# Effects of Computer-Assisted Instruction on College of Education Students' Achievement in Mathematics in Sokoto State, Nigeria

Bashiru Aliyu Gada and Mika'ilu Muhammed Department of Educational Technology, Shehu Shagari University of Education Sokoto, Nigeria. <u>bashirualiyugada@gmail.com</u> (07037757504) DOI: 10.56201/ijcsmt.vol.11.no5.2025.pg10.17

#### Abstract

This study examined the impact of Computer-Assisted Instruction (CAI) on students' achievement at Colleges of Education in Sokoto State, Nigeria. The research aimed to compare the pre-test and post-test achievement mean scores between the experimental and control groups and assess gender differences within the experimental group. To achieve this, two research questions and hypotheses were formulated to guide the study. A true experimental design was adopted, involving a sample of 64 (44 males, 20 - female) students from two intact classes, with the College of Education selected through a convenience sampling technique. Data was collected using the Mathematics Achievement Test (MAT). The validity of these instruments was confirmed through expert review from specialists in Mathematics Education, Technology Education, and Research, Measurement, and Evaluation. content validity was used for GAT. Reliability was determined Kuder- Richardson formula 29(K-R-20) for MAT of 0.79 were obtained for the achievement. Descriptive statistics, including mean and standard deviation, were used to answer the research questions. Data analysis was carried out using SPSS version 24. The results showed that the pretest mean scores of the experimental group were not statistically different from the pretest mean scores of the control group in the achievement of students in Mathematics. However, the post-test means scores of the experimental group revealed the statistical difference in the achievement of students in Mathematics with that of the control group. The result further revealed that there was no interaction effect of treatment and gender on both of the post-test achievement of mean scores of students in Mathematics. The findings of the study contributed in confirming that learners achieve better when taught Geometry using Computer-assisted Instruction. It was concluded that Computer-Assisted Instruction was an effective teaching approach for enhancing students' achievement in Mathematics. The findings confirm that students exposed to CAI perform better than those taught using the traditional lecture method, reinforcing the need for its integration into mathematics instruction in Colleges of Education.

### **INTRODUCTION**

Achievement is the extent to which a learner is profiting instructions in a given area of learning. Achievement thus means all those behavioral changes, which take place in the individual as a result of learning experiences of various kinds. Mathematics achievement refers to the degree or level of success or proficiency attained in some specific areas concerning Mathematics. In general, it refers to the score obtained in the annual exams. An achievement test assesses the knowledge of some school subjects. Achievement tests show how well students have mastered the

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subject matter in a course of instruction. Achievement in Mathematics plays an important role in the attainment of the ideal of the harmonious development of a student. In this rapidly changing world and with the growing advancement in science and technology, the place of Mathematics has become so vital that every parent today sets high goals for the students to achieve besides, student achievement was not good enough in Mathematics, especially in the following topics: geometry, trigonometric and bearings. The failure in geometry is well noticed in the performance of students in Colleges of Education in Sokoto state. It raises a big question, why is learning achievement especially Mathematics not good? Even though there are modern approaches to improving learning achievement. For example, Ntibi and Orim (2017) attributed poor achievement of students in Mathematics to the use of teacher-centered methods instead of the students-centered approach like CAI which improves motivation and achievement and is also gender friendly.

Poor Mathematics achievement to teacher centered methods, suggesting that student centered approaches like Computer-Assisted Instruction (CAI), which improve motivation and achievement and are gender-friendly, could be more effective. Gender issues have been linked with the achievement of students in academic tasks, in several studies but without any definite conclusion on which of the two male or female achieve better. Some researchers like Contini, Tommaso and Mendolia (2017) have found no statistically significant difference in boys' and girls' ability to solve problems requiring the application of spatial skills, while OECD (2015) found boys performing significantly better than girls in Mathematics. Based on this background, the focus of this study is investigating students' motivation and achievement in Mathematics using CAI.

Geometry, a foundational branch of Mathematics, focuses on the properties, shapes, and sizes of figures, involving key elements like points, lines, angles, and solids. It nurtures crucial skills such as visualization, critical thinking, problem-solving, deductive reasoning, and logical argumentation. This discipline plays a pivotal role in professions such as architecture, where geometric principles underpin all designs. In educational settings, geometry constitutes a significant portion of the curriculum in Colleges of Education (COEs), essential for developing spatial skills needed to manipulate objects in two and three dimensions. Mastery of geometry not only prepares students for advanced mathematical studies but also for careers in sectors like construction, engineering, and aviation, crucial for national development, including in Nigeria. Despite its importance, recent results from NCE 1 students consistently show weaknesses in geometry-related topics, with more students failing than passing. This issue has prompted investigations revealing teaching methods as a contributing factor to student failures in geometry at COEs, motivating this research into whether Computer-Assisted Instruction (CAI) can mitigate these challenges. Jackson (2023) highlights that CAI effectiveness in improving spatial skills across age groups, although its adoption remains limited among Nigerian educators. Despite the potential benefits of ICT in education, many teachers in Nigeria lack the necessary skills and experience to effectively integrate CAI into their teaching practices, relying instead on traditional methods like lectures (Adomi, 2010). CAI promotes learner centered education, allowing students to learn at their own pace, which could significantly enhance Mathematics education in Colleges of Education by fostering individualized learning experiences and motivation.

