



Effect of Computer-Assisted Instruction on Achievement in Geometry among NCE II Mathematics Students in Sokoto State Colleges of Education

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ABSTRACT

This study examines the effects of Computer-Assisted Instruction (CAI) on students' achievement in Geometry amongst NCE II Mathematics students in Sokoto State Colleges of Education. The study adopted a pretest posttest quasi experimental design with a population of 1, 469. Systematic random sampling was employed to select 76 students from this population, with 38 students each in the experimental and control groups as the sample size. The study used a special package of CAI called computer-based Mathematics learning software (COMBMATH LS) as an intervention to simplify the teaching and learning of Geometry through computer drills and practice, simulation and games. Geometry achievement test (GAT) was used as the instrument of data collection for the study. The results revealed that there was a significant difference between the post-test achievement of students in the control group and the experimental group. The results of the study may also be helpful to the Mathematics teachers who will see the need to adopt CAI make learning concrete and so as to improve their students' Mathematics achievement.

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INTRODUCTION

Achievement refers to the extent to which a learner benefits from instruction, encompassing all behavioral changes resulting from various learning experiences. In Mathematics, achievement indicates the level of success or proficiency in specific areas, often measured by annual exam scores. Achievement tests assess knowledge in school subjects, showing how well students have mastered the material. High achievement in Mathematics is crucial for students' holistic development, especially in a world driven by science and technology. However, student achievement in Mathematics, particularly in geometry, trigonometry, and bearings, remains inadequate, as seen in the performance of students in Colleges of Education in Sokoto state. This raises concerns about the effectiveness of current teaching methods. Ntibi and Orim (2017) attribute

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.

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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 2 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.

Objectives of the Study

The objectives of the study will be to:

1. Ascertain the geometry achievement of College of Education students before and after treatment.
2. Find out the geometry achievement of male and female in the experimental and control groups.

Research Questions

The following research questions were used to guide the study:

1. What is the geometry achievement mean score of College of Education students before and after treatment?
2. What is the geometry achievement mean score of male and female in the experimental and control groups?

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

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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 (2022) states 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 post-test 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 II 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. The study adopts a true-experimental design, specifically a pretest-posttest experimental and control group design, involving the manipulation of variables with randomization to ensure equal selection chances. The population comprises all NCE II Mathematics students in Sokoto State, with Shehu Shagari College of Education identified as the sole institution offering the relevant courses. From this population, 76 students will be sampled using systematic random sampling, divided equally into experimental and control groups. Purposive sampling will select Shehu Shagari College, and simple random sampling will assign students to groups. The Students' Geometry Achievement Test (SGAT), with validity and reliability assessed through the Kuder-Richardson formula 20 (K-R-20) for the SGAT. Data collection will follow permissions from relevant authorities, involving pretests, a treatment phase with CAI for the experimental group and traditional lectures for the control group, and posttests. Data analysis will utilize descriptive statistics for research questions and independent samples t-tests for hypotheses testing at a 0.05 significance level.

RESULT AND DISCUSSION

Research Question One: What is the pre-test and post-test achievement mean scores of College of Education students in Mathematics in the experimental and the control groups?

Table 1: Pretest and Posttest Achievement Mean Scores of Students in Learning Mathematics in the Experimental and Control Groups

Group	N	Pre-test		Post-test		\bar{x}_{gain}	diff.
		Mean	SD	Mean	SD		
Experimental	38	36.47	9.33	65.74	11.33	29.27	16.56
Control	38	32.79	7.65	45.50	2.47	12.71	

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Table 1 showed the pre-test and post-test achievement mean score of students' in learning Mathematics in the experimental and control groups. From the result, the post-test mean score (\bar{x} = 65.74, SD = 11.33) is higher than the pre-test mean score (\bar{x} = 36.47, SD = 9.33) with a mean gain of 29.27, indicating that there was improvement in the achievement of students after treatment. Also, for the control group the mean achievement score was 45.50 and a standard deviation of 2.47 for the pretest. However, the achievement mean score of students in the control group for the posttest increased to 45.50 and a standard deviation of 2.47. The findings revealed that students in the

experimental group had a higher achievement mean score (65.74) after treatment using CAI than those in the control group (45.50) who were not given treatment with a mean difference of 16.56. Table 3 revealed that students in the experimental group performed better than the control group after treatment. 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 is the pre-test and post-test achievement mean scores of College of Education male and female students taught Mathematics using CAI methods?

Table 2: Pretest and Posttest Achievement Mean Scores of Male and Female Students in Learning Mathematics in the Experimental Group

Gender	N	Pre-test		Post-test		\bar{x} gain	diff.
		Mean	SD	Mean	SD		
Male	26	36.88	9.301	63.31	12.23	26.43	8.99
Female	12	35.58	9.737	71.00	6.92	35.42	

Table 2 showed 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} = 63.31, SD = 12.23) is higher than the pre-test achievement mean score (\bar{x} = 36.88, SD = 9.30) with a mean gain of 26.43. For the female students the pre-test achievement mean score was 35.58 and a post-test mean score of 71.00 with a standard deviation of 6.92. Indicating that there was an increase in the achievement mean score of students after treatment with female students having a higher achievement. This implies that female students had a higher achievement in Mathematics when taught using CAI.

DISCUSSION

The findings of this study reveal significant differences in the achievement mean scores of College of Education students in Mathematics when taught using Computer-Assisted Instruction (CAI) compared to traditional

lecture methods. The analysis of pre-test and post-test achievement mean scores in the experimental and control groups shows a notable improvement in the experimental group. The post-test mean score for the experimental group increased from 36.47 (SD = 9.33) to 65.74 (SD = 11.33), with a mean gain of 29.27. In contrast, the control group, which received traditional instruction, saw a smaller increase from 32.79 (SD = 7.65) to 45.50 (SD = 2.47), with a mean gain of 12.71. The substantial mean difference of 16.56 between the post-test scores of the experimental and control groups highlights the effectiveness of CAI in enhancing students' mathematical achievement. This suggests that CAI significantly improves students' understanding and performance in Mathematics compared to traditional lecture methods.

Similarly, the study further discovered that both male and female students in the experimental group demonstrated considerable improvements in their post-test scores. Male students' achievement mean scores increased

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from 36.88 (SD = 9.30) to 63.31 (SD = 12.23), resulting in a mean gain of 26.43. Female students exhibited an even greater improvement, with their scores rising from 35.58 (SD = 9.737) to 71.00 (SD = 6.92), leading to a mean gain of 35.42. These results indicate that while both genders benefited from CAI, female students achieved higher post-test scores and experienced a greater increase in achievement compared to male students. This implies that CAI is particularly effective for female students, enhancing their mathematical performance more significantly.

The study demonstrates that CAI is a powerful tool for improving students' achievement in Mathematics, with particularly strong effects observed among female students. These findings support the integration of CAI into the curriculum to enhance educational outcomes and close gender gaps in mathematical achievement. The results underscore the potential of CAI to provide an engaging and effective learning environment, fostering better understanding and performance in mathematical subjects for all students.

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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