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## Effects of Laboratory Teaching Strategy on Academic Performance of Primary School Pupils in Mathematics

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### ABSTRACT

This study looked into how using a laboratory teaching style affected the math performance of elementary school students, in Ijebu Ode, Ogun State, Nigeria. A quantitative study was adopted using Pre-test, Post-test, and Control group quasi-experimental designs. The study involved a total of seventy (70) primary four pupils, separated into two whole groups from separate institutions. We used one class as the experimental group, where the laboratory teaching strategy was implemented and the other class served as the control group, utilizing conventional teaching methods. Mathematics performance tests ( $r = 0.76$ ) were administered to collect data on academic performance, in addition to carrying out the experimental group's treatment plan and the control group's traditional methods. An analysis of the data was done with ANCOVA, revealing the laboratory teaching technique has a noteworthy favorable impact on students' academic performance. However, gender was found to have not much influence on academic achievement, and likewise, the interaction effect was not significant. The findings bolster the assertion that the laboratory teaching strategy is an effective way to raise primary school pupils' performance in mathematics. As a recommendation, it is suggested that mathematics teachers should be encouraged to integrate this approach into their teaching practices.

## 1. Introduction

Education, as highlighted by Asanre et al. (2024), serves as the avenue for unlocking an individual's creative potential and fostering self-fulfillment while contributing to societal progress. It functions as a vital mechanism for cultivating the expertise and abilities necessary for the survival and advancement of society. Mathematics, a discipline dealing with calculations, numbers, and quantities, plays a crucial role in this educational process. In Nigeria, proficiency in mathematics is a prerequisite for admission into tertiary institutions across all disciplines. To progress in their academic pursuits, students are required to excel in this subject, achieving at least a credit, as emphasized by Wachikwu et al. (2017).

As highlighted by Asanre et al. (2024), the significance of mathematics pervades virtually all academic fields, regardless of their direct mathematical nature, and its influence extends to disciplines with mathematical connections. Ifamuyiwa et al. (2018) state that mathematics serves as a foundational subject across the sciences, emphasizing the importance of students pursuing science-focused courses to support Nigeria's progress in both technology and economy. Additionally, Asanre et al. (2023) underscore the pivotal role of mathematics in the Nigerian educational landscape, as schools at all levels are evaluated based on the quality of mathematics education provided. Thus, mathematics holds a crucial position within the Nigerian educational system and is integral to national developmental processes.

According to Ekpenyong et al. (2023), Mathematics stands as a fundamental subject within Nigeria's primary and secondary education systems, necessitating effective teaching and learning approaches to cultivate skills essential for scientific, technological, and national development endeavors. Despite its universal, social, cultural, and practical significance, Mathematics continues to pose challenges for students across educational stages. As highlighted by Asanre et al. (2024), students often struggle with the subject due to various factors, including the nature of Mathematics itself, shortcomings in teaching methodologies, communication barriers, and educators' failure to bridge the gap between mathematical concepts and students' real-world experiences.

Supporting Asanre's perspective, Makondo & Makondo (2020) underscore the crucial role of Mathematics functioning as a fundamental discipline in higher education across various subjects taught at colleges and universities. Notwithstanding its importance, there has been a concerning trend in student success in mathematics, as demonstrated particularly in national exams. As highlighted by Asanre et al. (2022), academic achievement reflects a student's current position in meeting learning objectives, serving as a vital indicator for teachers and peers to assess comprehension levels. The persistent issue of low achievement in mathematics necessitates the attention of educators, as emphasized by Asanre et al. (2023). They emphasize that effective teaching is integral to quality education, with instructional methods directly impacting students' ability to engage with and comprehend instructional content. While teacher-centered approaches may lead to passive learning and limited interaction, the adoption of student-centered strategies is essential for fostering meaningful learning and skill development.

In the view of Ogunfowote and Asanre (2019), effective knowledge transmission requires teachers to employ appropriate teaching methods aligned with specific learning objectives and outcomes. Manjunath (2018) highlighted that the absence of mathematics laboratories and the failure of mathematics teachers to utilize laboratory strategies significantly cause pupils to perform poorly academically in mathematics. Similarly, Malik et al. (2021) emphasizes the detrimental impact on elementary school pupils' academic performance caused by a lack of mathematics laboratories and instructors' disregard for laboratory methods, notably when teaching number and numeration. Building on this, Obiyemi et al. (2022) define

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the Mathematics Laboratory as a facility designed for demonstrating mathematical principles and constructing various mathematical objects, equipped with a variety of teaching aids to enhance learning experiences.

