

## **Evaluation of the Effectiveness of Computer-Assisted Instruction and Conventional Teaching Method in Enhancing Mathematics Achievement among Senior Secondary School Students in Ibadan Land**

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### *Abstract*

*This study investigated the effects of a computer-assisted instructional technology application to teach statistics on a sample of senior secondary school students. A total number of 40 subjects, 25 in an experimental group and 15 in a control group were used and the pre and post-test experimental research design was adopted. Achievement test on statistics was applied on both groups. The experimental group was taught with the aid of computer-assisted instruction on electronic instructional slides using Microsoft PowerPoint. During the training session teaching-learning process were done using computer-assisted instructional technology and vivid explanation were given to the experimental group and the control group was subjected to conventional teaching method. After eight weeks, both groups were given the Statistics achievement test again. Using Analysis of Covariance (ANCOVA) at  $\alpha = 0.05$ ,  $F = 12.562$ ,  $df = 2/38$ ,  $p < 0.05$  and Eta Square = 0.398. The findings revealed significant difference between the two groups and it's favoured the experimental group over the control group in the Statistics achievement test scores. Therefore, researcher concludes that computer-assisted instructional technique can enhance the academic performance of the students, and recommended that the expansion of computer-assisted instructional aide/applications to other subjects will promote teaching-learning process and will enhance academic performance of the learners generally.*

**Keywords:** Statistics, Computer-assisted instruction, Technology, Achievement, Experimental group, Control group.

### **Introduction**

Computers and related technologies are now in most of the schools all around the world. Advancements in technology are inevitably reflected in educational systems. According to Ayelaagbe (2011), asserted that, in most of the developed countries, education has been permeated by information technologies (IT); schools have computers, a large numbers of teachers use computers and new technologies while teaching, and more over textbooks have some parts devoted to new technologies. New technologies are integrated into disciplines and more disciplines are being influenced by the new technologies in an integrated way. Most of the educators and researchers try to use technologies in various subject matters, and this integration changes the nature, concepts and methods of work in each subject. For example, in Statistics education as a subset of Mathematics education, the way of teaching and learning, the roles and functions of the most concepts have changed with the use of technology (Ayelaagbe, 2011 & Alomari, 2006).

The early beginning of information technology to education in Nigeria can be traced to the colonial era when the manager of volunteers of agencies schools emphasized on the production and use of simple learning materials known as teaching aids. Training teachers and practicing teachers were expected to produce and use both representational materials such as pictures, maps, models, as well as real objects such as local seeds, plants etc. The colonial government in 1930, promulgated the first educational ordinals which provided that schools should have adequate teaching materials thus, resources aspect of educational technology/hardware approach permeated the educational system and involve with it.

Ayelaagbe, (2011) opined that in addition to the use of low cost materials in the schools the BBC London in 1933 transmitted the first educational programme in its West Africa overseas services. These were for English language and ones in a week. Similarly towards the end of 1950, the regional government establishes schools broadcasting unit in their regional quarters utilizing the broadcasting facilities of NBC. By 1961, each of the three regional governments had a radio and television stations on its own which transmitted programme on various subjects, teaching methodology, civic, geography and history to schools between 1959 and 1962. Audio visual centres were established by US agency for international development (USAID) in the former region of Nigeria. It was this audio visual centre that eventually formed the nucleus of the present educational resource centre in different states (Ayelaagbe, 2011).

The findings of modern educational technology in Nigeria may be traced to the contribution, supports and expert advice from such international organization such as UNESCO-Centre for educational development overseas (CEDO) in Britain then United State Agency for international development FORD foundation and the Canadian Universities overseas. These bodies assisted the ministry of education in the three regions in establishing audio-visual unit and the school broadcasting units. They also assisted the universities and some other institutions of higher learning in establishing their audio-visual unit. For example, the audio-visual aid unit of Institute of Education of University of Ibadan in 1962. The curriculum development and instructional material centre Nsukka. Audio-visual units of College of Education Abraka and Lagos and the macro teaching programme at the Alvan Nkoku College of Education Owerri are all example of technical aids and assistance rendered by the foreign agencies abroad. Not only did these international organization gives materials, financial and expert support but also enforced into the educational system. The idea of proper identification of educational problem, the statement of objectives logical sequencing and integration, evaluation and research. They contributed greatly to the introduction of learning method and application of Educational technology.

