
ASSESSING THE EFFECTIVENESS OF DEMONSTRATION METHOD ON STUDENTS' PERFORMANCE AND RETENTION IN ALGEBRA IN ARGUNGU EDUCATIONAL ZONE OF KEBBI STATE

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Abstract

The paper investigated the effect of the demonstration method on students' academic performance and retention in teaching algebra in the Argungu Educational Zone of Kebbi State, Nigeria. A quasi-experimental design was adopted, involving two groups: an experimental group that was taught using the demonstration method, and a control group that was taught using the conventional method. Two research objectives, two research questions, and two null hypotheses were formulated to guide the survey. The target population comprised all senior secondary school students in the Argungu Educational Zone of Kebbi State, totaling 3,576. A sample of 180 students was selected using convenience sampling technique. The instrument used for the study was the Algebra Performance and Retention Test (APRT), which was validated by experts from the Department of Science Education, Faculty of Education, Kebbi State University of Science and Technology, Aliero. The instrument was pilot-tested with 25 students, and the data obtained were analyzed using the Pearson Product Moment Correlation (PPMC), which yielded a reliability index of 0.83. The findings of the paper indicated that students taught using the demonstration method performed significantly better and demonstrated higher retention compared to those taught with the conventional method. The paper recommended the integration of the demonstration method into regular classroom instruction to enhance students' academic performance and retention, particularly in mathematics and algebra concepts.

Keywords: Demonstration method, academic performance, retention, algebra

Introduction

The issue of poor academic performance in Nigeria has raised significant concern among educators, parents, and society at large. Academic performance refers to the

measurable achievement of students following a specific instructional program. It reflects how students engage with their studies and complete tasks assigned by their teachers. According to Saba and Tarang (2011), performance is the visible demonstration of a person's understanding, skills, concepts, ideas, and knowledge, with grades serving as indicators of student performance. Therefore, it is crucial to manage students' academic performance effectively, taking into account the various factors that may positively or negatively influence it. The academic success of students in any given task has always been of great interest to educators, parents, and society (Saba, 2011).

Retention refers to the ability to maintain and recall learned information over time, either through recognition or recall. Julius and Jubert (2021) note that many students struggle with retaining mathematical concepts and skills. Several factors contribute to poor performance and weak retention in mathematics, including rote memorization of procedures without understanding underlying concepts, leading to diminished learning outcomes. Insufficient practice and review further contribute to forgetting and poor results (National Council of Teachers of Mathematics, 2014). Additionally, math anxiety poses a significant barrier to performance and retention, causing students to disengage and lose motivation (Ashcraft, 2002). Meaningful learning is closely tied to retention, and Ngwoke (2010) identifies ineffective teaching methods as a major cause of students' forgetfulness. Teaching strategies that discourage active learner participation tend to result in poor retention.

Algebra, a fundamental branch of mathematics, often challenges students due to its abstract concepts. In Nigeria, persistent poor performance in Algebra among secondary school students has motivated educators to explore more effective teaching methods. The demonstration method, which involves step-by-step practical instruction, aims to make abstract ideas more tangible for learners. In Kebbi State, similar to many other regions in Nigeria, students have shown low achievement in mathematics on public exams. Educators attribute this partly to ineffective teaching approaches. The demonstration method, known for its interactive and visual nature, is believed to improve students' understanding and retention of mathematical concepts. This study, therefore, seeks to investigate the impact of the demonstration method on students'

academic performance and retention in Algebra within the Argungu educational zone of Kebbi State.

Statement of the Problem

Despite Algebra's importance in the school curriculum, student performance in this subject remains poor, especially in the Argungu educational zone of Kebbi State. Several factors contribute to the low academic achievement and limited understanding of mathematical concepts, particularly the teaching methods employed. Traditional teaching methods have proven inadequate for effective mathematics instruction (WAEC 2020 Report). These conventional approaches have inherent limitations. Additionally, gender disparities exist in students' academic performance and retention when taught through different methods, making it important to consider gender as a factor in this research.

There is a clear need to explore alternative instructional strategies that can enhance learning outcomes. The demonstration method, which involves teachers actively showing the steps to solve problems, may provide a viable solution. This study aims to generate empirical data on the effectiveness of the demonstration method in improving students' academic performance and retention in Algebra in the Argungu educational zone. The findings will contribute toward addressing the widespread poor performance in Mathematics and provide Mathematics teachers with alternative approaches, moving beyond traditional, rigid teaching methods.

