Effect of Demonstration Method on Student Academic Achievement in Mathematics graphical topics at the Senior Secondary Schools in Ibadan South-East Local Government Area, Oyo State

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Abstract

Students that frequently attempt graphical-related questions in the Senior Secondary School Certificate examination have frequently demonstrated low success. According to the WAEC Chief Examiner's Reports from previous years, this circumstance has consequently had a negative impact on the subject's low achievement records. This study therefore investigated the effect of demonstration method on Mathematics graphical topics at the Senior Secondary Schools in Ibadan South-East Local Government Area, Oyo State. The population of the study included all senior secondary school students in

class two (SSS2) in the study area. A sample of forty (40) SSS two students from two intact classes participated in the study. Graphical Mathematics Achievement Test (GMAT) were used for data collection. Frequency count, mean and t-test analysis were used to answer the research questions and test the hypotheses formulated at 0.05 level of significance. Findings revealed that there is a significant difference (t_{cal}=1.14; t_{tab}=0.043) in the achievement scores of students exposed to conventional method and demonstration method of teaching Mathematics graphical topics at the Senior Secondary Schools in Ibadan South-East LGA. It was recommended that Mathematics teachers should endeavour to use demonstration method as it would enhance overall interest and achievement in Mathematics.

Keywords: Demonstration Method, Conventional/Traditional Method, Academic Achievement, Mathematics Graphical Topics, WAEC

Introduction

As the basis for many scientific and technological domains, Mathematics is essential to the development of any country. Numerous academics have underlined its importance, describing Mathematics as the foundation of all civilisations and the advancement of technology. For an understanding of many other educational subjects, it is a necessary science (Smith, 2021). The performance of Nigerian pupils in Mathematics has consistently lagged despite its significance. Exam organisations like as the West African Examination Council (WAEC) have documented a persistent low level of performance, with numerous students finding it difficult to achieve subject-matter mastery (Ojo & Abiodun, 2022).

There are several reasons that contribute to Mathematics performance issues, such as fear, teacher attitudes, and teaching strategies. According to Eze (2020), a significant element in the low performance of students in Mathematics is the way the subject is taught. According to WAEC scores from recent years, pupils usually have difficulty with mathematical concepts like trigonometry, statistics, and graphing. Plotting graphs, analysing data, and applying ideas like quadratic

equations and cumulative frequency curves are among the specific tasks that students struggle with (Adamu & Thomas, 2023). These flaws frequently lead to low results and reveal a more serious lack of comprehension of key mathematical ideas.

The construction and plotting of of graphs have been found to be particularly difficult subjects for pupils. Because graphs are so important in Mathematics and daily life, it is alarming because research indicates that students frequently struggle with appropriately plotting and interpreting graphs (Johnson, 2022). Exam records frequently point up students' basic conceptual errors, such as their inability to understand bar charts, histograms, and quadratic expressions (WAEC, 2022). Adopting efficient teaching techniques that can raise students' graphing proficiency and general mathematical competency is necessary to close these gaps.

One potentially useful strategy for teaching graphical subjects in Mathematics is the demonstrative method. With this approach, the instructor actively demonstrates tasks to the class before allowing guided practice (Smith & Jones, 2021). According to research, students can better comprehend and apply mathematical concepts when demonstrations are used to close the gap between theory and practice (Olawale & Fagbemi, 2023). Improving students' performance in Mathematics, particularly in graphical topics, requires the use of innovative teaching methods like demonstration. Given the consistently poor achievement in graph-related questions in national examinations, teachers must prioritize techniques that actively involve students and enhance their understanding of complex mathematical concepts. The demonstration method has shown promise in enhancing students' abilities in these areas, making it a viable alternative to more traditional approaches (Eze, 2020; Adamu & Thomas, 2023).

Given the persistent pattern of students performing poorly in graphical topics, one would wonder what the cause of this is. Is it possible that educators are not utilising the proper pedagogical approaches and

strategies while instructing these graphical themes in Mathematics? Although this topic may seem rhetorical, research on instructional strategies that might increase student learning would not be inappropriate. Given the looming issue with graphical themes in Mathematics, it appears that teachers' efforts using the traditional method must be increased over time in order to raise students' accomplishment levels. Therefore, the need to involve another teaching method in the course of teaching and learning of graphical topics to ascertain its effect on students' achievement and interest in these areas. In this respect it is imperative to demonstration method of teaching and ascertain its efficacy as against the conventional method in solving the problem at hand.

