

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

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Abstract

This study examined the impact of Computer-Assisted Instruction (CAI) on students' motivation at Colleges of Education in Sokoto State, Nigeria. The research aimed to compare the pre-test and post-test motivation and 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 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 of 0.80 were obtained for the motivation scale. 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. The findings revealed no significant differences in the pre-test motivation mean scores between the experimental and control groups. However, the post-test results indicated that students in the experimental group demonstrated higher motivation in mathematics compared to those in the control group, where motivation levels remained lower. Additionally, there was no statistically significant difference in post-test mean scores based on gender within the experimental group, suggesting that CAI was equally effective for both male and female students. The study concluded that Computer-Assisted Instruction is an effective teaching approach for enhancing students' motivation 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

Mathematics is a science subject that involves manipulating figures, and numbers for effective decision-making and promotion of investigation and development. It is a prerequisite subject for courses offered in higher institutions of learning such as medicine, pharmacy, engineering, nursing, architecture, accounting, business management, banking and finance, information communication, and technology among others. Mathematics has applications in all aspects of economic and social life. It is an indispensable ingredient in creating new knowledge. The importance of Mathematics cannot be overemphasized, without Mathematics, there will be no science, and without science, there will be no technology, and without technology, there will be no modern society.

In Nigeria, Mathematics is a core subject in the curriculum at all levels of education especially in primary and secondary schools. Mathematics is so important that the Nigerian education system made it compulsory at the primary and secondary levels as stated in the National Policy of Education (2013). The National Policy of Education also made it mandatory for students to pass Mathematics at the end of senior secondary school. It is also a benchmark for admission into any course in a Nigerian university. It is compulsory to pass mathematics at least at a credit level. It is also essential that a credit pass is needed for all students of colleges of education offering Science, Commercial, Technical, and Social Science courses. It is part of the admission requirements by the National Commission for Colleges of Education (NCCE) for any student to read those courses of study. Mathematics course in the curriculum (Minimum Standard) of the National Commission for Colleges of Education (NCCE) comprises the concepts of numerical concepts and operations, algebraic processes, trigonometry, and geometry among others.

Motivation is the driving power that has become active. It is also said that motivation is the psychological aspect of the discussion that many details on behavior, with different individuals and at the same individual from time to time. Motivation is the process of inducing, inspiring, and energizing people to work willingly with zeal, initiative, confidence, satisfaction, and an integrated manner to achieve desired goals. It is a moral boosting of activity. It can also be seen as an act of stimulating someone or oneself to get a desired course of action or to push the right button to get a desired reaction. Motivation can be said to be a response to an action that is the goal. The motivation arises from within humans, but its appearance depends on the presence of other elements, such as its purpose, and this purpose concerns the matter of necessity. Humans live with different needs, namely the need to do something for something, the need for others, the need to achieve results, and the need to address the difficulty. Therefore, the motivation for learning will appear when learning is accompanied by a sense of delight, wonder, and interest in the study. With high motivation, students will be able to carry out their work diligently and persistently strive to achieve learning goals. Based on the opinions of the experts, then concluded that motivation for learning is the effort that a person makes because of the learning objectives that concern a matter of necessity; namely, the need to do something to learn, the need to achieve results after learning, and the need to overcome learning difficulties. Learning outcomes are influenced by intrinsic and extrinsic factors. One of the intrinsic factors is motivation. Piaget believed that motivation is the best to gain students' achievement.

Poor motivation in Mathematics often leads to low achievement. For students to be motivated to learn in any discipline, they must participate in activities that are personally meaningful and worthwhile. In the case of traditional methods in Mathematics teaching, it is obvious that Mathematics concepts are usually being taught by using abstract examples and words. This way of teaching, which needs highly cognitive skills to assimilate the taught subjects, creates high pressure on the students leading them to lose their self-confidence and lower their use of capacities, hence achieving poorly due to low motivation.

The importance of studying mathematics to man and society cannot be overemphasized. The knowledge and skills in mathematic processes of counting, subtracting, multiplication, division, weighing, selling, and buying have a direct bearing on the daily life of almost every individual in society. These skills are always applied in occupations like accounting, banking, tailoring, carpentry, taxation, insurance, survey and telecommunication among others that contribute to the generation of income and revenue needed for the development of every nation. In this regard, the study of Mathematics is made compulsory for all students from primary to tertiary levels. The subject enrolment is only second to English language in Nigerian secondary schools. And there have been a lot of efforts and concerns from numerous stakeholders such as the government, researchers, non-governmental organizations, the National Commission for Colleges of Education (NCCE), the Mathematics Association of Nigeria (MAN), the Science Teachers Association of Nigeria (STAN) who sponsored and organized workshops, symposium, conferences, in-service training, training and re-training programs for mathematic teachers to improve the teaching of the subject.

