COMPUTER-ASSISTED INSTRUCTION AND SECONDARY SCHOOL STUDENTS' ACADEMIC PERFORMANCE IN STATISTICS IN AKURE, NIGERIA

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Abstract

This study investigated the effect of Computer-Assisted Instruction (CAI) on Senior Secondary School Students' academic performance in Statistics in Akure Metropolis, Ondo State, Nigeria. Two research questions were generated and two null hypotheses were formulated and tested at 0.05 level significance. The study employed pretest-posttest experimental control group design. The population for the study was made up of 135 senior secondary one (SS1) students offering Statistics concept of mathematics in Akure Metropolis, Ondo State. A sample size of 30 students found in the intact classes of two from two senior secondary schools using simple random sampling procedure were used. Instrument used for data collection was Statistics Performance Test (SPT) consisted of 50 items multiple-choice objective type. The SPT was constructed by the researcher and face validated by two experts in the field of mathematics Education and one in Measurement and evaluation, while its reliability coefficient was established as 0.88 using Pearson Product Moment Correlation Coefficient (PPMC) method. The Statistics performance Test (SPT) was administered to students as pre-test and post-test. The data obtained were analyzed using descriptive statistics of mean and standard deviation to answer the research questions and inferential statistics of Analysis of Covariance (ANCOVA) to test the null hypotheses. The findings showed that; there was significant difference between the mean performance scores of students taught Statistics using Computer-Assisted Instruction (CAI) and those taught using the Lecture Method (LM) ($p=0.00< \alpha = 0.05$. It was also found that there was significant difference between the post-test performance scores of male and female students taught using CAI ($p = 0.003<\alpha =0.05$). Based on these findings, it was recommended among others that; Computer-Assisted Instruction (CAI) be encouraged for teaching and learning Statistics and other concepts of mathematics in schools.

Keywords: Computer Assisted Instruction; Statistics; Lecture Method; Gender

Introduction

Mathematics is a core science subject offered in secondary schools whose significance and applications are a major pre-requisite for the achievement of scientific and technological development. The method of teaching mathematics concepts varies from time to time and in line with the societal trend and wave. Thus, the mathematics curriculum should always be revisited by curriculum planners to reform and address the call of trending societal problems. The world is presently functioning at the technological and digital level; an era where technological gadgets are integrated into our daily activities in all sectors. Thus, in Nigeria, re-engineering mathematics education for technological development will be of great significance to

the Country's economy. The use of technology to carry out instruction (teaching and learning) in mathematics is very critical, this is because it enables the teachers to provide instant feedback, individualization of learning opportunities, motivation, flexible and collaborative learning among students.

In the context of this study, Computer-Assisted Instruction (CAI) deals with the use of computer as a tool or instrument to facilitate and improve instruction. To Din and Iqbal (2017), it is an interactive method in which a computer is employed to present learning materials to learners (students) and monitor the learning that takes place in the classroom situation. Other terms used for computer assisted instruction are Computer-Assisted Learning (CAL), Computer Based Instruction (CBI), Computer Enriched Instruction (CEI), and Computer Managed Instruction (CMI) among others. Nwafor (2015) pointed that CAI are lessons delivered through Computer without constant teacher instruction. Computer Assisted Instructions are now common place and they are becoming more diverse. According to Mercer (2018) and Timothy in Agbo (2016), the use of computer for classroom instruction is usually referred to as Computer-Assisted Instruction (CAI). In this mode, the computer can be used to present instruction, use various media (like text, graphics, audio, video, computer visualizations of objects, guided drills and exercises) provide instructional activities or situations, quiz or otherwise require interaction from learners, evaluate learner responses and provide feedback. The Encyclopedia Brittanica (2014) pointed out that the use of Computers in educational instructions provide one-on-one interaction with students, as well as an instantaneous response to answers.