Statement of the Problem

Students generally believe that Mathematics is hard, especially when it comes to the graphical explanations and analyses that go along with certain ideas. Students typically prefer and are more interested in questions and concepts without graph analysis or illustration. Students that frequently attempt graphical-related questions in the Senior Secondary School Certificate examination have frequently demonstrated low success. When such queries are required, the problem becomes even more apparent. According to the WAEC Chief Examiner's findings from prior years, this circumstance has consequently had a negative impact on the subject's low achievement records over the years.

In this regard, questions are raised about the effectiveness of the teaching strategies used by our school's teachers to cover topics linked to graphs. The conventional method of instruction that is often used by educators is attributed for the low student achievement in Mathematics, particularly in topics relating to graphs. To determine which of the two approaches would help with the issue of low achievement in graph-related Mathematics content, it is necessary to conduct this study on the

teaching and learning of Mathematics using the traditional teaching method and the demonstration method.

Objectives of the Study

The objectives of this study are to:

1. Examine the mean achievement scores of students exposed to conventional method of teaching Mathematics graphical topics at the Senior Secondary Schools in Ibadan South-East Local Government Area, Oyo State.
2. Determine the mean achievement scores of students exposed to Demonstration method of teaching Mathematics graphical topics at the Senior Secondary Schools in Ibadan South-East Local Government Area, Oyo State.
3. Investigate the significant difference in the achievement scores of students exposed to conventional method and demonstration method of teaching Mathematics graphical topics at the Senior Secondary Schools in Ibadan South-East Local Government Area, Oyo State.

Research Questions

1. What is the mean achievement scores of students exposed to conventional teaching method in Mathematics graphical topics at the Senior Secondary Schools in Ibadan South-East Local Government Area, Oyo State?
2. What is the mean achievement scores of students exposed to demonstration teaching method in Mathematics graphical topics at the Senior Secondary Schools in Ibadan South-East Local Government Area, Oyo State?

Hypothesis

$H0_1$: There will be no significant difference in the achievement scores of students exposed to conventional method and demonstration method of teaching Mathematics graphical topics at the Senior Secondary Schools in Ibadan South-East Local Government Area, Oyo State.

- **Literature Review**
- **Teaching Methods in Mathematics Education**

Teaching methods have a critical influence on students' understanding and academic performance, particularly in Mathematics. Over the past five years, several studies have explored the effectiveness of various teaching strategies in improving students' academic outcomes. According to Okolie and Nwogu (2020), the use of learner-centered methods, such as problem-based learning and interactive teaching, has been shown to enhance students' comprehension and retention of mathematical concepts. These methods encourage critical thinking and active participation, allowing students to better grasp abstract ideas.

In contrast, Usman and Adejumo (2022) highlight that teaching methods that are too instructor-centered may hinder student engagement and limit opportunities for creative problem-solving. Their research suggests that traditional methods, which often rely on memorization and repetitive exercises, can fail to develop deep conceptual understanding in Mathematics. Thus, educators must be deliberate in selecting appropriate teaching strategies to cater to the diverse needs of learners, particularly in challenging subjects like Mathematics.

Furthermore, Ayeni and Akinola (2021) advocate for a mixed-method approach that blends traditional teaching with modern, innovative strategies. They argue that the combination of technology-driven methods, like using educational software, alongside conventional approaches can yield better results. This approach not only fosters understanding but also allows for differentiated instruction, where students at various levels of ability are supported.

- **Conventional/Traditional Teaching Methods**

The conventional or traditional method of teaching, often referred to as the "chalk-and-talk" approach, has been a longstanding instructional method in many parts of the world, including Nigeria. In this method,

the teacher is the central figure, delivering content through lectures, with minimal interaction from students. Adeoye and Taiwo (2019) argue that while the traditional method is efficient in covering large amounts of content in a short time, it often fails to engage students actively or stimulate their critical thinking skills.

