choice test was chosen because of its objectivity in marking, and vast flexibility in type of outcome assessed: knowledge goals, application goals, analysis goals, among others. The method of treatment and data collection was organized in two sections, the first deals with the training of research assistants and treatment, and the second deals with posttest and post-posttest administration.

Population and Sample

The population for the study consisted of 2511 Upper Basic II students in the 27 approved Basic Education schools in Jalingo. This was arrived at by summing the number of the Upper Basic II students in the 27 approved Upper Basic schools in the study Area. The choice of Upper Basic 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 sufficient basic science concepts at the Upper Basic I and II levels to give them a rich knowledge of the subject. Another consideration for the choice of Upper Basic 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 science including computers and had presented students for Junior Secondary Certificate Examination (JSCE)\(BECE) for at least five years.

The sample for this study was made up of 120 Upper Basic II basic science students drawn from the three sampled Upper Basic Education schools in Jalingo local government. Since the study utilize a quasi-experimental research design. To draw a sample size of 180 from a population of 2511 Del Siegel method was used, using the following steps:

- The population size (N): N = 2511
- The desired sample size (n): n = 120
- Calculating the sampling fraction (f): f = n / N = 120 / 2511 ≈ 0.0477 (or 4.77%)
- Calculating the interval (k): k = N / n = 2511 / 120 ≈ 14 (round to the nearest whole number)

selecting the sample:

- Randomly choose a starting point (SP) between 1 and k (14). SP = 4.
- Selecting every kth individual (14th individual) starting from the SP:
  - 7, 21, 35, 49, ..., 2511 (until the desired sample size of 120 was reached)

This method ensures a representative sample of 120 individuals from the population of 2511.
Note: The Del Siegel method is a systematic sampling technique that helps to reduce bias and ensure a more accurate representation of the population.

Source of Data and Reliability Test

Basic science Performance and Retention Test (BSPRT) attempted from BECE\JSCE past question papers was the instrument for data collection. The Basic Science Performance and Retention Test (BSPRT) was used for pretest, posttest and post-posttest in basic science. The contents of the instrument were based on the concepts of work, power and energy taught.
The researcher carried out a pilot testing in order to test the reliability of the research instrument. The school selected for the pilot study did not form part of the main study. The students were given the BSPRT containing a 40 item questions to answer without teaching them to ascertain the entry knowledge and to access the equality of the two groups. Forty students were selected from the school for the pilot study and test-retest method of reliability was used to measure the internal consistency of the instrument. The data collected from the pilot testing were analyzed using Kuder Richardson's (KR21) formula to establish the reliability coefficient of the instrument. This instrument gave a reliability coefficient (r) of 0.81.

Data Analysis

The data obtained through BSPRT were classified into pretest, posttest and post- posttest for both the experimental and control groups with respect to each research question and hypothesis. Research questions 1 and 2 were answered using descriptive statistical tools of mean and standard deviation. Similarly, hypotheses 1 and 2 were tested using an independent sample t – test, at 0.05 level of significance. The decision rule was that accept any hypothesis with p value greater than alpha value of 0.05 otherwise reject it if is less than alpha value. All analyses were carried out using a Statistical Package of Social Sciences, version 25.0.

The pretest scores were used as covariate while posttest scores were used as depended variable. The choice of this statistical tool was informed by the fact that the scores of BSPRT to be compared are generated on interval scale and from separate groups of students.

Results

This section presents and interprets the results of the data analyzed. Also, the findings of the study based on the research questions and hypotheses postulated were discussed.

Research Question 1

What is the difference in the mean performance scores of the students taught Basic Science using computer-aided instruction and those taught using guided-discovery strategy?

Table 1: Mean Performance Scores of Students Taught Basic Science Using Computer Aided Instruction and Guided-Discovery Strategy

Method	N	$\bar{X}$	SD	Mean Diff.
Computer-Aided Instruction	60	33.97	3.27	7.97
Guided-Discovery Method	60	26.00	3.09	

Key: N=Number of Students, $\bar{X}$= Mean Scores, SD = Standard Deviation

As presented in Table 1, the mean performance scores of students taught using Computer-Aided Instruction and Guided-Discovery strategy are 33.97 and 26.00 with their corresponding standard deviations as 3.27 and 3.09, respectively. The analysis presented further revealed that, the gap between the mean scores of the groups is wide (7.97) as students taught using Computer-Aided Instruction performed better than those students taught using Guided-Discovery strategy. This showed that the students in the CAI performed better compare to the students in the GDS with the mean gain of 7.97 in favor of the CAI.

Research Question 2

What is the difference in the mean retention scores of the students taught Basic Science using computer-aided instruction and those taught using guided-discovery strategy?