Objectives of the Study

The researchers formulated the following objectives to guide the study:

- i. To examine the effects of the demonstration method and the conventional method on students' academic performance in teaching algebra in the Argungu educational zone of Kebbi State.
- ii. To investigate the effects of the demonstration method on the retention ability of male and female students in teaching algebra in the Argungu educational zone of Kebbi State.

Research Questions

The study was guided by the following research questions:

- i. What are the effects of the demonstration method and the conventional method on students' academic performance in teaching algebra in the Argungu educational zone of Kebbi State?
- ii. What are the effects of the demonstration method on the retention ability of male and female students in teaching algebra in the Argungu educational zone of Kebbi State?

Research Hypotheses

The study tested the following null hypotheses:

- i. There is no significant difference in the academic performance of students taught algebra using the demonstration method compared to those taught using the conventional method in the Argungu educational zone of Kebbi State.
- ii. There is no significant difference in the retention ability of male and female students taught algebra using the demonstration method in the Argungu educational zone of Kebbi State.

Literature Review

Conceptual Framework

Teaching Methods

Teaching methods encompass the principles and strategies employed by educators to facilitate effective learning outcomes among students. The choice of these methods depends partly on the subject matter and partly on the characteristics of the learners. For a teaching method to be both appropriate and effective, it must align with the learners' attributes and the type of learning intended. However, no single teaching method suits every situation or all students universally.

Demonstration Teaching Method

Demonstration teaching method involves the teacher as the primary actor while learners observe with the intention of performing the task themselves later. In this

approach, the teacher models the actions or processes the students are expected to master by demonstrating and explaining each step in detail (Adekoya & Olatoye, 2011). Demonstrations offer a multi-sensory approach to explaining concepts or skills that might be difficult to grasp through verbal description alone (Cabibihan, 2013). This method fosters natural interaction between students and teachers, presenting real-life applications of the subject matter through hands-on use of tools and materials. It also serves to motivate students, especially when executed by skilled teachers, by clearly illustrating the correct way to perform tasks. For these reasons, researchers such as Daluba (2013), Vincent and Akpan (2014), Amaechi and Thompson (2016), and Osuyi and Ainetor (2018) advocate for the use of demonstration methods in vocational education. This student-centered and stimulating approach has been shown to improve academic achievement in subjects like Mathematics more effectively than teacher-centered methods.

Conventional Method

Conventional Method (CM), also known as the Traditional Method, centers the teaching-learning process around the teacher. In this experimental context, CM refers to a structured instructional approach where the teacher leads the lesson, sets objectives, and conducts stepwise assessments at various stages. Teaching and learning remain the core activities in secondary schools, with the teacher interacting face-to-face with students in the classroom (Yap, 2016). This method typically involves the teacher standing at the front of the class, using chalk-talk techniques and directing discussions focused on textbook content and notes. It is important that classroom interactions under this method foster equal opportunities for understanding across all students, including considerations of gender equity (Nnamani & Oyibe, 2016).

Academic Performance

Academic performance is defined as the measure of what a student has accomplished after undergoing an educational program (Khan et al., 2019). It serves as a key indicator of the student's mastery of course content. Evaluating academic performance through standardized testing is crucial for both schools and society, as learning goals and instructional standards are typically set by grade levels. Enhancing student

performance requires both quality instruction and effective teaching methods. According to Sinha et al. (2017), the success of educational institutions hinges largely on students meeting these academic standards. Therefore, adopting superior teaching methods is essential to help students excel and navigate the learning experiences provided by educators.

Retention

Retention refers to the ability to store and recall information or ideas when needed. This skill is vital for learners aiming for sustained success, as the inability to retain knowledge adversely affects academic achievement, especially in subjects like science. Olarewaju, cited in Ugwu, Jatau, and Gwamna (2020), defines retention as the process of storing and recalling acquired knowledge or experiences. The quality and quantity of retained information depend heavily on the nature of the content and the teaching techniques employed. Retention is critical in mathematics, where solving new problems requires the recall and application of previously learned concepts alongside new ones. Ugwuanyi (2009) emphasizes that the effectiveness of a teaching strategy significantly influences students' ability to retain and remember what they have learned.