To Orjika in Suleman, Hussain, Din and Iqbal (2017), the merits of CAI method include, ensuring the application of proven teaching methods to students; offering equal educational opportunities for students by using the same programme; changing the role of the teacher from teaching to that of a guide; also when properly handled, removing fright and embarrassment on students and bringing about meaningful learning and academic achievement (Orjika as cited in Suleman, Hussain, Din & Iqbal 2017). CAI instruction may also motivate both male and females (both gender) for better achievement in Statistics. According to Velasco (2020), CAI tends to increase students' access to information; increase the percentage of personalized instruction a student receives; increase students' independence and personal responsibility for education; improve students' attitudes; and lower the amount of time required to master certain materials.

Also, Statistics refers to a branch of mathematics that involves the collection, distribution, analysis, and inference of conclusions from quantitative data. In other words, it is the science concerned with developing and studying methods for collecting, analyzing, interpreting and presenting empirical data.

According to Dimgba (2016), Lecture Method (LM) can also be called traditional/conventional method of teaching where the presenter or the instructor/teacher teaches orally to a group of class participants and creates a break in the lecture during the process of teaching and learning in other to

give room for relevant demonstrations or activities. From the Researcher point of view, Lecture Method simply involves a teacher presenting information to students verbally, often in structured manner, in order to impart knowledge on a specific topic. It is the oldest and most traditional method of teaching widely used when an instructor delivers a structured presentation to a larger number of students in the classroom situation.

Gender, in the context of this study refers to male and female students in senior secondary schools. In Nigeria, gender differences in secondary Mathematics are important issue that has been the focus of many studies, with reported differences in Mathematics achievement between males and females as debatable (Akani, 2017). Alabi (2014) observed that more males choose science courses in high schools than females, particularly Mathematics, Physics, Biology and Chemistry. This is because of the view from the public domain that women are weaker vessels who cannot withstand Mathematics. According to Ukala (2018), gender refers characteristics of being male and female, man or woman, boy or girl, depending on the sex, this attributes, opportunities, biological sex and relationships are socially constructed and learned through socialization process.

According to Ifedili cited in Abdulahi and Galle (2018), maintained that gender discriminations which are highly peculiar to girl-child could only be eliminated through education and empowerment, this is because some girls have proved that they could be the best if given a chance academically. By assessing the extent to which topics were familiar to groups of pupils, the International Association for Evaluation study (Keeves, 2014) was able to report that, in almost every country; girls had less opportunity than boys to learn certain Mathematics concepts.

Many studies related to the present study have been conducted by other researchers with empirical findings, but lack consensus in the findings. Nwafor and Obetenokpoi (2016) examined the effects of CAI on junior secondary school students' achievement in basic science and found that CAI method of teaching enhanced students' achievement in basic science than LM. Danjuma (2015) examined the effects of computer-assisted instruction on academic achievement among NCE physics students of different abilities in Niger State, Nigeria and found no significant difference between male and female achievement in physics by Using CAI. Mchiri, (2018) revealed that males achieved higher than females on exposure to CAI method when the researcher investigated the effect of computer assisted teaching strategy on students' achievement by gender in agricultural education. Nwosu and Ndanwu (2020) on their study on the effect of computer aided instruction (CAI) on students' achievement in selected federal tertiary institutions in Anambra State in electronic libraries course found no significant difference in the posttest achievement mean scores of students taught electronic libraries using CAI method and those taught modified lecture method (LM). The study further revealed that female students in the experimental group had a higher mean gain than their counterparts in the electronics libraries achievement test. In a study carried

out by Ekundayo (2022), showedthat there was no significant difference between the achievement of male and female in both the experimental and the control groups. 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 and found that students taught using CAI performed better than the control group in retention test. Male and female students taught using CAI indicate no significant difference. Hence, due to inconsistency on the findings of the effect of computer assisted instruction on the performance of Senior Secondary School Students in Mathematics, the researcher had decided to further investigate the effect of Computer- Assisted Instruction (CAI) on the performance of Senior Secondary School Students in Statistics in Akure, Ondo State, Nigeria in particular.