Computer-managed instruction (CMI) can refer either to the use of computers by school staff to organize student data and make instructional decisions or to activities in which the computer evaluates students' test performance, guides them to appropriate instructional resources, and keeps records of their progress. Computer-enriched instruction (CEI) is defined as learning activities in which computers (1) generate data at the students' request to illustrate relationships in models of social or physical reality, (2) execute programmes developed by the students, or (3) provide general enrichment in relatively unstructured exercises designed to stimulate and motivate students. After providing a short reminding of the applications of computers, there is a need to mention the computer assisted instruction and the utilization of CAI methods.

In 2004, Stockly reviewed the state of the art in computer aided instruction (CAI) and first coined the term Intelligent Tutoring Systems (ITS) (although described in this study as ICAI) to describe these evolving systems and distinguish them from the previous CAI systems. With new AI techniques coming up it seemed that the computers were almost capable of "thinking" like humans. This motivated ICAI research further. Application of AI in ICAI made it possible to achieve the goals more easily. Other reasons which motivated ICAI research were-modular and fine grained the curriculum, customized for different student populations, individual presentation and assessment of the content, collection of data which instructors could use to tutor and remediate students. ICAI research has successfully delivered techniques and systems that provide adaptive support for student problem solving or question-answering activities in a variety of domains (e.g., programming, physics, algebra, geometry and introductory computer science).

Drill and Practice is concerned with the use of computers not only as a choice but to mediate the flow of information in the instruction process and the complementary means (Rushby, 1989; Sirkemaa, 2001). Drill-practice Computer based Instruction (DPCI) was utilized in the education as an educational medium in which delivers instructional activities in the late 1950s. Papert (1993) stated that "...programming the computer to administer the kinds of exercises traditionally given by a teacher at blackboard, a textbook, or a worksheet". Although the technology has been changing rapidly over the twenty years, computer-assisted instruction is still utilized in education. Drill-and practice, Tutorial, Games, and Simulation are commonly used CAI applications for educational purposes. Drill-and-practice programmes lead learners through a series of examples to increase dexterity and fluency in a skill. Drill-and-practice is used predominantly for math drills, foreign language translation and vocabulary building. In these programmes student is allowed several tries before the computer presents the correct answer. In computer-assisted tutorial applications that provide student different methods of answering a problem and immediate answers, exploratory software programmes allow students opportunities to engage in mathematical investigations, and programming skills that develop logical reasoning in students.

Another type of computer application in education is simulating experimentations. In the simulation environment, students investigate simulations on the computer screen as a replacement for of observing and doing something real, either in a laboratory or in the field. For instance, one programme popular in the early 90s was simulated a natural ecosystem, In this ecosystem simulation software, the students could change a number of characteristics of the habitat, the consequences of which were then played out for them to observe and from which they were to draw conclusions (Sasseville & Monke, 2004).

In the tutorial mode, computers act as the teacher by presenting information in small units to the students and then reinforcing it with questions or tasks. Then computer analyzes the student's responses and gives feedback or remedial instruction based on his or her response. For example *Mavis Beacon Teaches Typing* is a tutorial programme which guides students to learn touch-typing skills (Sife, Lwoga & Sanga, 2007)

The final mode is games. Sife et al. (2007) defines game as "...an activity in which participants follow prescribed rules that differ from those of real life as they strive to attain a challenging". Therefore, a game may or may not be instructional. If it contains academic skill practice then it is defined as an educational game. Game software provides elements of competition into learning activities. With computer games, students are competing against their own previous scores or against the designer of the game as they indicate their

understanding of educational content. Game assumes that students have already gained the knowledge of the content and generally it is designed based on the time-limitation to encourage students to respond quickly (Tinio, 2002). As an example, *King Arthur's Magic Castle* educational game was designed based on the problem solving strategies to emphasize entertainment (Sife et al. 2005).