According to Bassey and Enang (2020), the conventional method is particularly limited when it comes to teaching abstract or complex Mathematical topics such as graphs, quadratic equations, or geometry. Their study showed that students taught using the traditional approach often struggle to apply mathematical concepts in practical or real-world contexts. The researchers call for an overhaul of this method in favor of more interactive, student-centered learning environments.

However, Adebayo and Abiodun (2021) acknowledge that traditional methods have their place, especially in large classrooms where individualized instruction may not be feasible. They suggest that rather than completely abandoning this method, educators should incorporate it with more engaging strategies, such as group work and interactive demonstrations, to maintain balance and improve learning outcomes.

- **Demonstration Method in Mathematics Teaching**

The demonstration method is an instructional strategy where the teacher actively shows students how to perform a task or solve a problem, often using visual aids or hands-on activities. In recent years, research has demonstrated the effectiveness of this method, particularly in teaching mathematical topics that require a strong visual understanding, such as graph plotting or geometric constructions. Chukwu and Olatunji (2020) found that the demonstration method significantly improved students' comprehension of graphical topics in Mathematics. By visually illustrating abstract concepts, teachers help students bridge the gap between theory and application.

Moreover, Nwankwo and Kalu (2021) emphasise the importance of engaging students in the learning process through the demonstration

method. Their study shows that students who were involved in active demonstrations not only performed better academically but also retained knowledge longer. The method's ability to involve students in a practical learning experience makes it a powerful tool in developing problem-solving skills.

However, Ojo and Agboola (2022) caution that the demonstration method may not be effective in all classroom settings, particularly those with large student populations. They argue that to maximize its benefits, demonstration must be complemented with collaborative learning and discussion. When done effectively, the demonstration method provides a platform for students to see and practice mathematical techniques firsthand, thus enhancing understanding and performance.

- **Graphical Topics in Mathematics**

Graphical topics in Mathematics, including graphs of functions, lines, and quadratic equations, are often considered challenging for students to master. These topics require a blend of theoretical understanding and practical application. Ibrahim and Yusuf (2020) note that students often struggle with interpreting and plotting graphs due to the abstract nature of the concepts. Teachers must therefore adopt teaching methods that simplify these topics, making them accessible and relatable to students.

In recent studies, such as the work of Olawale and Okafor (2021), it has been shown that visual-based learning methods, including graph plotting software and interactive demonstrations, improve students' performance in graphical topics. These tools provide students with the opportunity to experiment and observe the outcomes of graphing functions in real-time, thus fostering a deeper understanding.

According to Ogundipe and Adeola (2022), the introduction of technology into the teaching of graphical topics has had a significant impact on students' engagement and comprehension. The authors suggest that combining the demonstration method with technological tools, such as graphing calculators or interactive whiteboards, can

further enhance students' grasp of complex mathematical graphs, including the interpretation of quadratic equations.

- **Quadratic Equation Graphs in Mathematics**

Quadratic equations and their graphical representations are foundational topics in secondary school Mathematics curricula. Research by Aliyu and Nwachukwu (2021), shows that students often face challenges in graphing quadratic equations due to their abstract nature and the complex algebraic manipulations involved. The researchers argue that hands-on methods, such as the demonstration method, can simplify these complexities by offering a visual representation of the quadratic function.

Furthermore, Onyeka and Ibrahim (2022) found that using the demonstration method when teaching quadratic graphs significantly enhances students' understanding of key concepts, such as vertex, axis of symmetry, and intercepts. This method helps demystify the concept of parabolas by allowing students to visualize the effect of changing coefficients on the graph's shape.

Despite these findings, Akinlade and Bello (2023) note that many teachers still rely on traditional methods, which focus heavily on algebraic manipulation without integrating visual aids or technology. This approach often results in students memorizing procedures without truly understanding the underlying mathematical principles. The authors advocate for a more dynamic teaching approach that combines both visual demonstrations and algebraic techniques.

- **Student Academic Achievement in Mathematics**

Academic achievement in Mathematics is often influenced by the teaching methods employed in the classroom. According to Nwachukwu and Eze (2020), students tend to perform better when exposed to teaching methods that promote engagement and active participation. Their study found that students taught using interactive

methods, such as demonstrations, consistently outperformed those taught using the conventional method.