Algebra

Algebra, a fundamental branch of mathematics, involves the use of symbols and rules for manipulating these symbols to represent numbers and quantities within formulas and equations. It is widely recognized as a core concept in mathematics worldwide, as evidenced by its inclusion in the curriculum of 65 countries participating in the Program for International Student Assessment (PISA), including Nigeria. This prominence is likely because algebra represents a gateway from concrete arithmetic operations to more abstract mathematical thinking (Skouras, 2014). The placement of algebra within school syllabi varies by country; some integrate it within a general mathematics syllabus, while others treat algebra as a distinct strand alongside arithmetic and geometry.

Theoretical Framework

The survey is grounded in Constructivist Learning Theory, which asserts that learners actively construct knowledge through their experiences. The demonstration method aligns well with this theory, as it enables learners to visualize and engage actively in the learning process. The application of constructivist principles to the demonstration method can be summarized as follows:

1. **Active Learning:** The demonstration method encourages students to observe and interact with the learning material, embodying a core principle of Constructivist Theory—learning through active participation.
2. **Concrete-Representational-Abstract (CRA) Sequence:** Demonstrations can be structured to follow the CRA sequence, where students are first presented with concrete examples, followed by representational models, and finally, abstract concepts. This sequence supports the constructivist notion of knowledge being constructed progressively through stages of increasing abstraction.
3. **Social Interaction:** Demonstrations facilitate social interaction, allowing students to ask questions, discuss ideas, and clarify their understanding with both teachers and peers. Such collaborative engagement is vital in Constructivist Theory, as knowledge is constructed through social discourse.

Empirical Studies

Several studies have investigated the effectiveness of teaching methods in mathematics education. For example, Akinsola (2013) found that students taught Geometry using the demonstration method outperformed those instructed through traditional lectures. Similarly, Nneji (2016) reported higher retention rates among students taught Algebra via demonstration techniques.

Methodology

Research Design

A quasi-experimental design was employed for this study. The design incorporated pre-test, post-test, and delayed post-test (post post-test) assessments for both experimental and control groups, facilitating comparison between the two groups.

Population and Sample

The population comprised all Senior Secondary Two (SS2) students in the senior secondary schools within the Argungu Educational Zone of Kebbi State. Four senior secondary schools were purposively selected, and convenience sampling technique was used to select 180 senior secondary students for the survey.

Instrumentation and Validation

The Algebraic Performance and Retention Test (APRT) was developed and validated by mathematics experts. The test consisted of 20 multiple-choice questions covering key Algebraic concepts. The APRT was administered as a pre-test to assess group homogeneity, a post-test to evaluate treatment effectiveness, and a delayed post-test (post post-test) to measure retention in both the experimental and control groups.

Research Procedure

The experimental group received instruction through the demonstration method over six weeks, while the control group was taught using conventional teaching methods. A pre-test was administered before the intervention, followed immediately by a post-test. A retention test was conducted four weeks after the post-test to assess long-term retention.

Data Analysis

Data collected were analyzed using SPSS software. Descriptive statistics (means and standard deviations) were computed to answer the research questions. Inferential statistics, specifically t-tests, were employed to test the null hypotheses at a 0.05 level of significance.

Results

The analysis was done by taking the research questions one after another in tabular form followed by description of the table systematically. The result of the analysis is presented in table 1.

Research Question 1**Table 1: Mean and Standard Deviations in the effects of demonstration and conventional method on students' academic performance in algebra in Argungu educational zone of Kebbi State.**

Method	N	Mean	S D	Mean Difference
Demonstration Method	90	34.50	16.79	2.33
Conventional Method	90	32.17	11.76	

Source: field work, 2025

The result in Table 1 showed the mean and standard deviation of demonstration method and conventional method on students' academic performance in teaching algebra in Argungu educational zone of Kebbi State. The result showed that; the demonstration method had a total mean of 34.50 with a standard deviation of 16.79 while the conventional method had a total mean of 32.17 with a standard deviation of 11.76. From the aforementioned result, the demonstration method is found to be more effective in teaching algebra with standard deviation of 16.79 and mean difference of 2.33 recorded.

Research Question 2**Table 2: Mean and Standard Deviations in the effects of demonstration method on male and female students' retention ability in algebra in Argungu educational zone of Kebbi State.**

Gender	N	Mean	SD	Mean Difference
Male	5	34.0	16.8	1.38
	0	0	1	
Female	4	35.3	16.8	
	0	8	9	

Source: field work, 2025

The result in Table 2 showed the mean and standard deviation of demonstration method on male and female students' retention ability in teaching algebra in Argungu educational zone of Kebbi State. Result showed that; the male students had a total mean of 34.00 with a standard deviation of 16.81 while the female students had a total mean of 35.38 with a standard deviation of 16.89. From the above result, the female students had higher retention ability in teaching algebra when demonstration method was used. It means that demonstration method favors female students with standard deviation of 16.89 with mean difference of 1.38 than male student.