Objectives of the Study

The general objective of this study was to investigate the Effect of Computer-Assisted Instruction (CAI) on Senior Secondary School Students' Academic Performance in Statistics in Akure Metropolis, Ondo State, Nigeria. Specifically, the study sought to:

1. find out if there are any difference between the mean performance scores of students taught Statistics using Computer-Assisted Instruction (CAI) and those taught using the Lecture Method (LM); and
2. find out whether there are any differences between the mean performance scores of the male and the female students taught Statistics using Computer-Assisted Instruction (CAI) and those taught using Lecture Method (LM)?

Research Questions

The following research questions were formulated to guide the study

1. What is the difference between the mean performance scores of students taught Statistics using Computer-Assisted Instruction (CAI) and those taught using the Lecture Method (LM)?
2. What is the difference between the mean performance scores of male and female students taught Statistics using Computer-Assisted Instruction (CAI)?

Hypotheses

The following hypotheses were formulated and tested at 0.05 level of significance for the study

1. There is no significant difference between the mean performance scores of students taught Statistics using Computer-Assisted Instruction (CAI) and those taught using the Lecture Method (LM).
2. There is no significant difference between the mean performance scores of male and female students taught Statistics using Computer-Assisted Instruction (CAI).

Research Method

The study employed pretest-posttest experimental control group design. This means non-randomized groups was used because the researcher cannot randomly sample and assign students into groups. Therefore, the researcher used the students as groups already organized in classes. The intact

classes were used in order not to disrupt the school activities or affairs during school hours. This design was also found appropriate in order to compare the effects of the treatment on the experimental group to the control group. The experimental group received the treatment of utilizing Computer-Assisted Instruction (CAI) to teach the real statistics concepts of mathematics, while the control group received Lecture Method (LM) without the use of Computer- Assisted Instruction software package. The pre-test was administered to both groups before the treatment to establish a baseline level of knowledge and the posttest was administered to both groups after given the treatment to assess their knowledge and skills in solving Statistics concepts using computer Assisted instructional software package. Symbolically, this design can be displayed as:

Group	PRE-TEST	EXPERIMENT	POST-TEST
Experimental (E)	O_1	CAI X_1	Q_2
Control (C)	O_2	LM X_2	O_2

Symbols:

E = Experimental Group
C = Control Group
O_1 = Pre-Test for experimental and control group
O_2 = Post-Test for experimental and control group
X_1 = Experimental Treatment (CAI)
X_2 = Control Treatment (LM)

The population for the study was made up of 135 senior secondary one (SS1) students offering Statistics concept of mathematics in Akure Metropolis, Ondo State. A sample size consisted of 30 students found in the intact classes of two senior secondary schools in Akure Metropolis, Ondo State. These senior secondary schools was selected using simple random sampling procedure. All the senior secondary one (SS1) students in each class of the schools participated in the study.

Statistics Performance Test with the acronym SPT developed by the researcher was used for data collection. The course outline for senior secondary one (SS1) was used which contains topics; measures of central tendency (Mode, mean and median) and measures of variation (range, variance and standard deviation). The SPT consisted of fifty (50) multiple choice performance test items each with four alternatives (A-D) to determine the performance of students in Statistics. One (1) mark for each item correctly answered while zero (0) mark for each item wrongly answered. Thus, the maximum score obtainable is 50 marks.

The research material used was Computer-Assisted Instruction Software designed by the researcher with the help of program developer. The software is titled “Computer Interactive Device” (CID) which was designed in a branched manner and responded to instruction. The software was designed using the Rapid Application Development (RAD) model of James Martins approach of 1980. This model comprised four operational stages of: (1). the requirement planning (2). User design phase (3). Construction phase and (4). Cut over or the implementation phase. Topics in the Senior

Secondary One (SS1) curriculum used for the study was then transformed into CAI software. This software is interactive and user friendly programme and composed of CAI tutorials which are presented in one or more windows. The CID (software) was then installed in the computer laboratory of the experimental school for the students to be exposed to while the control group was left to the Lecture Method of teaching. The SPT was face and content validated by two (2) experts in Mathematics Education and one (1) in Test and Measurement validated the lesson plans on the topics taught to the students. These three experts were from University of Jos and the reliability coefficient of SPT was established as 0.88 using Pearson Product Moment Correlation (PPMC) method. This signifies that the items of the instrument were reliable.

