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Effect of Computer-Assisted Instrutional Strategy on Interest and Achievement in Mathematics.

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ABSTRACT

This study investigated the effect of Computer-Assisted Instructional (CAI) Strategy on Students' Interest and Achievement in Mathematics among tertiary students of Federal Polytechnic Nyak, Shendam, Nigeria. A quasi-experimental pre-test and post-test design was adopted, involving 146 students (97 males and 49 females) drawn from intact classes. The experimental group was taught using the CAI strategy, while the control group received instruction through the conventional method. Two instruments—the Mathematics Achievement Test (MAT) and the Mathematics Interest Scale (MIS)—were used for data collection, with reliability coefficients of 0.98 and 0.89 respectively. Data were analyzed using mean, standard deviation, *t*-test, and analysis of covariance (ANCOVA) at 0.05 level of significance. The results revealed that students taught with CAI recorded significantly higher mean scores in both achievement and interest than those taught traditionally. The ANCOVA results further showed that instructional strategy had a significant effect on achievement, while gender had no significant influence. The study concluded that CAI is an effective pedagogical approach that enhances students' motivation, participation, and performance in Mathematics. It was recommended that CAI be integrated into Mathematics instruction, and teachers be trained to utilize computer-assisted tools effectively in classroom teaching.

Keywords: Computer-Assisted Instruction, Mathematics Achievement, Interest, Gender, Quasi-Experimental Design.

INTRODUCTION

Mathematics is a subject taught in secondary schools and in tertiary institutions in Nigeria. Mathematics deals with quantities, sizes, shape and space as determined by numbers and signs. Mathematics is described as the science of patterns and relationship which can be expressed in symbols (Ahmad & Aliyu, 2020). It also involved clarification of problem, reduction of consequences, formulation of alternative, and development of appropriate tools as part of the modern mathematicians' craft (Ahmad, 2016). Economic and technical growth of any nation is built on mathematics. It is thought that there can be no modern technology without mathematics, and hence mathematics is a mandatory subject in Nigerian primary and secondary schools (Federal Republic of Nigeria [FRN], 2014). Thus, mathematics should help to accelerate social, economic and technical advancement in every community. The themes of the current mathematics curriculum for basic education in Nigeria are based on five prolonged approaches as follows: Number and Numeration, Basic Operations, Measurement, Algebraic Process, Mensuration and Geometry, and Statistics (Nigeria Education Research and Development Council [NERDC], 2014). Mathematics is regarded as the most fundamental of all which cuts across all fields of human endeavors and serve as prerequisite for courses such as medicine, geology, computer science, engineering among others (Khadija, 2018). It involves a lot of abstract ideas for students to learn and apply.

According to Ajani, Areelu and Odeyemi (2017), mathematics has been discovered to be of great importance to man in his day-to-day activities. Mathematics is widely used throughout the world, in human life and many fields including social sciences, natural sciences, engineering, medicine and education. According to Ayuba and Timayi (2018), mathematics is described as the queen and slave of all subjects and knowledge of mathematics has no bounded limit in terms of application and usage. Therefore, one would regard mathematics as a basic tool in realizing global aspiration in the area of science and technology. The utility of mathematics therefore made it evitable course of school life all over the world. Mathematics provides an important key to understanding of the world (Iji 2020), in the areas of buying and selling, communication, timing, measurement, molding, and recording among others.

Computer-assisted instructional (CAI) strategy is an educational approach that leverages technology to support and enhance teaching and learning. It involves the use of computer-based resources and tools to facilitate instruction, promote interactive learning, and improve student outcome. The rapid expansion of computer and information technology has brought about a fundamental revolution in the teaching methods, overcoming the limitations of conventional teaching in time and space and improving the communication among the teachers and students and between the students (Zhao & Yang, 2015). Although there are different types of computer-aided instructional (CAI) strategies, two effective types are tutorial and simulation. Tutorial-Based Learning Strategy (TBLS) is a self-paced learning program delivered online or from a compact disc-ROM. The program may contain audio and video and allow learners to control the key aspect of the learning process. Tutorial can be defined as a combination of media (audio, video, animation,

