



## Effect of Computer Assisted Instruction on Mathematics achievement among Secondary School Students in Delta State, Nigeria

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**Abstract.** The study investigated the effect of computer assisted instruction in Mathematics achievement among secondary school students in Delta State. Two research questions were raised and two hypotheses were tested at 0.05 level of significance. The study adopted the pre-test, post-test, non-randomized control group design and the population of the study comprised of 1337 senior secondary school students in Aniocha South Local Government Area Delta State. Purposive sampling technique was used to select two public and two private schools to give a sample size of 141 students. The research instrument was the Mathematics Achievement Test (MAT). The Kuder-Richardson Formula- 20 yielded a reliability coefficient of 0.80. Data were analyzed using mean, standard deviation, t-test and ANCOVA statistics. The study revealed, that there was a significant difference between the mean achievement scores of students taught mathematics with computer Assisted Instruction (CAI) method and those taught using the lecture method. A significant difference was found in the mean scores of Mathematics students taught with computer assisted instruction based on their gender. It was concluded that computer assisted instruction method is an effective method for improving students' mathematics achievement in secondary school students in Aniocha South Local Government Area of Delta State. It is therefore recommended that computer assisted instruction should be applied in the teaching of Mathematics in senior secondary schools in Delta State to improve academic achievements.

**Keywords:** Mathematics Academic Achievement, Computer Assisted Instruction, Academic Abilities, High Academic Ability, Low Academic Ability

### 1. Introduction

Mathematics has always occupied an important position in school curriculum. It provides us inductive and deductive knowledge to enrich our imagination and modes of thinking and even behavior to excel in life (Devajit & Gunendra, 2020). Mathematics has made a great progress and new topics and concepts have been injected in school mathematics. New Mathematical structures are introduced and new approaches, adopted to modernize mathematics teaching for greater utility to secondary school students. Secondary level is an important stage of school education which serves as a bridge between primary level and higher education in Nigeria.

Nigeria as a country, and Delta State in particular, is in dire need of sustainability in education, technological and economic development. Chinweoke (2015) states that Mathematics is one of the subjects needed for the realization of scientific and technological advancement in our country. Regrettably, students' poor performance in mathematics from 2015 to 2018 (WAEC Chief Examiner Reports, 2020) seems to be a hindrance in realization of the noble goals. This is probably due to production of inadequate manpower knowledgeable in mathematics and its application in workplaces, which may have resulted from the fact that mathematics is seen by students as a difficult subject to learn, and hence the low academic achievement.

Academic achievement is the learning outcome - the determination of the extent to which a student has achieved her educational goal, and which can be measured by any form of assessment technique. Abe, Omodara and Egbon in Olofinlade (2015) defined academic achievement as the extent to which one is

able to accomplish a task, trade, profession, training and learning. The ability for any individual to attain a peak depends on the performance which is a measure of actions of a group or groups who are given a learning task. McMillan and Adeyemi (2008) have earlier opined that academic achievement depends on how students deal with their studies and how they cope with or accomplish different tasks given to them by their teacher. It is also the ability to study and remember facts and being able to communicate it. Therefore, academic achievement of students in mathematics indicates the extent to which they have acquired the necessary knowledge, skills and abilities needed for solving mathematical problems. Kurumeh and Chianson (2012) declare that the major learning goals of students in mathematics are to enable them become problem-solvers, critical thinkers, team-based workers, logical thinkers and renowned scientists and technologists with innovative abilities. However, some students lack the skills and abilities to interpret and solve mathematics problems (WAEC Chief Examiner Reports, 2017).

Although, some variables such as study habit, students' interest and the teachers' qualification have been suggested to affect students learning outcomes in mathematics, the teaching methods applied are of much concern as these have great effect on the students' academic achievement. Therefore, the performance of students in mathematics in senior secondary schools may be attributed to the methods of teaching popularly used by teachers in instructional delivery. One of such methods is the lecture method.