#### STATEMENT OF THE PROBLEM

This study was motivated by poor student's achievements in mathematics especially in the area of geometry as observed by the researcher. Despite extensive efforts by stakeholders including the government, NGOs, and educational organizations to enhance Mathematics education through

various training programs, performance in the subject remains low, particularly in Colleges of Education (COEs). For example, at Shehu Shagari College of Education, only seven out of 56 students passed the mathematics exams in 2023, with poor performance attributed to ineffective teaching methods and inadequate subject knowledge. This persistent underachievement concerns educational authorities, as it affects the future pool of professionals. Consequently, this research aims to explore whether a computer-assisted instructional approach, which focuses on student centered learning, can improve students' achievement in geometry.

## AIM AND OBJECTIVES OF THE STUDY

The aims of the study were to examine the effects of Computer-Assisted Instruction on Students' motivation and achievement in Geometry in Colleges of Education in Sokoto State Nigeria. The specific objectives of the study were to:

- 1. determine the pre-test and post-test achievement mean scores of students in Geometry in the experimental and control groups.
- 2. ascertain the pre-test and post-test achievement mean scores of male and female students in the experimental group.

# **RESEARCH QUESTIONS**

The following research questions were answered:

- 1. What are the pre-test and post-test achievement mean scores of students in Geometry in the experimental and control groups?
- 2. What are the pre-test and post-test achievement mean scores of male and female students in the experimental group?

### LITERATURE REVIEW

Computer-Aided Instruction is a teaching strategy that involved the use of information and communication technology in teaching. This reduces the abstract nature of mathematics and geometry at large (Jupri, Drijvers, & Van Den 2015). According to Tolbert and Carmella (2015), CAI improved student's achievement in mathematics. This is because it provides the learner the opportunity to use the computer tools and it is a problem-solving skills development strategy. Accordingly, (Jupri, Drijvers & Heuvel Panhuizen, 2015; and Valencia, 2016), maintained that students taught using CAI significantly achieved higher than the control group. This revealed that utilising this teaching strategy in mathematics can be able to reduce the low achievement rate of students in mathematics generally. Sedega, Mishiwo, Fletcher, Kofi and Awudetsey (2017) discover that CAI was equally effective for the students in the experimental group because it helped students to develop Mathematical concepts adequately with limited teacher guidance.

Akpan and Daniel (2019); Pilli and Aksu (2020); Ebhomien (2020); Katuku, Twoli and Waititu (2023) discovered that there was no single method that qualified as the most effective in enhancing students' academic performance and learning using lesson packages in Physics. However, when gender was considered, TET was discovered as being the most effective in enhancing female students' academic performance and learning using lesson packages in Physics. Also, Danjuma (2018) states that CAI is gender friendly teaching strategy and learners at all levels can learn using the strategy as study by Danjuma (2018) concludes that the academic achievement of low, medium and high abilities taught using CAI was not different from one another significantly. Moreover, Anthony, Peter and Festus (2021) revealed the benefits of CAI to third

year Electronic Libraries course students. Ukaigwe and Goi-tanen (2022states that students taught with computer assisted instruction performed higher than those taught with traditional instructional methods. Findings also revealed that there is a significant difference between the pretest and posttest achievement scores of students taught Mathematics with computer assisted instructional method.

# METHODS AND PROCEDURES

This section outlines the detailed methods and procedures employed in the study on the impact of Computer-Assisted Instruction (CAI) on achievement in Geometry among NCE I Mathematics students in Sokoto State Colleges of Education. The methodology encompasses the research design, population and sample, sampling technique, instruments for data collection, validity and reliability of instruments, procedure for data collection, and method of data analysis. A true experimental design was adopted, involving a sample of 64 (44 - males, 20 - female) students from two intact classes, with the College of Education selected through a convenience sampling technique. Data was collected using the Students' Geometry Motivation Scale (SGMS). The validity of these instrument was confirmed through expert review from specialists in Mathematics Education, Technology Education, and Research, Measurement, and Evaluation. Construct validity for the SGMS was established using factor analysis. Reliability was determined using Cronbach's alpha for SGMS (0.80). Descriptive statistics, including mean and standard deviation, were used to answer the research questions, while inferential statistics, specifically the t-test at a 0.05 level of significance, were used to test the hypotheses. Data analysis was carried out using SPSS version 24.

# **RESULTS AND DISCUSSION**

Table 1

**Research question one:** determine the pre-test and post-test achievement mean scores of students in Geometry in the experimental and control groups.