Computer-Assisted Instruction (CAI) is defined as programmed instruction designed to enhance learners' comprehension and understanding of content through the use of computer and telecommunication devices. Findings from research have revealed that CAI is a sure means of improving spatial skills in children and adults, but Nigerian teachers rarely use it for their instruction (Jackson, 2023). Computer-Assisted Instruction can also be referred to as a self-learning technique usually offline/online, involving the interaction of students with programmed instructional materials (Ntib & Orim, 2017).

Despite the relevance of ICT in education, teachers are still reluctant, ineffective, and unproductive in using CAI facilities to improve students' motivation and achievement especially in Mathematics. Colleges of Education trainers in developing countries like Nigeria still have a long way to go before will be able to take advantage of the opportunity provided by the 21st-century technology. For instance, Adomi (2010) has reported that 75% of teachers in Nigerian secondary schools have little or no experience and expertise regarding ICT education. The teachers' poor ICT skills account for their use of traditional teaching methods such as the lecture method. This approach will definitely promote the learning of mathematics in the College of Education.

STATEMENT OF THE PROBLEM

Despite these efforts and benefits accruing from the study of Mathematics, research findings have revealed a continuing devastating performance in the subject at all levels (Martins, 2018; Yusuf, 2020 & John, 2021). Similarly, the 2023 summary of results of students offering Mathematics in Shehu Shagari College of Education, Sokoto revealed the devastating nature of

the failure of students out of 56 students that sat for the Mathematics Examinations from various combinations only seven passed the course the remaining 49 students either fail or withdrawn from the course. The poor achievement in mathematics has been attributed to approaches, teaching materials, and methods employed in teaching and learning the subject. Some studies suggest that the instructional approach is the major contributor to the poor achievement in the subject (Abugu, 2017). A report from Shehu Shagari College of Education (SSCOE) Shows that students of mathematics perform poorly (SSCOE, 2019/2020 and 2021). The failure is attributed to inadequate knowledge of the subject matter, the inability of the candidates to draw and label diagrams, construct graphs as well as solve simple calculations in mathematical manipulations.

Consequently, Government, Mathematics Departments, Schools, and College Administrators are worried about graduating mathematics teachers with poor teaching approach, inadequate preparation for examination by students and teachers not using appropriate instructional material in the lesson which again leads to students' poor motivation and achievement in Mathematics at all levels. This may lead to the collapse of such an important branch of Knowledge consequently if students fail mathematics this will affect the number of individuals that will have an interest in professional courses in the universities. Therefore, this research wants to verify if computer-assisted instructional approach which makes teaching and learning students-centred will improve students' motivation in mathematics

AIM AND OBJECTIVES OF THE STUDY

The aim of this study is to examine the effect of Computer Assisted Instruction on Colleges of Education Students' motivation in Mathematics in Sokoto State Nigeria. To achieve this, the study will specifically:

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

RESEARCH QUESTIONS

The following research questions were answered:

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

Empirically, all of studies have shown that the use of instructional material in teaching and learning have improved students achievements level in virtually all fields of study Rogayan, Padrique and Costales (2021) investigated the effects of Computer-Assisted Instruction (CAI) on motivation and academic performance in social studies among students in a public secondary school in Zambales, Findings revealed that students motivational level of both the experimental and control group improved at the posttest level. Similarly, (Padrique & Costales) concluded that there was a significant difference in the motivation and academic performance of students after the application of the CAI. Palculict (2022), mentioned that computer-based interventions have a

significant impact on student learning. Further research is recommended to explore the impact across grade levels. Omar, Ibahim, Akmanisah and Kadir (2023) investigated the effectiveness of computerized simulation with electronic circuits on students' motivation, achievement and cognitive load in Malaysia. It was concluded that electronic circuit simulation has a positive effect on students' motivation, achievement and cognitive load.

Furthermore, Hassan, Abdullah and Ismail (2023) examined rethinking strategy on developing students' levels of geometric thinking in Sokoto state, Nigeria. Findings of the study revealed that the experimental group performed better than the control group. This indicated the effectiveness of utilising instructional material like CAI which improve students' achievement and motivational effects that leads to high performance

The reviewed study examined rethinking strategy on developing students' levels of geometric thinking in Sokoto 2023, interviews for the mathematics teachers and a van Hiele test for geometric thinking were used to collect data, descriptive statistics and Mann-Whitney U test were used for the analysis, while the present study examined the effects of CAI on NCE II College of Education students' motivation and achievement in Geometry in Sokoto in 2024, used achievement test and motivation scale to collect data and used True-experimental design and descriptive statistics and t-test for data analysis. These variations formed the gaps that the present research intends to fill.