Lecture method of teaching is an oral presentation of instructional content, ideas and principles about topics to the students. Okoro (2004) described the lecture method as when a teacher or some other knowledgeable person supplies information to the students. The attributes of lecture method include the following: teacher-centered, teacher-active, learner-passive, content driven, wide concept of instruction, large class size and minimal use of chalkboard and low level of interaction. Egwu and Okigbo (2021) observed that, although the conventional Lecture method of teaching has been found less effective, teachers mostly used it for teaching and learning because it is more suitable for teaching large group of students and for covering large content areas. There are some other innovative methods that could enhance the students' achievement level in mathematics, like the Computer Assisted Instruction (CAI) strategies.

The Computer Assisted Instruction is an automated instructional method in which a computer (electronic machine) is used to present an instruction to the learner through an interactive process. Gana (2016) described

Computer Assisted Instruction (CAI) as virtually any kind of computer use for teaching in educational settings which include drill and practice, tutorials, simulations and instructional management. The CAI is learner-centered and activity oriented. The advantages of computer-based programme instructional method, according to Orjika (2018), 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 capacity to that of a guide; also, when properly handled, removing fright and embarrassment on students and bringing about meaningful learning and academic achievement. The CAI instructional packages consist of materials, tools, hardware and software that helps the learners to interact with learning tasks with the guidance of the teacher. Cotton (2014) asserted that computer software provides many instructional benefits and computer-based programme instruction can have a much greater impact on students' learning. According to Worthington (2016), computerized study guides can impact and improve students' overall level of mastery as testing may be improved if students' complete tasks on computer screens and receive immediate feedback about their performance. Computer assisted instruction, which both tests students' abilities and mark their progress may supplement classroom activities, help students to develop ideas and skill independently (Mohammed, 2014). Furthermore, Garnalita (2018) opined that computer-based programme instruction could be of great help because of the drill, practice exercise, tutorial or simulation activities offered either by themselves or as a supplement to the traditional teacher-directed instruction. With the increasing popularity of computer technology, it is essential for administrators to support and encourage computer technology in our educational system, since it is now an important medium in instructional delivery and management. To Egunjobi (2002) computerized instruction permits a high degree of individualization students working on their own pace, own interest and talent. For both male and female students to improve their academic achievement in mathematics they need to be grounded in the application of technological tools to their studies through Computer Assisted Instructional (CAI) strategies.

Gender is a state of being male or female. It refers to the social interpretation of one's biological sex. It refers to the sum of cultural values, attitudes, roles, practice and characteristic based on sex. Both boys and girls need help sorting out gender role expectation, how it affects their behaviours in relationships, leisure activities and careers. Gender systems are often

dichotomous and hierarchical. Male dominate certain professional fields like engineering, sciences, piloting, boxing, policing, etc. On the other hand, women dominate professional fields like nursing, teaching, home economics, fashion designing, hairdressing etc. In other words, due to their physical fitness and tasks involve in the career, some professions are perceived as exclusively for male and not female. It has been noted that men are more skillful in technology; they have more technological skills in activities such as basic computer functions and online participatory communication higher than women (Chen 2006). Also, since Computers are commonly identified in the areas of Mathematics and science: areas in which for many years there has been a widespread concern about sex-related differences, it might not be surprising then for the same differences emerging in the area of computer education.

Yusuf and Afolabi (2010) investigated the effects of computer assisted instruction (CAI) on 120 secondary school students' performance in biology in Oyo state, Nigeria. Also, the influence of gender on the performance of students exposed to CAI in individualised or cooperative learning settings package was examined. The research was a quasi-experimental involving a 3 x 2 factorial design. The findings of the study showed that the performance of students exposed to CAI either individually or cooperatively were better than their counterparts exposed to the conventional classroom instruction. However, no significant difference existed in the performance of male and female students exposed to CAI in either individual or cooperative setting.

Lidon (2017) investigated the effects of computer-aided instruction on mathematics performance of pupils at the Grade 4 level with respect to gender in Region 5, Berbice, Guyana. The Quasi Experimental, Nonequivalent Control Group design was employed for this study. The findings of the study indicated that there was a significant difference between the academic performance of pupils in mathematics who were taught using computer-aided instruction and those who were taught using the traditional method of teaching. Second, there was a significant difference between the academic performance of male and female pupils who were taught using computer-aided instruction and those who were taught using the traditional method of teaching. In addition, there was a significant difference between the academic performance of lower- and middle-income pupils who were taught using computer-aided instruction and those who were taught using the traditional method.