The above modes of CAI are the ones that are widely used in the educational practices. However there are other utilization methods of CAI: such as Discovery and Problems solving programmes. The goal of quality education seems to have the computers as new learning/teaching resource rather than a teacher's aid in the future. Distance Education, Virtual Reality (VR), Electronic-Books (e-Books) and Electronic Learning (e-Learning) have become the feature of teach (Alomari, 2006).

Although the research studies on the effectiveness of computers in the field of education reveals contradictory results, majority of the research studies indicates that DPCI brings several possible advantages as a teaching/learning tool. The main strength of the computer as a learning medium is its ability to process information quickly. This makes it possible for the computer to accept and act upon a variety of different kinds of response from the learner and to provide information in textual, graphical, and animated form (Rushby, 1989). According to Clements (1991), there are three advantages of usage of technology in teaching and learning Mathematics; interactivity, connectivity and controlling of learning environments. Furthermore computer suggest opportunities for learner-control, improved enthusiasm, associations to the real world, and enhance student achievement as measured in variety of ways, including, but not exclusively limited to, "standardized achievement tests". Ertmer (1999) stated that "DPCI benefits most students when compared with traditional instruction because it increases student interest, reduces anxiety, provides more time on task, and provides instant feedback for the student". Besides, DPCI could also benefits students with the following: self-sufficient learning, independent learning, the exercising of various senses and the ability to represent content in a variety of media. In computer-assisted environment students can fix their pace of learning. That is to say, with self-paced learning, learners can progress as slowly or as quickly as they like through a programme. In addition to this, if students want to replicate some task or review some material again, they can do so as many times as they wish. The programme will not tire out or complain about repetitions as sometimes teachers do. Also, students can leave out a topic if content is already known or understood, making the learning process more efficient.

CAI provides a self-directed learning to students, and allows learners to become empowered to take increasingly more responsibility to choose, control, and evaluate their own learning activities which can be pursued at any time, in any place, through any means, at any age. Simply put, learners can decide what they want to learn and in what order. According to Fletcher (1990), people remember 20% of what they hear, 40% of what they see and hear and 75% of what they see, hear and do. Therefore, the more senses are used through which we obtain information, the easier to keep in mind. The fact that the computer can exercise various senses and present information in a variety of media can enhance the learning process. As a result, students can retain knowledge.

Further, CAI is visually attractive, when it presents concepts using demonstrations that are made attractive by animation, colour, and sound. Besides this, computer assisted instruction captures and holds the students' attention by providing opportunities for

competition where the opponent is the student's previous performance (Bondarouk, 2006). CAI also eliminates the misconceptions by providing immediate feedback, since immediate feedback prevents learning concepts incorrectly.

As Beebe (2004) indicated teachers can benefit from CAI since it can be programmed with concept, level and ability specificity; that is, the students are not challenged outside his or her demonstrated ability range, nor are they allowed moving to a higher level until they have mastered the level on which they are working.

#### Statement of the Problem

Considering academic reports from West African Examination Council (WAEC), mass failure in nearly all subjects is still on the high side. Many students could not get admission into higher institutions of learning. Due to this persistent and aggravating poor performance in English language and Mathematics, which often makes many shy away from Mathematics-related courses while choosing careers in life? Similarly, this has consequently resulted in loss of interest in aspiring for post-secondary education, depression, academic withdrawal syndrome, examination malpractices, and forgery of result and eventually turns into vagabond and miscreants. The problem of students' achievement in Mathematics has been traced to poor method of teaching and the notion created by some teachers on the difficult nature of the subject which has brought fear, with learners developing irrational beliefs. Therefore, this study intend to enhancing Mathematics achievement among secondary school students that participated in the study using Computer assisted instruction strategy among selected secondary school students in Ibadan.

#### Purpose of the Study

The purpose of the study is to investigate the effectiveness of Computer-assisted instruction over Conventional teaching method in enhancing academic performance in mathematics among secondary school students in Ibadan land, Nigeria.

