

Effects of Computer Assisted Instruction (CAI) on Senior Secondary School Students' Learning Outcome in Mathematics

¹Abiodun, T.O. & ²Asanre, A.A.

^{1,2}Department of Physics, Tai Solarin University of Education, Ijagun. Ijebu-Ode, Ogun State.

Corresponding Author E-Mail: abiodunto@tasued.edu.ng

Abstract

The impacts of Computer-Assisted Instruction (CAI) on senior secondary school students' learning outcomes in mathematics in Ogun State, Nigeria, was examined using a quasi-experimental type of the pre-test, post-test, non-randomized, control group design. All 19, 691 Senior Secondary School II students made up the population. Using a simple random sample technique, 120 respondents were chosen to take part in the survey. Three research questions and three hypotheses guided the study. Data was gathered Mathematics Achievement Test, which has a reliability of 0.78 using kuder Richardson formula 20 (K-R20). Data were analysed using inferential statistics of analysis of covariance at the 0.05 level of significance. The findings revealed that students' academic achievement in mathematics were significantly impacted by the Computer Assisted Instruction (CAI) approach compared to the lecture method of teaching.

Introduction

The study of mathematics has long held a significant place in the curriculum. It gives us both deductive and inductive knowledge to improve our thinking, behavior, and creativity so that we can succeed in life (Devajit & Gunendra, 2020). To update mathematics instruction and make it more useful for secondary school students, new mathematical structures and methodologies should be implemented. In Nigeria, the secondary level is a crucial educational phase that acts as a link between primary and higher education. Any type of assessment method can be used to measure academic performance, which is the learning outcome—the degree to which a student has met her educational objective. According to Kurumeh and Chianson (2012), the main objectives of mathematics education are to prepare students to become logical thinkers, problem solvers, critical thinkers, team players, and distinguished scientists and technologists with creative skills. However, for a variety of reasons, students struggle in mathematics, making it one of the courses they dislike the most.

A number of factors, including teaching strategies, motivation, and attitude, are connected to students' poor performance in mathematics According to Abiodun et al. (2022). Students' poor performance in a mathematics is typically linked to the employment of

teaching strategies that are deemed unproductive (Barakaev et al., 2020). Teachers must therefore be knowledgeable about teaching methods that will raise student achievement. Traditional methods of learning mathematics focused on the teacher-centered approach, where teachers would typically provide input and students would primarily absorb and memorize the knowledge. In contrast, modern methods of learning mathematics encourage the process of exchanging ideas and incorporating ideas of others. Traditional teaching methods like lecturing or using a chalkboard are among the finest ways to provide students with knowledge, even though there is no guarantee that they will retain it. Abiodun et al. (2022) state that the old method of mathematics instruction is still used, which has been found to be inadequate. In comparison to traditional methods, a number of studies have demonstrated that Computer-Assisted Instruction improves student proficiency in mathematics.

CAI encompasses almost any type of computer program used in educational environments, including word processor writing, database development, simulations, instructional exercises, supplemental exercises (Cotten, 2021). it is an activity-oriented and learner-cantered. Since computer-assisted learning may encourage active learning across a wide range of

subjects, from literature to the social sciences and beyond, the problem is how to make the most of computer use. New opportunities for providing high-quality learning are presented by the use and expanding use of technology in the classroom. Teachers employ technology to improve their lessons, and this approach has proven to be more successful and enriching (Maina, Dare & Yusuf, 2018). Using technology in the classroom can help teachers manage their approaches as an effective teaching strategy. Cher (2010) lists several advantages of the CAI method, such as guaranteeing that students are taught using tried-and-true techniques, giving students in the same program equal educational opportunities, changing the teacher's role from one of instruction to one of guidance, and, when applied properly, easing students' anxiety and embarrassment while fostering academic success and meaningful learning. It has been shown that students who utilize computers are more effective and motivated to learn than those who get instruction in traditional classroom settings, and they also display higher levels of self-assurance and confidence (Muhammad, 2022).