Testing the Null Hypotheses

After answering the research Questions, all the null hypotheses were tested at 0.05 level of significance to express significant difference.

Null Hypothesis 1

Table 3: T-test Analysis of the significant difference in the mean performance of students taught using demonstration method and those taught using conventional method in teaching algebra in Argungu educational of Kebbi State.

Method	N	Mean	SD	DF	t-test	P-Value	Decision
Demonstration	90	34.50	16.79	178	1.08	0.00	Rejected
Method							
Conventional	90	32.17	11.76	178	1.08	0.00	Rejected
Method							

Source: field work, 2025

$\alpha = 0.05$

The result in Table 3 shows the t-test analysis of the significant difference in the mean performance of students taught using demonstration method and those taught using conventional method in teaching algebra in Argungu educational zone of Kebbi State. Result shows that; the students taught using demonstration method has the higher mean score of 34.50 as compared to that of conventional method with mean score of 32.17. The t-test calculated value was 0.25 while the p-value is 0.00 which was less than $\alpha = 0.05$ level of significance at 178 degree of freedom. Hence, the null hypothesis which stated that there is no significant difference in the performance of students taught using demonstration method and those taught using conventional

method in teaching algebra in Argungu educational zone of Kebbi State was rejected. Therefore, students perform better when taught using demonstration method compared to conventional method.

Null Hypothesis 2

Table 4: T-test Analysis of the significant difference in the mean between male and female students' retention ability when taught using demonstration method in teaching algebra in Argungu educational zone of Kebbi State.

Gender	N	Mean	SD	DF	t-test	P-Value	Decision
Male	50	34.00	16.81	88	0.39	0.94	Retained
Female	40	35.38	16.89				

Source: field work, 2025

$\alpha = 0.05$

The result in Table 4 shows the t-test analysis of the significant difference in the mean between male and female students' retention ability when taught using demonstration method in teaching algebra in Argungu educational zone of Kebbi State. Result shows that; the female students has the higher mean score of 35.38 as compared to that of male students with mean score of 34.00. The t-test calculated value was 0.39 while the p-value is 0.94 which was greater than $\alpha = 0.05$ level of significance at 88 degree of freedom. Hence, the null hypothesis which stated that there is no significant difference in the mean between male and female students' retention ability when taught using demonstration method in teaching algebra in Argungu educational zone of Kebbi State was retained. Therefore, male and female students had no different retention ability when taught using demonstration method.

Discussions of findings

The data were presented in tabular form, with detailed analysis conducted using means and standard deviations to address all research questions. Independent t-tests were employed to test the null hypotheses at the 0.05 level of significance. The results

revealed that Hypothesis 1 was rejected, while Hypothesis 2 was retained. Each hypothesis was tested at the specified level of significance ($\alpha = 0.05$).

The findings indicate that the demonstration method significantly improved students' academic performance and retention in the teaching of Algebra when compared to the conventional method. However, no significant difference was observed in the mean retention scores between male and female students taught using the demonstration method in Algebra within the Argungu Educational Zone of Kebbi State.

These results align with prior research and support the constructivist perspective that active participation in learning enhances comprehension. The findings are consistent with those of Andi et al. (2019), Okoko (2014), Ehiwario et al. (2019), Titus & Babangida (2018), and Blessing & Patrick (2023), all of whom reported that the demonstration method had a greater impact on students' academic performance than the conventional approach. However, the findings contradict those of Felix & Mogege (2023), Lubna, Arshad, & Ali (2017), and Irene et al. (2020), who found a significant gender difference in students' retention scores when taught Algebra using the demonstration method.

Conclusion

The study concluded that the demonstration method is more effective than the conventional method in teaching Algebra to senior secondary school students in Kebbi State. It also enhances students' retention of mathematical concepts, underscoring its value in improving mathematics instruction.

Recommendations

Based on the study's findings, the following recommendations are proposed:

- i. The demonstration method should be integrated into regular classroom instruction to improve students' academic performance and retention in mathematics, particularly in Algebra.
- ii. Teachers should receive training and encouragement to adopt the demonstration method as a core instructional strategy.

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