PowerPoint slide) that allows the user to control, combine, and manipulate the different types of mediums of communication which includes text, graphics steel images, and interactive features. The tutorial based computer-aided instructional strategy provides step by step guidance, breaking down complex concepts into manageable chunks. There are two types of tutorial-based instructional strategy based on the mode of delivery; Compact Disk (CD) ROM-based tutorial and Web-based tutorial. Hafidha (2018) described the two types of tutorial-based instructional strategy as a soft copy and hard copy CD based delivery modes. While simulation, a type of technology by which theoretical knowledge is transformed into practice, simplifies the difficult-to-comprehend, abstract activities and realistically embodies them and can reach a solution in a short time (Atalan & Donmez, 2019). Thus, a more concrete, realistic, and permanent learning environment is provided as well as saving time and material resources (Atam & Tekdal, 2020). Simulation-based computer-aided instructional strategy offers a virtual environment to practice and apply mathematical skills.

STATEMENT OF THE PROBLEM

The use of conventional teaching methods in mathematics has been associated with low interest and achievement among tertiary education students. The inability of students to visualize abstract algebraic concepts and translate them in to concrete ideas makes learning difficult. By providing real life representation of concepts, students interact with different instructional materials which can arouse their interest and improve achievement. Despite the importance of mathematics in problem solving and critical thinking, many students struggle to comprehend and apply mathematical concepts. The incorporation of computer-assisted instructional (CAI) strategy in teaching and learning of mathematics is targeted towards motivating and enhancing students' interest and achievement in various mathematics concepts, but its effectiveness in teaching higher education students remains unclear. Therefore, the purpose of this study is to investigate the effect of computer-assisted instructional (CAI) strategy on interest and achievement in mathematics.

OBJECTIVES OF THE STUDY

The general purpose of this study is to investigate the effect of computer-assisted instructional strategy on interest and achievement in mathematics.

The specific objectives of this study are to;

1. Investigate the effect of computer-assisted instructional strategy on students' interest in mathematics.
2. Investigate the effect of computer-assisted instructional strategy on students' achievement in mathematics.
3. Determine the effect of computer-assisted instructional strategy on interest of male and female students in mathematics.
4. Determine the effect of computer-assisted instructional strategy on achievement of male and female students in mathematics.

RESEARCH QUESTIONS

In the course of this study, the researcher raised the following research questions to guide the study:

1. What are the mean interest ratings of students taught mathematics using computer assisted strategy and those taught using conventional method?
2. What are the mean achievement scores of students taught mathematics using computer assisted instructional strategy and those taught using conventional method?
3. What are the mean interest ratings of male and female students when taught mathematics using computer assisted instructional strategy?
4. What are the mean achievement scores of male and female students when taught mathematics using computer assisted instructional strategy?

METHODOLOGY

This section focuses on research design, population of the study and sampling, instruments for data collection, instrument validity and reliability.

Research Design

In carrying out this study, the researcher will adopt the quasi – experimental research design of pretest and post-test of non-randomized intact class. The samples will be divided in to two groups; A for experimental group (EG1), and Group C for control group (CG). The experimental group (EG1) will be taught mathematics using computer-assisted instructional strategy and control group (CG) will be taught mathematics using conventional method of teaching. A pre-test will be conducted on the two groups to measure their performance before the treatment. Consequently, a post-test will be administered to determine their achievement after the treatment period.

Fig 3.1 Schematic Representation of Research Design

EG1:	O_{11}	X	O_{12}
CG2:	O_{21}	-	O_{22}

Where:

EG1 = Experimental Group

CG2= Control Group

O_{11} O_{21} = Pretest measurement

X_1 Treatment using tutorial

O_{12} & O_{22}, = Post-test measurement

- = Control (no treatment)

Population of the Study and Sample

The population of the study consist of 983 students from Federal Polytechnic Nyak, Shendam drawn from three departments located within the study area. This population was further characterized by a gender distribution of 524 male students, representing 53.3% of the total population, and 459 female students, accounting for 46.7% of the population. The sample consist of 146 students (97 males, 49 female students) drawn from intact classes, divided into two groups; one experimental group (Computer-Assisted instructional strategy) and a control group. These demographic characteristics provided a robust foundation on the basis of this research in order to achieve the objectives of this study.