#### Significance of the Study

The expected findings of the study should bring to the attention of the government agencies the necessity for recruitment of teachers that will be able to expose learners to the use of computer-assisted instruction in all the subject areas. Also, the findings generated from the study will hopefully be useful to students in that it will enhance their academic performance in mathematics and the parents will also be relieved of paying for multiple registrations of WAEC and NECO examinations in the public examination.

**Null Hypothesis:** There is no significant main effect of treatment on academic performance of secondary school students in mathematics among participants.

#### Research Design

This study employs a pretest-postTest, control group experimental design. It consists of treatment at two levels to evaluate the outcome of the use of two therapies in improving academic performance among senior secondary school in Ibadan. The design consists of computer-assisted instruction (CAI) and conventional teaching method (CTM) groups. The population for the study are almost about 250,000 Senior Secondary School II students in Ibadan, Nigeria.

Multistage random sampling technique was employed to select two local government areas (LGAs) and a school each was selected from each local government and class of SS2 students were randomly selected from each school in Oyo State. The LGAs are Ibadan North and Ibadan South-West. The participants are in SSS II in their respective schools. The participants' ages range from 15 to 21 years with mean age of 15.8. The reason for using this category of students is that they are no longer suffering the effect of transition from Junior Secondary School to Senior Secondary School and they are not yet ready to sit for their senior secondary school certificate examination. The sample consisted of 20 males and 20 females. Through simple ballot randomisation, the participants were distributed into the CAI Group and the Conventional method of teaching group.

This study utilised one instrument for data collection. This is:

1) Mathematics Achievement Test

Mathematics Achievement Test: The main instrument used for this study is the Mathematics Achievement Test (MAT) developed by the researcher. The scale consists of two sections, section A deals with demographic information about the participants. Section B of the scale consists of 50 items; all the items are based statistical knowledge aspect of mathematics skills. Completing the MAT requires about two hours. Responses are made on 4-point options. The MAT was developed and validated by researcher. The instrument was pilot tested by the researcher for validation using 50 Senior Secondary School Students (SSS II) (27 female and 23 male) in Saki Oyo State. The method used was test-re-test and the time interval between the two administrations was two weeks. The test-re-test reliability coefficient using Pearson Product Moment Correlation formula gave the coefficient of  $r = 0.78$ .

#### Procedure

The study was carried out in four phases: the pre-session activities, pre-test, treatment and post-test.

The first phase activities include assignment of participants into two experimental (treatment) groups. Permission was sought from the schools' principals to carry out the study. Sampled schools were visited before hand to enable the researcher gets acquainted with the schools, their environment and solicit for support of staff and students. The teachers were adequately informed of the purpose of the research work while the students were equally addressed and informed about the importance of the research to them and what they stand to benefit from it. At the pre-test stage the MAT was administered to the participants. The researcher held a 90 minutes session for each of the experimental groups for six weeks. At the post-test stage the two groups were assessed via the administration of the MAT following the completion of the programme.

#### Control for Extraneous Variables

The researcher guides against the effects of extraneous variables by taking the following into consideration; appropriate randomisation of participants into the two intervention groups; adherence to inclusion criteria; and the analysis of covariance (ANCOVA) statistical tool used equally took care of likely extraneous variables.

#### Inclusion Criteria

The following criteria were used in selecting the participants for the study:

The respondents were senior secondary school II students.

1. The ages fall between 15 and 21 being the age of secondary school students.
2. Adolescents with evidence of consent from their parents.

### Method of Data Analysis

Data generated for this study was analyzed using the analysis of ANCOVA. ANCOVA was used to test for the significance of the difference among means of the two groups. Scheffe classification analysis was employed to determine the effect of treatment on the experimental groups.

### Results

$H_{01}$ : There is no significant main effect of treatment in enhancing performance in mathematics among senior secondary school students in Ibadan land.