With the help of CAI, students may comprehend abstract ideas, which eventually leads to a thorough comprehension of the theory. Kumar (2015). According to empirical data, CAI is a great teaching strategy that improves student performance, piques their attention, and lessens their fatigue and abstract nature. (Raniga, 2021; Adeosun, 2020). The traditional teaching approach and method may deny students the freedom that CAI offers. Because CAI includes tutorial, simulation, and drill-and-practice activities, it could be quite helpful. Numerous instructional benefits are provided by computer programming, and when compared to traditional methods. It also improves learning proportion, meaning that students can learn a comparable amount of material in less time than those who receive conventional instruction. Additionally, CAI significantly improves student retention (Cotton, 2021). CAI can support the development of students' communication, data processing, and decision-making and critical thinking skills. Students can access a wealth of learning resources and increase their exposure to diverse viewpoints on any topic by using computers in the classroom (Opara & Nwaukwu, 2019).

Exercises that are computer-programmed to assist students in visualizing abstract ideas can improve their mental understanding. These activities, which may be computer simulations and animations or tangible physical exercises, would be consistent and in line with traditional teaching methods. Simulations give teachers

the opportunity to give students a teaching tool that can help them convert their vague ideas about science into accurate ideas. Students were able to separate and adjust parameters, which also helped students develop an understanding of the connections between physical concepts, variables, and phenomena. (Tuzemen & Hancer, 2014). The use of CAI in mathematics would increase students' exposure to and capacity for developing knowledge, skills, and information accessibility in a technologically advanced environment. Building such skills will improve a country's social, mechanical, and sustainable growth. This study made use of multimedia presentation as the computer Assisted Instruction.

Another way to guarantee effective learning is to involve students in the teaching and learning process, which deviates from the traditional teaching approach. Multimedia presentations can help students understand mathematical concepts and enable the use of visible, real-world content (Akinoso, 2015). Students' learning is greatly impacted by multimedia. Lessons can be more engaging and successful when there is an abundance of textual, audiovisual, and instructional materials available. Additionally, ICT's self-production capabilities can help teachers create engaging lessons. According to Akkoyunlu and Yilmaz (2005), when appropriately designed, multimedia use can have a favorable impact on teaching and learning when compared to traditional methods of education in terms of student performance. Schools can benefit greatly from the usage of multimedia packages for instruction and learning. The multimedia packages include of educational software like Microsoft Power Point for creating lesson presentations with a digital projector, drill and practice programs, educational games, simulations, recreational games, tutorials, and encyclopedias on CD-ROM (Bharatka, 2006).

Tools and instruments with an educational purpose that convey an educational message from the sender to the recipient are referred to as educational media. These tools and instruments can be used to carry out instructions and help students meet their learning objectives. A more productive learning environment may be produced with the use of this tool (Capuno et al., 2019). This kind of media stimulates students' ideas and emotions as well as their focus and attention to promote the learning process. The teacher delivers the message, and the students accept it. The information or messages offered by educational media are frequently created in a way that allows students to actively participate in the learning process while also meeting

their educational and learning needs (Widodo, 2018). Audio, visual, audiovisual, and multimodal media are some of the categories into which educational media can be divided. However, if multimedia instructional strategies are integrated into the teaching and learning system, there will be an immediate transformation that will have a significant impact on the traditional educational system. Multimedia components including music and video, animation, graphics, and text can be used to provide the educational information in a multisensory setting. The employment of digital multimedia technologies and strategies is creating a new paradigm in educational technology (Neo & Neo, 2000). Neo and Neo (2000) added that multimedia has enabled unique and new ways to provide students with instructional aids and given a new development mode of instruction. When multimedia and content are combined, the resultant effective content can be expressed in several dimensions and made available for various teaching and learning modalities, including mixed mode, student-centered, and teacher-centered (Neo & Neo, 2000).