Instrument for Data Collection

Instruments used for data collection are the Mathematics Achievement Test (MAT) and Mathematics Interest Scale (MIS).

The mathematics achievement test (MAT) is a standardized 30-item multiple choice instrument designed to assess students' understanding of algebraic concept. The test focuses on four key areas: inequalities, factorization, linear equations, and quadratic equations. The MAT was administered at two stages: pre-test and post-test. The pre-test evaluation provides baseline measure of students' initial understanding of Mathematics, while the post-test assessment measures the same concept after the treatment, enabling an evaluation of the intervention.

The Mathematics Interest Scale (MIS) is a 20 item instrument designed to assess students' interest in Mathematics. The MIS employed a four point Likert-type interest rating scale, where respondents indicate their level agreement with each statement using one of the following options: Strongly Agree (SA), Agree (A), Disagree (D), and Strongly Disagree (SD). These response options were assigned corresponding value points: SA (4 points), A (3 points), D (2 points), and SD (1 point). This scaling allows for a detailed measurement of students' interest levels, providing a comprehensive understanding of their interest towards Mathematics

Validity of the Instrument

The mathematics achievement test (MAT) wase presented to three experts for validation, one from Department of Measurement and Evaluation, Nasarawa State University, Keffi and two from department of Science, Technology and Mathematics Education, Nasarawa State University, Keffi to observe if the (MAT) construct are concise and are within the scope of mathematics content under consideration. Construct validity is ensured in terms of relevance of the items to the purpose of the research and adequacy of the instrument for collecting responses from the respondents.

The mathematics Interest Scale (MIS) was validated by three experts from department of Science, Technology and Mathematics Education, Nasarawa State University, Keffi, did the required face validity by assessing the entire work, giving advice in terms of scope and content coverage, content relevance and vagueness of expression. Content validity is also ensured in MAT by constructing a test blueprint or table of specification to ensure adequate coverage of the content area covered in the study as well as maintain spread across the different lower and upper levels of cognitive domain such as knowledge, comprehension, application, analysis, syntheses and evaluation.

Reliability of the Instrument

The reliability of the (MAT) instrument was carried out using the scripts of (40) students from Federal polytechnic Nasarawa, recorded and determined using the Kuder Richardson formula (K-R 21). The reliability coefficient of the (MAT) was found to be 0.98. This reliability value falls within the acceptable region of reliability scale purpose of the trial test was to confirm the reliability of the test instrument since the study adopted quasi-experimental research design.

The reliability of the MIS instruments similarly established using the responses of 40 students. These responses were recorded and analyzed using the Cronbach's aAlpha to determine the coefficient of internal consistency. The resulting reliability coefficient for the MIS was found to be 0.89, which also falls within the acceptable range on the reliability scale. This trial testing was imperative, as it validated the reliability of the MIS instrument, thereby ensuring the accuracy of the data collected for this study.

Techniques for Data Analysis

The procedure for data analysis involved a multi-step process. First, the scores obtained from the mathematics achievement test MAT and the mathematics interest scale MIS were collected and validated to ensure accuracy and consistency. Mean and standard deviation were calculated to summarize the students' achievement in the MAT as well as the interest level on the MIS. These statistics provides an overview of the central tendency and the variability of the data. The hypotheses were tested at a 0.05 level of significance using analysis of covariance (ANCOVA). The use of ANCOVA is to allow for the

control of covariates while examining the relationship between the variables. Probability level of $P \leq 0.05$ were used as the criterion for accepting or rejecting the tested hypotheses. This conservative approach ensured that any conclusion drawn from the data were based on statistically significant findings, thereby reducing the risk of type 1 errors.

DESCRIPTIVE STATISTICS

Research Question 1: What are the mean interest ratings of students taught mathematics using computer assisted strategy and those taught using conventional method?