Table 1: Significant Main Effect of Treatment on Mathematics Academic Performance of Senior Secondary School Students

Source	Type III sum of squares	DF	Mean Square	F	Sig	Eta Square
Corrected Model	28530.321	3	9510.103	21.066	0.000	0.624
Pre-test	6884.665	1	6884.665	15.250	0.000	0.266
Treatment group	11342.501	2	5671.251	12.562	0.000	0.398
Error	17155.159	38	451.452			
Corrected Total	45685.480	40				

The results from Table1 showed that there is significant main effect of treatments in enhancing performance in mathematics among senior secondary school students ( $F_{2, 38} = 12.562, p < 0.05, \eta^2 = 0.398$ ). This means there is significant difference in the mean scores of mathematics achievement scores of the participants exposed to treatments computer-assisted instruction technology (CAIT) and Conventional Teaching Method (CTM) when compared with each other. Hence, hypothesis one is not accepted. It was therefore concluded that there is significant main effect of treatments in enhancing performance in mathematics among senior secondary school students. This implies that Computer-Assisted Instruction Technology and Conventional Teaching Method are effective in enhancing performance in mathematics among senior secondary school students.

To further provide information in the enhancement of the performance of the participants among the two groups (CAIT and CTM), it is good to ascertain the direction of the differences and determine the magnitude of the mean scores of the participants in each of the treatments approach). Thus, the Scheffe post-hoc analysis was calculated and presented in Table 2.

Table 2: Significant Differences in the Treatment Groups

TREATMENT	N	Subset for alpha = 0.05	
		1	2
CAIT	25	39.1622	
CTM	15		21.950
Sig.		.985	1.000

The participants in CAIT (Mean = 39.16) enhanced the mathematics achievement better than those in the CTM (Mean = 21.950).

The following observations were made on Table 2, (1) There was statistical significant difference between the post-hoc test mean scores in enhancing the mathematic achievement among the participants in the CAIT and CTM groups in favour of CAIT.

### Discussion of findings

The result is attributable to several reasons. The first thing is that the students have the opportunity of listening and re-listening to instruction on CAI unlike their counterparts on CTM which has no access to the instruction again until they found themselves in school again. CAI, enable users to do-undo-redo their learning and practices at home and followed the instruction step by step, and many other elements which can be provided only by computers. This also would allow students to go over their work moving forward and backward during the practicing process which gives them more opportunities to add, remove, or modify their works to be more perfect which is consistent with Cousins and Ross (1993). The findings are consistent with Alomari (2006) and Hyun (2005) in which the rich environment of information and communication (ICT) tools will increase students' learning activities and expertise. Eventually, using computer technologies in education and learning opens wide horizons of interaction among the learners, learning materials, and learning process and strategies which enhances their creative thinking skills and makes learning and thinking enjoyable.

Most of the computer applications were designed creatively, Microsoft PowerPoint one of these applications that contains rich and numerous features which allow the users to create original work, do a specific work in different ways, and modify existed work to fit specific purposes. Several studies in the literature investigated the roles of computers in enhancing the achievement. However, only this study investigated the effects of CAI in enhance mathematics achievement. Significant findings were reported adding to the literature of information and communication technology (ICT) and teaching thinking the importance of using computers technologies in training, learning, and teaching which maximizes the students thinking and learning skills and minimizes time, effort, and cost in acquiring and developing new skills and expertise. However, more studies are recommended to investigate other computer technologies and applications impacts in enhancing achievement among students.

### Recommendations

Based on the findings of this study the researcher recommended that

1. Computer-Assisted Instructional technique should be made compulsory in mathematics and in all subjects to promote teaching-learning process and to enhance academic performance of the learners generally.

2. Curriculum planners should also ensure that the curriculum is flexible to enable teachers to incorporate CAI into classroom activities.
3. Teachers and students should be sensitized and enlightened through seminar and workshop on the benefits of making use of CAI to enhance academic performance among the school going adolescents.
4. Teachers and students should be taught on how to utilize CAI to impart and improve knowledge.

Conclusion: Based on the findings of this study the researcher concludes that Computer-Assisted Instruction could enhance mathematics achievement among senior secondary school students.

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