Experimental and Control Groups											
Group		Pre-test		Post-test							
	Ν	Mean	SD	Mean	SD	$ar{x}$ gain	diff.				
Experimental	32	38.75	8.29	63.97	10.95	25.22					
							21.16				
Control	32	35.91	7.92	39.97	11.13	4.06					

Pre-test and post-test Achievement Mean Scores of Students in Geometry in the

Table 1 shows the pre-test and post-test achievement mean scores of students in Geometry in the experimental and control groups. From the result, the post-test mean score ( $\bar{x} = 63.97$ , SD = 10.95) is higher than the pre-test mean score ( $\bar{x} = 38.75$ , SD = 8.29) with a mean gain of 25.22, indicating that there was an improvement in the achievement of students after treatment. Also, for the control group, the pre-test means achievement score ( $\bar{x} = 35.91$ , SD = 7.92) was lower than the post-test mean score ( $\bar{x} = 39.97$ , SD = 11.13). The findings revealed that students in the experimental group had a higher achievement mean score (63.97) after treatment using CAI than those in the control group (39.97) who were not given treatment with a mean difference of 21.16. This implies that students in the experimental group had a higher achievement mean score compared to the students in the control group.

**Research Question two:** What are the pre-test and post-test achievement mean scores of male and female students in the experimental group?

Table 2													
Achievement Mean Scores of Male and Female Students in the Experimental Group													
Group	Gender		Pre-test		Post-test								
		Ν	Mean	SD	Mean	SD	<i>x</i> gain	diff.					
	Male	20	38.55	8.67	65.10	11.13	26.55						
Experimental								3.55					
	Female	12	39.08	7.97	62.08	10.87	23						

Table 2 shows the Pre-test and Post-test achievement mean scores of male and female students taught mathematics using CAI. From the result, the post-test male students' achievement mean score ( $\bar{x} = 65.10$ , SD = 11.13) is higher than the pre-test achievement mean score ( $\bar{x} = 38.55$ , SD = 8.67) with a mean gain of 26.55. For the female students, the pre-test achievement mean score was 39.08, and the post-test mean score of 62.08 with standard deviations of 7.97 and 10.87 respectively. Indicating that there was an increase in the achievement mean score of students after treatment with male students having a higher achievement. This implies that male students had a higher achievement in Geometry when taught using CAI.

### DISCUSSION

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### Achievements of students in Geometry in the experimental and control groups.

Computer assisted instruction was found to be effective in improving the achievement of college of education students in Geometry in Sokoto state as indicated in the results that there is a significant difference between the post-test achievement of students in the experimental and control groups. The results indicated that majority of students in the experimental group had a higher motivation mean score towards Geometry in the Post-test as against the control group where majority of the students still had lower motivation mean score towards Geometry at the post-test. This finding aligns with previous research by Mohammed and Yarinchi (2013), Usman and Madudili (2020), Ntib and Orim (2017), Laleye (2019), and Ramani and Patadia (2012). These studies collectively suggest that CAI can enhance student achievement and motivation in mathematics-related subjects. The results also collaborate with studies by Akinsola and Ifamuyiwa (2008) and Bello and Yusuf (2020), which demonstrated that CAI facilitates understanding by breaking down complex concepts and reducing cognitive overload. Geometry, which often requires spatial reasoning and visualization, benefits greatly from the interactive features of CAI, such as visual aids and step-by-step problem-solving. These findings highlight the transformative potential of CAI in improving student performance in challenging subjects.

### Achievements of students in Geometry before and after the treatment based on gender

The results revealed that there no significant difference between the post-test achievement mean scores of male and female students taught Geometry using CAI and taught using traditional lecture method in colleges of education, Sokoto State. This finding is consistent with that of Danjuma (2018), Jackson (2023), and Lubienski and Ganley (2017), who reported no significant gender differences in Mathematics achievement. However, it disagrees with Okpe, Ezugorie, and Aneke (2022), Ogunleye and Adeyemi (2016) and Allahnana (2018), who found that males achieve higher than females in Mathematics. These conflicting results highlight the ongoing debate and complexity surrounding gender differences in educational outcomes, suggesting that further research is needed to explore these dynamics in different contexts and populations.

The integration of CAI in teaching Mathematics demonstrated its effectiveness in improving both achievement among students. By addressing gender-specific needs and preferences, CAI creates an inclusive learning environment that enhances academic performance. These findings highlight the transformative potential of CAI and call for further refinement of digital learning platforms to maximize their impact on diverse learner groups.

#### RECOMMENDATION

Based on the significant findings of this study, it was recommended that educational institutions, particularly Colleges of Education, incorporate Computer-Assisted Instruction (CAI) into their Mathematics curriculum, supported by comprehensive teacher training and professional development. Sufficient resources should be allocated for the necessary technological infrastructure and ongoing technical support.

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