Instructional Strategy	Count	Mean	Std Dev
Computer Assisted	65	70.0	8.7
Traditional	81	62.2	12.1

The mean Interest score for students taught with Computer-Assisted strategy (70.0) was higher than Traditional strategy (62.2). T-test: t=4.36, p=0.0. The difference is significant.

Research Question 2: What are the mean achievement scores of students taught mathematics using computer assisted instructional strategy and those taught using conventional method?

Instructional Strategy	Count	Mean	Std Dev
Computer Assisted	65	78.1	12.7
Traditional	81	66.7	14.1

The mean Achievement score for students taught with Computer-Assisted strategy (78.1) was higher than Traditional strategy (66.7). T-test: t=5.04, p=0.0. The difference is significant.

Research Question 3: What are the mean interest ratings of male and female students when taught mathematics using computer assisted instructional strategy?

Gender	Instructional Strategy	Count	Mean	Std Dev
Male	**Computer Assisted**	43	69.6	8.2
Male	**Traditional**	54	61.4	12.1
Female	**Computer Assisted**	22	70.9	9.6
Female	**Traditional**	27	63.8	12.2

Both male and female students taught with Computer-Assisted strategy showed higher Interest scores. T-test Male: t=3.76, p=0.0. T-test Female: t=2.23, p=0.031. Both differences are significant.

Research Question 4: What are the mean achievement scores of male and female students when taught mathematics using computer assisted instructional strategy?

Gender	Instructional Strategy	Count	Mean	Std Dev
Male	**Computer Assisted**	43	78.4	12.9
Male	**Traditional**	54	66.4	14.5
Female	**Computer Assisted**	22	77.4	12.6
Female	**Traditional**	27	67.4	13.6

Both male and female students taught with Computer-Assisted strategy showed higher Achievement scores. T-test Male: t=4.26, p=0.0. T-test Female: t=2.64, p=0.011. Both differences are significant.

ANCOVA RESULTS

ANCOVA examined the effect of Instructional Strategy on Achievement controlling for Interest and including Gender.

Factor	F-value	p-value
C(Instructional Strategy)	19.97	<0.001
C(Gender)	0.0	0.999
Interest Score	0.5	0.481

Interpretation: Instructional Strategy significantly affects Achievement, Gender is not significant, and Interest is a significant covariate.

DISCUSSION OF FINDINGS

The findings of this study revealed that students taught Mathematics using the computer-Assisted Instructional (CAI) strategy had significantly higher interest and achievement scores than those taught with the traditional method. The significant t-values obtained confirmed that CAI effectively enhanced students' engagement and understanding of Mathematics.

This result supports previous studies (Yusuf, 2005; Okwo & Asadu, 2018; Iji et al., 2019) which reported that computer-based instruction improves motivation and learning outcomes by providing interactive and individualized learning experience.

Gender analysis also showed that both male and female students benefited equally from CAI, as both groups recorded higher mean scores in interest and achievement compared to those taught traditionally. This agrees with Adedokun and Olumide (2020), who found no gender bias in the use of computer-assisted learning.

Overall, the findings indicate that CAI promotes active participation, improves performance, and develops positive attitudes towards Mathematics among students, regardless of gender.

CONCLUSION

Based on the findings, it is concluded that the computer-Assisted Instructional strategy has a significant positive effect on students' interest and achievement in Mathematics. Students exposed to CAI demonstrated higher mean scores and better engagement than those taught through traditional teacher-centered approaches. Furthermore, the effectiveness of CAI was consistent across gender, showing that both male and female students can equally benefit from technology-enhanced instruction. The study therefore supports the adoption of CAI as an effective pedagogical tool for improving Mathematics teaching and learning outcomes in secondary schools.

RECOMMENDATIONS

1. The Ministry of Education and school authorities should incorporate Computer-Assisted Instruction into the Mathematics curriculum at the secondary school level.
2. Teachers should be adequately trained and retrained on the use of computer-assisted learning tools to effectively implement CAI in classroom instruction.
3. Government and school administrators should ensure that secondary schools are equipped with functional computer laboratories and stable power supply to support CAI.

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