Abdulhamid et al. (2017) emphasizes that the utilization of a laboratory approach in teaching necessitates the application of effective tools to foster active learning. They stress that without such tools, students may become disengaged from Mathematics classes. The significance of the laboratory approach in teaching mathematical concepts cannot be overstated. They highlight its importance, noting that through exploration and experimentation, students can discover mathematical relations and properties, thereby enhancing their understanding and interest in the subject. This approach stimulates and sustains students' engagement by encouraging mathematical exploration and manipulation. Building on this, Malik et al. (2021) affirms that the absence of mathematics laboratories and the neglect of laboratory strategies by teachers significantly contribute to poor academic performance, particularly in subjects like number and numeration, among primary school pupils.

Ibok et al. (2020) uncovered a disparity in academic performance between male and female primary school pupils, with males outperforming females in science and mathematics. This difference is attributed to gender stereotyping, which influences students' interests in subjects based on societal expectations of their gender roles. Male students are noted to exhibit higher levels of engagement and participation in active-learning activities related to mathematics concepts in the classroom. Building on this concern, Abiodun et al. (2022) stress the significance of addressing gender differences in academic performance, highlighting the observation that pupils lacking practical skills struggle to excel in subjects like number and numeration, crucial for technological, scientific, and business applications of mathematics. They advocate for the adoption of approaches such as laboratory strategies for teaching number and numeration to enhance students' understanding and academic achievement in school. Given these considerations, it is imperative to investigate the effect of laboratory teaching approaches on the mathematical proficiency of students in elementary schools.

The major goal is to investigate how a laboratory teaching technique affects primary school students' performance in mathematics. while specifically, is

1. To assess the main impact of the strategies on the academic performance of primary students in mathematics.
2. To access the influence of gender on the academic performance of primary students in mathematics.
3. To access the interaction effect of teaching strategy and gender on the academic performance of primary students in mathematics.

### **Hypotheses**

**H<sub>01</sub>:** There is no significant main impact of the strategies on the academic performance of primary students in mathematics.

**H<sub>02</sub>:** There is no significant influence of gender on the academic performance of primary students in mathematics.

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**H<sub>03</sub>:** There is no significant interaction effect of teaching strategy and gender on the academic performance of primary students in mathematics.

## 2. Methodology

Pre-test, Post-test, and Control group quasi-experimental designs were used for this investigation. Because it addresses biases of any kind and records student opinions at many points throughout the study, this design and methodology are deemed adequate. The Mathematics Achievement Test (MAT) was used to gather the study's data. The student's biographical information is contained in the first portion, while mathematical problems are found in the second. For face and content validity, the senior colleague and elementary school instructors of mathematics revalidated the instrument. The instrument's reliability was determined utilizing a different sample from another local government, the reliability of MAT was then assessed using the test-retest procedure, which was given twice over the course of two weeks. When analyzing the data, Pearson product moment correlation was used, reliability co-efficient obtained is 0.76. 70 elementary school students in Ogun State, Nigeria's Ijebu Ode local government area was the study's population. They were chosen by selective selection from two primary schools. The experimental group was one of the schools, while the control group was the other. Prior to the experimental group implementing the new teaching style and the control group using the traditional method, both groups took a pre-test. Also, a teaching guide on the laboratory strategy was used to guide the mode of instruction in the experimental group and using a traditional approach in the control group, to ensure the same mode of instruction was not used. The teaching was done in the space of 6 weeks teaching topics on different shapes, number and numeration. The selected schools were visited, and permission was taken from the school authority and the consent the respondents was gotten, thereafter, they were briefed on the purpose of the study and clarification was made on the importance. Analysis of Covariance (ANCOVA) was used to analyze the data that were acquired. Below are the figures of activity with the pupils in the classroom.





Figure 1. Showing the classroom activities with the pupils.

In fig 1 above, it shows how the teacher introduces the class activities to the pupils through enlighten them with the different shapes and showing them samples before allowing the pupils to build each shape themselves using the provided materials. This laboratory approach enables pupils to benefit from both theory and practical activities.