Table 2: Mean Retention Scores of Students Taught Basic Science Using Computer-Aided Instruction and Guided-Discovery Strategy

Method	N	$\bar{X}$	SD	Mean Diff.
Computer-Aided Instruction	60	35.30	2.84	6.75
Guided-Discovery Method	60	28.55	4.68	

Data presented in Table 2 showed that the mean retention score of students in Basic Science after being taught using Computer-Aided Instruction is 35.30 with value of standard deviation of 2.84 while students exposed to Guided-Discovery strategy had mean retention score of 28.55 with value of standard deviation of 4.68. The analysis revealed the mean retention scores of the students as exposed to different teaching methods are not equal as students taught using Computer-Aided Instruction retained higher mean scores (with a gap of 6.75) than those students exposed to Guided-Discovery method.

Hypotheses Testing

Ho_1: There is no significant difference in the mean performance scores of students taught Basic science using computer-aided instruction and those taught the same concepts using guided-discovery strategy.

Table 3: Analysis of Difference Between the Mean Performance Scores of Students Taught Basic Science Using Computer-Aided Instruction and Guided-Discovery Strategy

Method	N	Mean Score	Df	$t\text{-}_{cal}$	p-value	Decision
Computer-Aided Instruction	60	33.97	118	13.718	0.000	Significant
Guided-Discovery	60	26.00				

The calculated t value as shown in Table 5 is 13.718 with a p value of 0.000, which is less than the significance level of 0.05. This implies that the null hypothesis initially stated is rejected. It can be deduced from the analysis that there is a significant difference in the mean performance scores

of students taught Basic science using computer-aided instruction and those taught the same concepts using guided-discovery strategy in favor of the CAI group.

Ho_2: There is no significant difference in the mean retention scores of students taught Basic Science using computer-aided instruction and those taught using guided-discovery strategy.

Table 4: Analysis of Difference Between the Mean Retention Scores of Students Taught Basic Science Using Computer-Aided Instruction and Guided-Discovery Strategy

Method	N	Mean Score	Df	$t\text{-}_{cal}$	p-value	Decision
Computer-Aided Instruction	60	35.30	118	9.547	0.000	Significant
Guided-Discovery	60	28.55				

Based on the analysis presented in Table 6, the value obtained is 9.547 with a p value of 0.000, which is less than the significance level of 0.05. This implies that the null hypothesis stated is rejected. Therefore, it is established the analysis that there is significant difference in the mean retention scores of students taught Basic Science using computer-aided instruction and those taught using guided-discovery strategy in favor of the CAI group.

DISCUSSION

This paper investigated the effect of computer-aided and computer-assisted instructions on performance and retention of students of basic science in Jalingo, Taraba state, Nigeria. The results are discussed in the following manner; The result of the finding in table 1 found out that students taught using computer-aided instruction performed higher in the performance test than those taught using Guided-discovery strategy. The reason for the effectiveness of this method could be because the students were stimulated to learn by the use of computer-aided instruction which increase their performance and excitement, total involvement in teaching and learning process, and encouraged students to work at their own pace. The results of the study therefore call for the adoption and development of appropriate instructional strategy like computer-aided instruction by developing CAI packages to enhance meaningful teaching and learning in basic science. The result of this finding is similar to that of Egbodo (2016) who found out that computer-aided instruction was more effective in helping students' achievement and retention. The result of the finding is in agreement with the findings of (Lawal, 2020; Nnaobi, 2013; Oka & Nwafor, 2016; Atif, 2014) who found and reported that computer aided instruction (CAI) was more effective in enhancing students' performance than guided discovery method. However, the finding of this study disagrees with previous studies as conducted by Bayraktar (2008) who could not found any significant difference between the students exposed to CaI and those exposed to guided discovery method. The result of the finding in table 2 indicates that students taught using computer-aided instruction retained and retrieved basic science concepts better than those taught by guided-discovery strategy. Based on the results of this study and the findings of previous, it can be concluded that computer-aided instruction is one of the most valuable strategies that can be used to impact concepts of basic science to 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 students taught basic science by CAI and those taught by guided discovery method. The result is in agreement with the findings of lean (2020); Chimaobi (2016); Lawal (2020) who found significant difference in the retention scores of students taught with CAI and guided discovery method.

The implication of the findings is that the treatment on performance and retention could be said to be as a result of the treatment or teaching strategy that is, computer-aided instruction and not any other factor.

CONCLUSION AND RECOMMENDATION

Based on the findings of this research, it was concluded that computer-aided instruction in basic science enhance performance and retention of the upper Basic Education students. Hence, it implies that computer-aided instruction may be a valuable tool for enhancing grouped or individualized instruction, performance, retention in learning.

On the basis of findings from this study, it is recommended that, 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 education in Nigerian schools. Schools should train science teachers on the use of ICT resources for science 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. Computer literacy programmed should be provided for both students and teachers for full integration of ICT resources in Science Education Programmed. These recommendations aim to enhance the teaching and learning of Basic Science using technology-based strategies to ensure inclusive education among students.

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