Researchers, educators, and mathematicians both inside and outside of Nigeria are still somewhat concerned about the possible prevalence of gender imbalance in mathematics. This is due to the fact that it is unclear which gender excels at mathematics. Male students outperform female students in mathematics, according to certain researchers like Alio and Harbor-Peters (2020); Ezugo and Agwagah (2017); however, Adolphus & Omeodu (2020) and Ogbonna (2017) discovered that female students outperform male students. In his research, Etukodo (2017) found no discernible difference in the mathematical achievement of male and female students. Researchers are yet to determine which of gender does better than the other in this field. Therefore, the need to look into whether CAI affect students' performance in mathematics in terms of gender.

According to the literature, mathematics teachers and other educational stakeholders in Nigeria have been gravely concerned about students' subpar performance in the subject. Researchers have shown that one of the issues behind this poor performance in mathematics is the instructional tactics teachers employ. If pupils' weak math performance persists, educational objectives for the country's scientific and technical advancement may not be met. Therefore, the purpose of this study was to investigate how senior school students' performance in mathematics was

affected by the multimedia instructional (CAI) technique.

Research Questions

- (i) What are the mean scores of students who received computer-assisted education versus those who received lecture-based instruction in mathematics?
- (ii) What are the mean mathematics achievement scores for male and female students?
- (iii) How do gender and instructional strategies interact to affect students' academic performance in mathematics?

Hypotheses Statement

- (i) The mean achievement scores of students who received computer-assisted instruction and those who received lecture-based instruction in mathematics do not differ significantly.
- (ii) The mean achievement scores of male and female students in mathematics do not differ significantly.
- (iii) The interaction effect of gender and instructional strategies on students' academic performance in mathematics does not differ significantly.

Population and Research design

A pre-test, post-test, control group quasi-experimental design was used in the investigation. The 73 SSS2 students is the population of the students. The study's sample was selected from Ogun State, Nigeria's public Senior Secondary Schools II mathematics students.

Sample and Sampling Techniques

Four public senior secondary schools from throughout Ogun-State were chosen using a Sampling Random since every member has an equal chance to be picked. One hundred and twenty (120) students were used. As study assistants, the classroom Mathematics teachers from the sampled schools were used. All the students took the test before the intervention and also after the intervention. Both the control and experimental groups received the post-test following the four-week course of treatment. Scores were generated after scripts were marked.

The Instrument

The Mathematics Achievement Test (MAT, reliability =0.78 by kuder Richardson formula 20. MAT was

developed by the researchers. Data was analysed by the use of t-test, standard deviation and mean.

Data analysis and interpretations

Table 1: Average achievement mark with standard deviation of students in experimental and control group.

Groups		Before intervention	After intervention
Computer assisted instruction	N	60	60
	Mean	18.34	28.90
	S. D	6.845	5.145
Lecture method	N	60	60
	mean	17.96	19.47
	S. D	5.534	5.102

Table 1 displays achievement marks and standard deviations of students who received instruction after the experiment in the CAI group had (\bar{X} = 28.90, σ =5.145) and those in LM group after the intervention had (\bar{X} = 19.47, σ =5.102).

Table 2: Average achievement mark with standard deviation of students in CAI group based on gender

Gender		Before intervention	After intervention
Male	N	28	28
	Mean	20.06	28.93
	S. D	7.762	6.489
Female	N	32	32
	Mean	18.49	29.03
	S. D	6.239	5.298

Table 2 is showing the average achievement mark with standard deviation of students in CAI group based on gender. The result shows that male student had the following statistics (\bar{X} = 28.93, σ =6.489) and the female students had the following statistics (\bar{X} = 29.03, σ =5.298).

Table 3: Average achievement mark with standard deviation of students in CAI group on interactions between gender and teaching method

Groups	gender		Before intervention	After intervention
Computer assisted instruction	Male	N	28	28
		Mean	18.76	28.93
		S.D	4.094	6.489
	Female	N	23	23
		Mean	17.83	29.03
		S.D	5.843	5.298
Lecture method	Male	N	30	30
		Mean	17.65	20.45
		S.D	6.347	7.932
	Female	N	30	30
		Mean	18.19	19.88

S.D	7.341	6.723
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Table 1 dis showing the average achievement mark with standard deviation of students in CAI group on interactions between gender and teaching method. Male students in the experimental group had \bar{X} = 28.93, σ = 6.489; and female students in the experimental

group had \bar{X} = 29.03, σ = 5.298). Similarly, male students in the LM group had (\bar{X} = 20.45, σ = 7.932); and female students in the LM group had (\bar{X} = 19.88, σ = 6.723) respectively.