Chukwuedozie (2016) did a study 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 in Nassarawa Education Zone. 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.

Chinweoke (2016) examined the effect of use of information, communication and technology (ICT) on secondary school students' achievement in trigonometry in Ihiala Local Government Area of Nnewi Education Zone of Anambra State. The study was a quasi-experimental, non-randomized pre-test, post-test, non-equivalent control group design. The result obtained revealed that students taught with ICT achieved significantly better than their counterparts taught with conventional lecture method. The result again showed that ICT was gender friendly as the male students' achievement did not differ significantly from that of their female counterparts taught trigonometry using ICT.

Ahmad, Gambari, Abdul-Rasaq and Alabi (2017) investigated the effect of computer assisted instruction on secondary school mathematics students' spatial visualization ability, achievement and attitude in Niger State. The finding of the study revealed that the males outperformed the females in spatial ability tasks and had higher positive attitude towards learning mathematics with technology.

Adolphus and Omeodu (2020) examined the effects of Computer-assisted instruction (CAI) on students' achievement in atomic and nuclear physics in Rivers State. It was found that students that were taught atomic and nuclear physics with CAI have higher mean achievement scores than those taught with lecture method (44.1). This implies that students taught atomic and nuclear physics using computer assisted instruction performed better than those taught with lecture method. Also, Suleman, Hussain, Ud-Din and Iqbal (2017) examined effects of computer-assisted instruction (CAI) on students' academic achievement in Physics at secondary level in Pakistan. The findings showed that computer-assisted instruction has a significant positive effect on students' academic achievement and retention in Physics. It further showed that high academic achievers performed better than low achiever when taught with CAI.

However, Rosali (2020) investigated effect of computer-assisted instruction (CAI) on the academic achievement in secondary physics and found to significant improvement in CAI utilization. The research utilized the quasi-experimental pre-test—post-test control group design on 157 Grade 10 students of a private school in the Philippines. The findings of the study showed 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 was compared, there was no significant difference between their effects on academic achievement of the students.

Most of the studies reviewed showed significant effect of computer assisted Instruction on students’ academic achievement in other science subjects but mathematics. The reviewed studies were located outside Nigeria and in particular outside Delta state. Therefore, this study sought to examine the effect of computer assisted instruction on mathematics achievement among secondary school students in Delta State, Nigeria.

### 1.1 Statement of the Problem

The goals of Mathematics education are geared towards making students problem solvers, critical and analytical thinkers, creative in manipulative skills, team-based workers, and renowned scientists and technologists with innovative abilities. Achieving these goals is one that has been met with so many challenges resulting in the continuous decline in academic performance of secondary school students in Mathematics, which has been a major concern to all educational stake holders. And more recently, a major challenge to education was the breakout of the novel coronavirus in December 2019.

The novel Coronavirus (Covid-19) pandemic turned out to be a cankerworm that stagnated the economy, education and health sectors of the world generally and Nigeria in particular (Kandola, 2020). Covid-19 affected mostly all activities carried out most especially on the education, and in particular on secondary school education. In a bid to curtail the spread of the Covid-19, the initial response of the Nigerian Government was the closure of all schools which led to an abrupt end to in-person academic activities and disrupting academic calendars across various schools (Ifijeh & Yusuf, 2020). The major step that was taken to mitigate the damage caused by Covid-19 on the education sector was the use of computer assisted instruction in form of online learning.

To mitigate the negative effect of COVID-19 on in-person attendance in schools, the Computer Assisted Instruction methods have become the reasonable and tested alternative for out of school teaching and learning. Hence, this study examined the effect of computer assisted instruction on mathematics achievement among secondary school students in Delta state, Nigeria.

### 1.2 Purpose of the Study

The purpose of this study was to investigate the effect of computer assisted instruction in mathematics achievement among secondary school students in Delta State, Nigeria.

### 1.3 Research Questions

The following research questions guided the study:

- What is the difference in the post-test mean scores of students taught with computer assisted instruction in Mathematics and those taught with lecture method?
- What is the difference in the mean scores of Mathematics students taught with Computer Assisted Instruction and lecture method based on gender?
- What is the treatment and sex interaction effect on students’ achievement mean scores in Mathematics?