The researcher used 15 working days to teach the control group. The teaching was done using lecture method. In the experimental group, students were taught using Computer-Assisted Instruction by allowing them to actively take part in the learning processfor the same period of time. The test questions were administered to the students before the treatment and after the treatment. The tests were marked and the scores recorded. Data obtained was then analyzed using descriptive statistics of mean and standard deviation to answer research questions and inferential statistics of Analysis of Covariance (ANCOVA) was used to test the null hypotheses. ANCOVA was appropriate for the fact that intact classes were used.

Results

The results of data analysis were presented in accordance with the research questions and null hypotheses:

Research Question 1: What is the difference between the mean performance scores of students taught Statistics using Computer-Assisted Instruction (CAI) and those taught using Lecture Method (LM)? Data used to answer this research question were presented in Table.1

Table 1: Mean Scores and Standard Deviations of Students Taught Statistics using Computer-Assisted Instruction (CAI) and Lecture Method (LM) in SPT

Group	N	Mean Pre-test	Std. Dev	Mean Post-test	Std. Dev
CAI	15	28.10	8.21	77.23	4.26
L M	15	26.50	8.10	53.90	4.59

Table 1 shows that the students that were taught Statistics with Computer - Assisted Instruction had mean scores of 28.10 and 77.23 in the pre-test and post-test

respectively and standard deviations of 8.21 and 4.26 in that order. For students in control group, it was observed that they had mean scores of 26.50 and 53.90 in the pre-test and post-test respectively and standard deviations of 8.10 and 4.59 in that order.

Research Question 2: What is the difference between the mean performance scores of male and female students taught Statistics using Computer-Assisted Instruction (CAI)? Data used to answer this research question 2 were presented in Table 3

Table 2: Mean Scores and Standard Deviations of Students Taught Statistics using Computer-Assisted Instruction (CAI) based on Gender

Gender	N	Mean Pretest	SD	Mean Posttest	SD
Male	7	24.10	7.53	32.27	11.23
Female	8	27.30	5.33	42.34	10.59

Table 2 shows that the mean scores and standard deviations of students taught Statistics using Computer -Assisted Instruction (CIA) based on gender. Male students had mean scores of 24.10 and 32.27 in pre-test and post-test with standard deviations of 7.53 and 111.23, while female students had mean scores of 24.30 and 42.34 in pretest and post-test respectively and standard deviations of 5.33 and 10.59.

Hypothesis 1: There is no significant difference between the mean performance scores of students taught Statistics using Computer-Assisted Instruction (CAI) and those taught using the Lecture Method (LM).

Table 3: Summary of ANCOVA test for Significant Difference between the Mean Performance Scores of Students Taught Statistics using Computer-Assisted Instruction (CAI) and Lecture Method (LM)

Source	**Type III Sum of Squares**	**Df**	**MS**	**F**	**P-value.**	**Decision**
Corrected Model	12682.67	2	5486.78	64.41	0.00	
Intercept	544.57.86	1	4357.87	53.60	0,00	
Pretest 1	4015. 41	1	3046.41	36.16	0.00	
Group	3325.18	1	2525. 18	31.18	0.00*	S
Error	4782.15	27	75.86			
Total	232343.000	30				
Corrected Total	16357.82	29				

S* = Significant at 0.05 level

As seen in Table 3, the obtained value of F (1, 27) = 31.18 is significant at 0.00 for the group main effect (P<0.05). This implies that there is significant difference between the mean performance scores of students taught Statistics using Computer-Assisted Instruction (CAI) and those taught with Lecture Method (LM) of teaching. The null hypothesis was out rightly rejected.

Hypothesis 2: There is no significant difference between the mean performance scores of male and female students taught Statistics using Computer-Assisted Instruction (CAI).