Table 4: *t*-test showing the difference in computer assisted Instruction group and lecture method.

Strategies	Number	\bar{X}	σ	Degree of freedom	t	P-value	comment
computer assisted Instruction	60	28.90	7.986	118	5.342	0.01	Sig.
Lecture method	60	19.47	6.098				

Table 4 shows that the mean achievement scores of students who received computer-assisted instruction and those who received lecture-based instruction in mathematics do differ significantly ($p = 0.01 < 0.05$, $df = 118$; $p < 0.05$). The hypothesis is thus

disproved. This proves the hypothesis's validity and supports the finding that, when the approach is used, students' levels of mathematical achievement differ significantly, favouring those in the experimental group.

Table 5: *t*-test Analysis of difference in experimental group after intervention based on gender

Gender	Number	\bar{X}	σ	Degree of freedom	t	P-value	comment
Male	28	28.93	6.489	58	0.189	0.328	Not sig
Female	32	29.03	5.298				

Table 5 showed that the mean achievement scores of male and female students in mathematics do not differ significantly, as shown in Table 5. ($p =$

$0.189 > 0.05$; $t = 0.189$, $df = 58$). The null hypothesis is thus disproved.

Table 6: *t*-test of the interaction effect of gender and teaching methods

Strategy	Number	\bar{X}	σ	Degree of freedom	t	P-value	comment	Number
Computer Assisted Instruction	Male	28	28.93	6.489	58	0.189	0.328	Not significant
	Female	32	29.03	5.298				
Lecture method	Male	30	20.45	7.932	58	0.342	0.193	Not Significant
	Female	30	19.88	6.723				

Table 6 showing that the interaction effect of gender and instructional strategies on students' academic performance in mathematics does not differ significantly in relation to gender. Hence, the hypothesis is accepted.

Discussion of Findings

When compared to traditional teaching approaches, it is clear from the study's findings that employing CAI can raise students' performance levels

in mathematics. Students who were taught utilizing the CAI strategy did better than those in the control group, according to the findings. This outcome supports the findings of Adolphus and Omeodu (2020), who found that students who received CAI method in atomic and nuclear physics outperformed those who got lecture teaching in terms of mean achievement scores. Similarly, Chinweoke (2016) discovered that students who were taught through CAI did better than those who were taught through the conventional lecture method. Moreover, the results of Abdul Karim and Rabiru (2013), also established that the students that are exposed to CAI performed better students in lecture method group.

The study's findings also demonstrated that there is no discernible difference in the mean accomplishment scores of male and female students in math classes that use computer-assisted instruction. The results of Uduosoro (2011), who found that students' academic achievement was unaffected by their gender, whether they were male or female, are supported by this. This conclusion is further supported by Chukwuedozie (2016), who found no gender disparities in the effect of CAI use on students' chemistry achievement. However, this finding runs counter to Chinweoke (2016), who asserted that students exposed to CAI teaching performed differently based on their gender, with male students performing better in geometry.

The results showed no significant difference in the interaction effect of gender and instructional styles on students' mathematical performance. This finding implied that there was no discernible difference in the mean post-test achievement in mathematics between the two treatment strategy levels used in the study for the two student gender levels (male and female). This implies that computer-assisted training is an effective teaching method for both male and female students, and that a student's success in mathematics is more influenced by their orientation than by their gender. These characteristics lessen gender-based disparities in traditional math training and accommodate a variety of learning styles. This result is consistent with the findings of Kumar (2015) that the students exposed to number Computer Assisted Instruction showed improved performance in basic operations regardless of gender, indicating the strategy's universal applicability.

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