Isah and Hamza (2023) examined the influence of play way method of teaching among full time and part time NCE students' attitude in Mathematics in Shehu Shagari College of Education Sokoto State, Nigeria. It was recommended that play way method of teaching mathematics should be encouraged by stake holders in the education sectors. Because it improved student's motivation and achievement level.

METHOD AND PROCEDURE

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

Research question one: What are the pre-test and post-test motivation mean scores of students in Geometry in the experimental and control groups?

Table 1

Pre-test and post-test Motivation Mean Scores of Students in the Experimental and Control Groups

Group	Pre-test		Post-test		\bar{x} gain	diff.
	N	Mean	SD	Mean	SD	
Experimental	32	38.34	5.98	62.50	11.41	24.16
						20.91
Control	32	37.03	6.11	40.28	8.70	3.25

Table 1 shows the Pre-test and Post-test motivation mean scores of the students in Geometry when taught using CAI and those taught using the traditional lecture methods. From the result, the post-test motivation mean score ($\bar{x} = 62.50$, $SD = 11.41$) is higher than the pre-test motivation mean score ($\bar{x} = 38.34$, $SD = 5.98$) with a mean gain of 24.16, indicating that there was an increase in the motivation mean score of students after treatment. Also, for the control group the mean motivation score was 37.03 and a standard deviation of 6.11 for the pretest. The motivation mean score of students in the control group for the posttest increased to 40.28; with a standard deviation of 8.70. It further reveals that students in the experimental group had a higher motivation mean score after treatment using CAI than those in the control group who were not given treatment with a mean difference of 20.91. This implies that students in the experimental group had higher motivation towards learning Geometry compared to the students in the control group.

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

Table 2

Pre-test and post-test Motivation Mean Scores of Male and Female Students in the Experimental Group

Group	Gender	Pre-test			Post-test		\bar{x} gain	diff.
		N	Mean	SD	Mean	SD		
Experimental	Male	20	39.20	4.360	62.45	10.37 4	23.25	2.41
	Female	12	36.92	8.028	62.58	13.44 0	25.66	

Table 2 shows the Pre-test and Post-test motivation mean scores of male and female students taught mathematics using CAI. From the result, the post-test male student's motivation mean score ($\bar{x} = 62.45$, $SD = 10.37$) is higher than the pre-test motivation mean score ($\bar{x} = 39.20$, $SD = 4.36$) with a mean gain of 23.25. For the female students, the pre-test motivation mean score was 36.92, and the post-test mean score was 62.58, with a standard deviation of 8.03 and 13.44, respectively. This indicates that there was an increase in the motivation mean score of students after treatment, with female students having a slightly higher motivation mean score. This implies that female students had almost the same motivation towards Geometry when taught using CAI.

DISCUSSION

Motivation of students in Geometry in the experimental and control groups.

The analysis revealed a significant difference in motivation mean scores between the experimental and control groups, favouring the experimental group. This result underscores the efficacy of CAI in fostering motivation, as it provides interactive and personalized learning experiences that engage students. These findings support studies by Yusuf and Afolabi (2010) and Olusi (2008), demonstrating that CAI increases students' interest and engagement by providing immediate feedback and adaptable content. The interactive nature of CAI offers students opportunities to take control of their learning processes, leading to improved engagement and a more enjoyable learning experience. This reinforces the value of integrating digital tools into traditional classroom settings to enhance student motivation.

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

The findings indicated no significant gender differences in the experimental group, where female and male students have almost the same motivation scores. This suggests that CAI effectively mitigates gender disparities in motivation. The equitable learning platform provided by CAI minimized gender disparities in the experimental group, as Okeke and Adedoyin (2013) supported. These results emphasize the potential of CAI to create inclusive learning environments that accommodate diverse learner preferences and needs. The finding contradicts with research by

Agwagah (2008) and Eze and Egbo (2015), which highlighted the tendency of female learners to excel in structured, interactive environments than males. The interactive features of CAI, such as immediate feedback and engaging content, may have contributed to these results. However, the findings also suggest a need to incorporate additional features in CAI platforms, such as gamified or competitive elements, to better engage both female and male students. This understanding can further enhance the motivation of students in Geometry.

Recommendations

Based on the findings, the study makes the following recommendations:

1. Colleges of Education should integrate CAI into their teaching strategies to enhance students' motivation in Mathematics.
2. Teachers should be trained in the effective use of CAI tools to maximize their instructional benefits.
3. Educational institutions should invest in technological infrastructure, including computer laboratories and digital learning resources, to support CAI implementation.
4. Studies should be carried out to explore the effectiveness of CAI in different educational levels and subject areas to generalize its applicability.

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