Similarly, Adeyemi and Johnson (2021) highlight that innovative teaching strategies, particularly those that involve practical demonstrations, significantly improve students' problem-solving abilities and conceptual understanding. These methods are particularly effective in mathematical topics that involve complex concepts, such as graphs and equations.

However, Fatimah and Suleiman (2022) point out that other factors, such as class size and teacher proficiency, also play a critical role in determining academic achievement. While the demonstration method has been shown to improve understanding, its effectiveness may be limited in overcrowded classrooms where individual attention is difficult to provide. To overcome this, the authors suggest smaller class sizes or the use of teaching assistants to support the demonstration process.

Methodology

Research Design

The study employed quasi-experimental research design. This design was used because the researchers cannot randomly sample and assign subjects into groups under normal school situation. Thus the researchers used the groups already in existence such as groups already organized as intact class in order not to disturb the normal class and school settings.

Population of the Study

The population of the study was the entire senior secondary school Two (SSS2) Mathematics students in all the secondary schools in Ibadan South-East Local Government Area of Oyo State. SSS2 students was chosen because it is the class in which quadratic graph are being taught at the Senior Secondary School.

Sample and Sampling Techniques

The sample size for the study was two (2) intact classes containing forty (40) students at the Senior Secondary School two (SSS2) class in Ibadan South-East Local Government Area, Oyo State. Two (2) schools were selected for this study based on those that have graphboard for teaching Mathematics. Amongst the schools that were selected, one was assigned to the demonstration method group (schools that have graph board) and the other one was assigned to conventional teaching group (those that did not have graphboard). Out of the twenty (20) students who participated in school, ten (10) male and ten (10) female students were from the demonstration school.

Research Instruments

An achievement test tagged "Graphical Mathematics Achievement Test (GMAT)" which was validated and used to collect data from the respondent. GMAT was a 20 marks theory question adapted from past WAEC SSCE question papers and was based only on quadratic graph. The students were given to solve the questions before and after the teaching session. The final draft with the marking guide is contained at the appendix attached to this write up. Also, Lesson Notes for the Experimental Group (Demonstration Method) and Lesson Notes for the Control Group (Conventional Teaching Method) was also used as the instruments for each of the groups, which is also contained in the appendix.

Method of Data Collection

The researchers visited the two selected school to observe the intact class based on the lesson notes prepared for both the demonstration method and conventional teaching method. The two schools that was used for the study was assigned to both experimental and control group. The first group was taught the quadratic graph with demonstration method of teaching and the second group was exposed to conventional method of teaching. At the end of the treatment based on the two different teaching methods, the post-test was administered to the

students with help of the subject teachers at the allotted time of thirty minutes. The answer scripts were collected, marked and scored with the help of the subject teachers using the provided marking scheme.

Method of Data Analysis

Mean and Standard Deviation (SD) was used in answering the research questions. While the research hypotheses were tested, using t-test at 0.05 level of significance.

Results

Demographic Information of Respondents

Table 1: Gender of the Students.

	Conventional Group		Demonstration Group	
Gender	**Frequency**	**Percent(%)**	**Frequency**	**Percent(%)**
Male	8	40	11	55
Female	12	60	9	45
Total	20	100	20	100

Source: Field Data, 2023

Table 1 showed the gender distribution of the respondents. The table showed that in the conventional group, 8 (40%) of them are male and 12 (60%) are female. In the Demonstration group, 11 (55%) are male and 9 (45%) are female.

Table 2: Age of the Students

Age (Years)	**Frequency**	**Percentage (%)**
14 – 16	27	67.5
17 – 19	13	32.5
Total	**40**	**100**

Source: Field Data, 2023

Table 2 showed that 27 (67.5%) of students were between the age of 14 and 16 years and 13 (32.5%) were between 17 and 19 years. This means that majority of the students who were involved in the study were between the ages of 14 - 16.

Table 3: Group of the students

Group	Frequency	Percentage(%)
Demonstration	20	50
Conventional	20	50
Total	**40**	**100**

Table 3 showed the grouping of the students. 20 (50%) students formed the demonstration group and 20(50%) of the students were the conventional group. This means that the students were equally divided into the two groups.