### 1.4 Hypotheses

The following hypotheses were formulated and tested at 0.05 level of significance:

- There is no significant difference in the post-test mean scores of students taught with computer assisted instruction and those taught with lecture method.
- There is no significant treatment and sex interaction effect on students’ achievement mean scores in Mathematics.

## 2. Methodology

The study adopted the pre-test, post-test, non-randomized control group design. Teaching methods (Computer Assisted Instruction and lecture method) was the independent variable, while Mathematics achievement was the dependent variable with gender intervening variable. The population of the study comprised of one thousand three hundred and thirty-seven (1337) senior secondary school (SSS2) students in Aniocha South Local Government Area Delta State

based on the enrolment of 2021/2022 session. The sample size for the study was 141 mathematics students in four public and private senior secondary school sampled which comprised of 68 female and 73 male students. The four senior secondary schools were purposively sampled based on availability of facilities for computer assisted instruction and equitable distribution of students along variables of the study.

The instrument for data collection was the Mathematics Achievement Test (MAT). The MAT was an objective question test measuring students' achievement in selected topics in Trigonometry.

Programmed computer software (Trigonometry App) was used as Instructional Package for Mathematics (IPM) to teach the experimental group Traditional teaching method manuals were designed for the control group. A four-week lesson notes covering sine and cosine rule in trigonometry were written for both the intervention and control groups. Kuder-Richardson Formula- 20 (KR-20) was used to determine the reliability of the MAT which yielded a coefficient of 0.80. Data were analyzed using mean to answer research questions while ANCOVA statistic was used to test the hypotheses at a significance level of 0.05.

**3. Results**

**Research Question One:** What is the difference in the pretest and post-test mean achievement scores of students taught with Computer Assisted Instruction (CAI) in mathematics and those taught with Lecture Method (LM)?

**Table 1:** Mean and standard deviation for difference in pretest and post-test mean scores of Computer Assisted Instruction and lecture method group

Group	N	Pretest		Post test		Mean Difference
		Mean	SD	Mean	SD	
CAI	62	8.63	2.68	9.30	2.97	1.82
LM	54	7.22	3.33	7.48	2.52	

Results from table 1 shows that the mean difference is 1.82 in favour of the students taught with the experimental method. To test whether the difference is significant, the ANCOVA statistics was used as presented in table 2. Hypothesis One: There is no significant difference in the post-test mean scores of students taught with computer assisted instruction and those taught with lecture method.

**Table 2:** ANCOVA of differences in the posttest mean achievement scores of students taught with CAI and lecture methods.

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	107.383a	2	53.692	7.021	.001
Intercept	807.452	1	807.452	105.584	.000
Pretest	12.574	1	12.574	1.644	.202
Methods	105.907	1	105.907	13.849	.000
Error	864.169	113	7.648		
Total	9016.000	116			
Corrected Total	971.552	115			

Table 2 contains an *F-Value* of 13.849 and a *P-Value* of .000. Testing at alpha level of 0.05, the *P-Value* is less than the alpha level. Therefore, the null hypothesis is rejected. This means that there is a significant difference between the post-test mean scores of students taught with computer assisted instruction and those taught with the lecture method. **Research Question Two:** What is the difference in the mean scores of Mathematics students taught with Computer Assisted Instruction and lecture method based on gender?

**Table 3:** Mean and Standard Deviation of Difference between the mean score for male and female students taught with CAI and LM

Groups	Sex	N	Pretest		Post Test		Mean Diff.
			Mean	Std. Dev.	Mean	Std. Dev.	
CAI	Male	34	8.62	2.30	7.59	2.76	-1.03
	Female	28	8.64	3.13	7.36	3.26	-1.28
	Total	62	8.63	2.68	7.48	2.97	-1.15
LM	Male	28	7.61	3.67	8.43	2.62	0.82
	Female	26	6.81	2.94	10.23	2.08	3.42
	Total	54	7.22	3.33	9.30	2.52	2.08

