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COMPUTER SIMULATIONS AS A TOOL FOR ENHANCING ALGEBRA RETENTION IN JUNIOR SECONDARY SCHOOLS: AN ANALYSIS

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ABSTRACT

Over the years, Nigerian students have consistently performed poorly in mathematics. The West African Examination Council (WAEC) reports a steady decline in math performance among examinees outside the school system. Research papers and Chief Examiners' Reports have highlighted that students struggle with certain math tasks, indicating general deficiencies in mathematical skills. This research aimed to investigate the impact of computer simulation on students' retention of algebraic mathematics. The study was guided by two research questions and two hypotheses. A quasi-experimental design was employed, involving fifty-four students from two different schools. Each school had two junior secondary streams, with experimental and control groups assigned randomly. The lessons were conducted by the students' regular math teachers, who also served as research assistants. The Algebra Achievement Test (AAT) was used to measure retention, with a reliability coefficient 0.98. Data analysis was performed using SPSS software, with a significance level set at 0.05. The results revealed no statistically significant differences in the mean retention scores of male and female students who received algebra instruction through computer simulation.

Keywords: Algebraic Mathematics, Retention, Computer Simulation, Gender, Quasi-Experimental Design

INTRODUCTION

Mathematics, the study of patterns, structures, change, and space, plays a crucial role in daily life and education. It encompasses the study of numbers and figures, equipping children with essential problem-solving skills applicable to everyday challenges. In Nigeria, the secondary mathematics curriculum is built on fundamental topics such as algebra numbers and numeration. However, at the junior secondary school level, students' performance and retention in mathematics, particularly algebra, have remained consistently low (Egara, Okeke, & Nzeadibe, 2019). Onyeka and Arokoyu (2018) highlighted that less than half of the candidates passed mathematics at the credit level in Nigeria's Senior Secondary Certificate Examination from 2010 to 2015. This trend was further confirmed by the Chief Examiners' Reports from 2014 to 2018, which showed subpar performance in mathematics (WAEC, 2018).

A major factor contributing to this poor performance is the inadequate use of effective teaching strategies by teachers, often relying on traditional methods such as the talk and chalk technique (Okwonu et al., 2023). Retention, defined as the ability to recall information or behaviours, is crucial in mathematics, where solving new problems requires synthesizing new ideas and applying previously taught principles (Bichi, 2002; Okwonu et al., 2021). Effective teaching strategies significantly impact students' ability to retain and recall taught material (Ugwuanyi, 2009; Nneji, 2011). Effective instructional delivery, rather than rote memorization, enhances retention (Iji, 2012; Aderibigbe & Apanapudor, 2014a; Apanapudor et al., 2020).

Computer simulations have been identified as a powerful tool for enhancing student retention in mathematics. A computer simulation mimics a conceptual model of a system, facilitating drills and practice in an organized manner (Olaniyan & Salman, 2015). It helps students visualize abstract concepts, create mental models and integrate new knowledge with prior understanding (Jayantha, 2018; Akhigbe & Ogufere, 2019). Despite their advantages, computer simulations also have limitations, including time consumption and the need for proper mentoring (Heinich et al., 1999; Min, 2001).

The main purpose of this study was to investigate the impact of computer simulations on students' retention in mathematics, specifically algebra. The study aimed to:

i. Determine the effect of computer simulations on students' retention scores in algebra.
ii. Assess the differences in retention scores between male and female students taught using computer simulations.

Research Questions

i. What is the average retention score of students taught algebra using a computer simulation compared to those taught using traditional methods?
ii. What are the average retention scores of male and female students in algebra classes using computer simulations?

Hypotheses

At a significance level of 0.05, the following hypotheses were tested:

i. There is no significant difference in the mean retention scores of students taught algebra using computer simulations compared to those taught using traditional methods.
ii. There is no significant difference in the mean retention scores of male and female students in algebra taught via computer simulation.

MATERIALS AND METHODS

Study Design and Sample

A quasi-experimental design was used for this study, conducted in the Isoko North Local Government Area Education Zone in Delta State, Nigeria. The study sample included 54 students from two single-gender secondary schools, selected purposively due to their availability of electricity and computers. One class from each school was randomly assigned to either the experimental or control group. Data were collected using the Algebra Achievement

Test (AAT), a validated and reliable instrument with a Kuder Richardson Formula 20 (K-R 20) reliability score of 0.98.

Experimental Procedure and Data Analysis

The experimental group was taught using computer simulations, while the control group received traditional instruction. Mathematics teachers received training on using computer simulations to teach algebraic principles. Pre-testing with the AAT was conducted before the experiment, and post-test results were recorded after four weeks. Data were analyzed using mean, standard deviation, and analysis of covariance (ANCOVA) at the 0.05 significance level.

RESULT AND ANALYSIS

Research Question 1

Table 1: The mean retention scores of students taught algebra using a computer simulation versus those taught using traditional methods

Group	N	Retention Mean	SD
Experimental Group	62	73.15	11.39
Control Group	58	59.14	12.74
Total	120		
Mean Difference		14.01	

Hypothesis 1

Table 2: The analysis of covariance of students' mean retention scores in algebra subjected to both experimental and control groups

Source of Variation	Type III Sum of Squares	DF	Mean Sum of Squares	F Cal	Sig.	Partial Eta Squared
Corrected Model	9230.856a	4	2307.714	19.207	.000	.401
Intercept	3313.549	1	3313.549	27.578	.000	.193
Posttest	3231.656	1	3231.656	26.897	.000	.190
Gender	56.344	1	56.344	.469	.495	.004
Group	2990.156	1	2990.156	24.887	.000	.178
Group*Gender	21.084	1	21.084			
Error	13817.269	115	120.150			
Total	551725.000	120				
Corrected Total	23048.125	119				

Research Question 2

Table 3: The mean retention scores of male and female students in algebra taught using computer simulation

Group	N	Retention Mean	SD
Male	58	65.78	13.85
Female	62	66.94	14.07
Total	120		
Mean Difference		1.16	

Hypothesis 2

Gender is not a significant factor in students' retention in algebra, as indicated by F (1, 115) = .469, P = .495. Therefore, the null hypothesis was not rejected, indicating no significant difference in the mean retention scores of male and female students in algebra taught using computer simulation.

The results indicate that students taught using computer simulations had significantly higher mean retention scores compared to those taught using traditional methods. This aligns with previous studies by Olaniyan and Salman (2015), Olorukooba et al. (2016), and Olalekan and Oludipe (2016), who found that computer simulations improved student retention. Additionally, there was no significant difference in retention scores between male and female students, suggesting that computer simulations are equally effective for both genders.

CONCLUSION

This study demonstrates the effectiveness of computer simulations in enhancing students' retention of algebra concepts in junior secondary schools. By providing an interactive and visual learning experience, computer simulations help students better understand and retain abstract mathematical concepts. These findings suggest that incorporating computer simulations into the mathematics curriculum could improve student performance and retention in algebra, benefiting both male and female students.

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