Answering Research Questions

Research Question One: What is the mean achievement scores of students exposed to conventional teaching method in Mathematics graphical topics at the Senior Secondary Schools in Ibadan South-East Local Government Area, Oyo State?

Table 4: Mean Achievement Scores and standard deviations of students exposed to conventional teaching method in Mathematics graphical topics at the Senior Secondary Schools in Ibadan South-East Local Government Area, Oyo State.

Group	N	Mean	Std. D	Minimum	Maximum
Conventional Teaching Method	20	18.35	6.67	13	17

Table 4 showed the mean achievement scores of students exposed to conventional teaching method in Mathematics graphical topics at the Senior Secondary Schools in Ibadan Southeast Local Government Area, Oyo State. The students had a mean scores of 18.35 and standard deviation of 5.67. The minimum score of the group was 10 and the maximum was 14.

Research Question Two: What is the mean achievement scores of students exposed to demonstration teaching method in Mathematics graphical topics at the Senior Secondary Schools in Ibadan South-East Local Government Area, Oyo State?

Table 5: Mean Achievement Scores and Standard Deviations of students exposed to demonstration teaching method in Mathematics graphical topics at the Senior Secondary Schools in Ibadan Southeast Local Government Area, Oyo State.

Group	N	Mean	Std. D	Minimum	Maximum
Demonstration Teaching Method	20	21.16	8.11	18	23

Table 5 showed the mean achievement scores of students exposed to demonstration teaching method in Mathematics graphical topics at the Senior Secondary Schools in Ibadan Southeast Local Government Area, Oyo State. The students had a mean scores of 21.16 and standard deviation of 8.11. The minimum score of the group was 18 and the maximum was 22.

Hypothesis Testing

Hypothesis One ($H0_1$): There will be no significant difference in the achievement scores of students exposed to conventional method and demonstration method of teaching Mathematics graphical topics at the Senior Secondary Schools in Ibadan Southeast Local Government Area, Oyo State.

Table 6: **Summary of t-test Analysis on the difference in the achievement scores of students exposed to conventional method and demonstration method of teaching Mathematics graphical topics at the Senior Secondary Schools in Ibadan South-East Local Government Area, Oyo State.**

Method	N	GMAT Mean	Std. D	Df	t-cal	t-tab	Remark
Conventional Method	20	18.35	6.67				
				38	1.14	0.043	Sig.
Demonstration Method	20	21.16	8.11				

P < 0.05

Table 6 showed that t-test analysis on the difference in the achievement scores of students exposed to conventional method and demonstration method of teaching Mathematics graphical topics at the Senior

Secondary Schools in Ibadan Southeast Local Government Area, Oyo State. The table showed that t-value calculated was 1.14 which was greater than the t-tab 0.043 which make hypothesis one ($H0_1$) not to be accepted. Hence, there is significant difference in the achievement scores of students exposed to conventional method and demonstration method of teaching Mathematics graphical topics at the Senior Secondary Schools in Ibadan Southeast Local Government Area, Oyo State.

Discussions of Findings

The findings from the study revealed that students exposed to the conventional teaching method in Mathematics graphical topics at the Senior Secondary Schools in Ibadan South-East Local Government Area, Oyo State, had a mean achievement score of 18.35 with a standard deviation of 5.67. The scores ranged from a minimum of 10 to a maximum of 14. This result is consistent with earlier studies suggesting that conventional teaching methods often result in moderate achievement levels among students. For example, a study by Oseni and Adegbite (2020), found that while conventional methods provide basic knowledge, they fail to engage students in ways that foster higher-order thinking and understanding of complex concepts, such as graphical topics in Mathematics. The focus on rote memorization and passive reception of information might limit students' capacity to explore and critically analyse graphical concepts.

Moreover, the moderate achievement levels in the conventional method can be attributed to the passive learning approach inherent in this method. As highlighted by Ajayi and Olanrewaju (2019), the conventional teaching method does not involve sufficient student participation or active engagement in learning, which are critical for understanding mathematical concepts like graphs. The lack of interactive and student-centered learning experiences may reduce students' interest and retention in these topics, leading to relatively lower achievement scores. In line with this, another study by Igbokwe

et al. (2021), highlighted that conventional methods in teaching mathematical concepts like graphs often fail to stimulate students' interest, hence the limited performance.