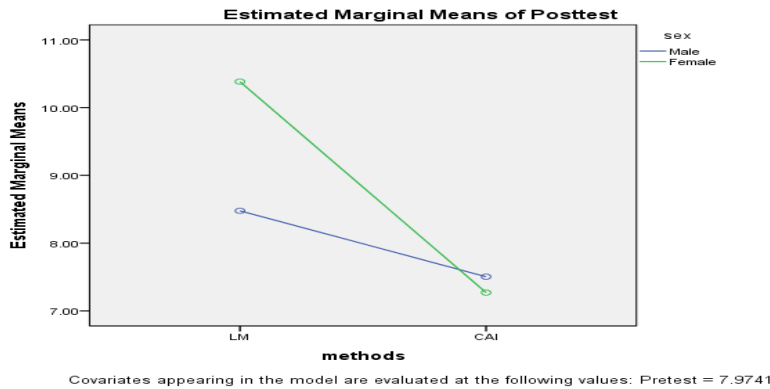
Table 3 presents the number of participants in each group to their sex with the respective mean and standard deviation at both pretest and posttest. The student had higher mean scores in the pre-test using the computer assisted instruction while the lecture method yielded higher mean scores at posttest. To test for significant difference based on sex the ANCOVA statistic was used as displayed in Table 4.

**Hypothesis Two:** There is no significant treatment and sex interaction effect on students’ achievement in Mathematics.

**Table 4:** Two-way Analysis of Covariance (ANCOVA) of Treatment by Sex Interaction Effect.

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	156.828 <sup>a</sup>	4	39.207	5.342	.001
Intercept	771.005	1	771.005	105.044	.000
Pretest	17.413	1	17.413	2.372	.126
methods	113.387	1	113.387	15.448	.000
sex	19.994	1	19.994	2.724	.102
methods * sex	32.755	1	32.755	4.463	.037
Error	814.723	111	7.340		
Total	9016.000	116			
Corrected Total	971.552	115			

Table 4 contains an *F-Value* of 4.463 and a *P-Value* of .037. Testing at alpha level of 0.05, the null hypothesis is rejected. This shows that there is main interaction effect methods and sex on the achievement of students in mathematics. This implies that the treatment did have effect on male and female students’ achievement in mathematics in favour of the male students. This is clearly shown by figure 1.



**Figure 1:** Results from analysis

**4. Discussion**

The findings from research question one revealed that the students taught with the Computer Assisted Instruction (CAI) method achieved higher in mathematics in post-test compared to those taught with the Lecture Method. This was further confirmed by hypothesis two which showed that there was a significant difference between post-test mean scores of students taught with CAI and those taught with the LM in favour of CAI. This implies that the treatment was effective as the experimental group had a higher mean gain compared to the control group. This finding is at consonance with those of Adolphus and Omeodu (2020) that students that were taught atomic and nuclear physics with CAI have higher mean

achievement scores than those taught with lecture method. Similarly, Chinweoke (2016) reported that students taught with CAI achieved significantly better than their counterparts taught with conventional lecture method.

Findings from research question two revealed that the students had higher mean scores in the pre-test using the computer assisted instruction while the lecture method yielded higher mean scores at posttest. The null hypothesis was rejected implying that the treatment did have effect on male and female students. This finding is supported by Chukwuedozie (2016) study that there was no gender difference on use of CAI on students’ achievement in Chemistry. However, this finding is in variance with Chinweoke

(2016), who reported that ICT was gender friendly and that male students' achievement did not differ significantly from that of their female counterparts taught trigonometry using ICT.

## 5. Conclusion

Based on the findings of the study, it can be concluded that computer assisted instruction method is an effective method for improving achievement in mathematics among secondary school students in Aniocha South Local Government Area of Delta State. Furthermore, gender differences exist in mathematics academic achievement among Students taught with Computer Assisted Instruction.

## 6. Recommendations

Based on the findings of the study, the following recommendations are made:

- Computer assisted instruction should be deployed in the teaching of mathematics in senior secondary schools in Delta State to improve academic achievements.
- Also, students, especially male, should be sensitized on the importance of computer assisted instruction so as to improve their interest as well their academic performance to close gender disparity.

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