Table 4: Summary of ANCOVA test for Significance Difference between the Mean Performance Scores of Male and Female Students Taught Statistics using Computer-Assisted Instruction (CAI) Based on Gender.

Source	Type III Sum of Squares	Df	F	P-value	Decision
Corrected Model	5240.342[a]	2	41.473	.000	
Intercept	2538. 380	1	30.321	,000	
Pretest	87.204	1	0.009	.082	
Gender	251.736	1	0.723	.086[*]	NS
Error	437.224	12			
Total	273645. 000	15			
Corrected Total	15235.172	14			

NS[*] = Not Significant at 0.05 level

As observed in Table 4, F (1, 13) = 0.723 is not significant at 0.086 for the gender main effect (P>0.05). This shows there is no significant difference between the mean performance scores of male and female students taught Statistics using Computer-Assisted Instruction (CAI). The null hypothesis was therefore not rejected but retained.

Discussion of Findings

The result showed that there was a significant difference between the mean performance of students in Statistics when they are taught using CAI compared to those taught using the Lecture Method of instruction. The students taught with CAI performed better which means that CAI has significant effect on the students' performance in Statistics. The better performance seen in Statistics after could be as a result of the effectiveness of the CAI package providing an opportunity for students to work hard at their own pace. This probably improved statistics students' learning and aroused their motivation and interest over what was taught. This finding is not surprising as research carried out by Lashley (2017) in the past had confirmed that CAI group performed better than LM in classroom situation. This finding supports the

finding of Lawal (2020) who found that students taught using CAI performed better than the control group in retention test.

The finding also agrees with the finding of Nwafor and Obetenokpoi (2016) who found that CAI method of teaching enhanced students' achievement in basic science than LM. This finding negates the finding of Nwosu and Ndanwu (2020) who found no significant difference in the posttest achievement mean scores of students taught electronic libraries using CAI method and those taught modified LM method. Similarly, the projector, video and audio provided by the Computer-Assisted Instruction were not present in Lecture Method, the privacy and individual adherence or attention afforded by a computer relieved the students the embarrassment of going more slowly through lessons than other classmates which made a better academic performance of CAI group.

On the other hand, the results of analysis of covariance (ANCOVA) on the performance of male and female students taught using Computer-Assisted Instruction (CAI) method of teaching revealed no significant difference. This finding is in consonance with that of Ekundayo (2022) who revealed that there was no significant difference between the achievement of male and female in both the experimental and the control groups. This finding also in line with the finding of Danjuma (2015) who examined the effects of Computer-Assisted Instruction on academic achievement among NCE Physics students of different abilities in Niger State, Nigeria and found no significant difference between male and female achievement in physics by Using CAI. This finding contradicts the finding of Nwosu and Ndanwu (2020) who in their study revealed that female students in the experimental group had a higher mean gain than their counterparts in the electronics libraries achievement test.. The finding further contradicts the finding of Mchiri, (2018) who revealed that males achieved higher than females on exposure to CAI method. These findings have gone a long way to prove that both male and female students benefit when they are taught using Computer- Assisted Instructions (CAI).

Conclusion

In line with the findings of this study, the following conclusions were drawn. The study has thus far proven that the use of CAI packages enhanced the performance of students in Statistics concept of Mathematics than LM. The CAI is therefore seen as an effective teaching strategy that should be employed by teachers of mathematics than LM in engendering students 'performance in Statistics. Also, the effect of CAI on male and female students in Statistics was found to be at parity. This shows that CAI method is found viable in teaching Statistics concept of Mathematics and can be used for teaching both male and female students.

Recommendations

Based on the findings of this study, the following recommendations were advanced:

1. Computer-Assisted Instruction should be encouraged for teaching and learning of Statistics and other concepts of mathematics in schools.
2. Computers should be used to motivate male and female students

particularly in Statistics since they enhance learning. Workshops and seminars should be organized by stakeholders for teachers of mathematics on how to teach Statistics/Mathematics using Computer-Assisted Instructional software packages.

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