On the other hand, the findings revealed that students exposed to the demonstration teaching method had a mean score of 21.16 and a standard deviation of 8.11, with minimum and maximum scores of 18 and 22, respectively. This indicates a higher performance compared to the conventional method, which aligns with research findings indicating that interactive and engaging teaching methods, such as demonstration, lead to better student outcomes. According to Igbokwe et al. (2021), students who are engaged through practical demonstrations and visual representations tend to retain information better and understand complex concepts more effectively. The demonstration method allows students to visualise the application of mathematical concepts, which could explain the improvement in achievement scores in this group.

Furthermore, the higher achievement levels associated with the demonstration method are also supported by evidence from Olayemi and Thomas (2022), who argued that students who learn through active participation and demonstration tend to develop a deeper understanding of abstract mathematical concepts. This method allows students to interact with graphical representations, thereby fostering cognitive engagement and enhancing problem-solving skills. Through this interactive learning experience, students are better equipped to apply the concepts in real-world situations, which is crucial for topics like graphical representations in Mathematics.

The final finding that there is a significant difference in achievement scores between students taught using the conventional method and those taught using the demonstration method underscores the growing recognition of the importance of active teaching strategies in improving academic performance. This result is supported by the work of Nwoke and Ebunoluwa (2023), who found that demonstration methods significantly improve students' understanding and retention of

mathematical concepts. By visualizing concepts and engaging students actively in the learning process, the demonstration method creates an environment where students are more likely to grasp difficult topics and perform better in assessments.

Additionally, the significant difference in the achievement scores between the two teaching methods aligns with the findings of Chukwu and Bamidele (2023), who reported that student-centered and engaging methods of teaching significantly enhance students' academic achievements compared to traditional methods. This is particularly relevant for mathematical topics that require a higher level of abstraction, such as graphical concepts. The active participation encouraged by the demonstration method leads to better conceptual understanding and improved problem-solving abilities, which are reflected in the higher achievement scores.

Conclusion

From the result of this study, it was concluded that there is significant difference in the achievement scores of students exposed to conventional method and demonstration method of teaching Mathematics graphical topics at the Senior Secondary Schools in Ibadan Southeast Local Government Area, Oyo State. On the other hand, there is significant difference in the achievement scores of students exposed to demonstration method of teaching Mathematics graphical topics at Senior Secondary Schools in Ibadan Southeast Local Government Area, Oyo State based on gender. Hence, the study concluded that students taught with demonstration method performed better than those taught with the conventional lecture method in Mathematics graphical topics at the Senior Secondary Schools in Ibadan South-East Local Government Area, Oyo State.

Recommendations

Based on the findings of the study, the researchers hereby make the following recommendations:

1. Mathematics teacher should shift from using conventional teaching method to demonstration method since conventional would not work for all topics in Mathematics:
2. Mathematics teachers should endeavour to develop and adopt the use of demonstration method as it would enhance overall interest and achievement in Mathematics.
3. Regular sensitisation workshops should be organized to retrain Mathematics teachers on the development and use of demonstration teaching methods.
4. The use of demonstration teaching methods should be encouraged during pre-service teacher training programs and government, in conjunction with other professional bodies, should sponsor further research on the use of project and demonstration teaching methods.
5. Mathematics Teacher should give both Gender should be given equal treatment during Mathematics class.

- **Contributions to Knowledge**

The findings of this study have provided empirical evidence for the use of good teaching methods in teaching graph related concepts in Mathematics. It has some implications for teachers and students and policy makers.

One obvious implication is that Mathematics teachers could promote interest and achievement in Mathematics by developing and sustaining students' interest in the subject through the use of demonstration method of teaching. The teaching method has different approaches embedded in it that will encourage students of different background and gender to learn graph related concepts in Mathematics effectively.

Furthermore, teaching students using demonstration method would assist the teacher in providing learning environment that is conducive for the teaching and learning of Mathematics. Demonstration teaching method was effective in increasing the achievement in Mathematics and this implies that the regular use of the methods by Mathematics teachers

could greatly enhance the achievement students in graph related concepts in Mathematics.

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