### 3. Results and Discussion

#### Descriptive statistics

The results of the data analyzed are shown in the tables and figure below

Table 1. The descriptive statistics of the respondents based on the strategies and genders

Strategy	Gender	Mean	Std. Dev	N
<b>Experimental</b>	Male	30.07	6.294	14
	Female	28.95	6.484	21
<b>Conventional</b>	Male	23.64	4.271	22
	Female	23.77	7.672	13

The average and standard deviation of male and female students' success scores who were subjected to the laboratory teaching approach and the conventional method were shown in Table 1. The mean for the laboratory teaching approach group for male pupils was 30.07, the standard deviation of 6.294, whereas female students' mean accomplishment score was 28.95, the standard deviation of 6.484. In the conventional group, the mean for male pupils was 23.64 with a standard deviation of 4.271, whereas female students' mean accomplishment score was 23.77, with a standard deviation of 7.672.

Below is the graphical representation of the study showing the groups mean scores, standard deviation and number are shown in Figure 2.

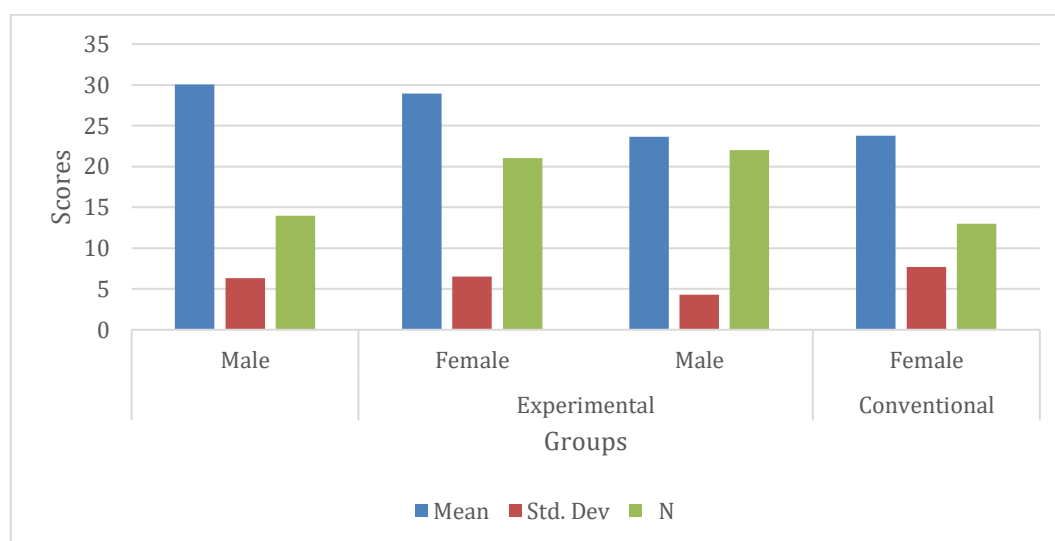


Figure 1: Graphical representation of the groups mean scores, standard deviation and numbers

**Hypothesis One:** There is no significant main impact of the strategies on the academic performance of primary students in mathematics.

Table 2: Summary of the Analysis of Covariance of students' performance in Mathematics according to the strategies and gender.

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	582.092 <sup>a</sup>	3	194.031	5.237	.003
Intercept	46918.118	1	46918.118	1266.357	.000
Strategy	559.109	1	559.109	15.091	.000
Gender	4.028	1	4.028	.109	.743
Strategy * Gender	6.492	1	6.492	.175	.677
Error	2445.280	66	37.050		
Total	52344.000	70			
Corrected Total	3027.371	69			
Corrected Model	582.092 <sup>a</sup>	3	194.031	5.237	.003

<sup>a</sup> R Squared = .192 (Adjusted R Squared = .156)

The main effects of the method (laboratory teaching strategy) on the pupils' performance in mathematics were shown by the results in Table 2. The results of the data were significant ( $F(1, 66) = 15.091$  and  $p < 0.05$ ). This suggests that the students' post-mean achievement scores who are open to the two levels of the instructional methodologies significantly differ from each another. Thus, the null hypothesis, according to which the performance score does not change significantly of the pupils subjected to these strategies is therefore rejected. We come to the conclusion that the laboratory teaching approach has a major main impact on the academic performance of elementary school pupils in mathematics

**Hypothesis Two:** There is no significant influence of gender on the academic performance of primary students in mathematics.



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The influence of gender on the academic performance of primary students in mathematics is showed in Table 2, which indicates that the relationship between students' gender and their math performance is not statistically significant ( $F(1, 66) = 0.109$  and  $p < 0.05$ ). This demonstrates that there is no discernible difference between male and female pupils' mean performance scores. The outcome is that the null hypothesis, which states that there is no significant influence of gender on the academic performance of primary students in mathematics, is therefore accepted, and we draw the conclusion that the mathematics performance scores of male and female students do not differ significantly from one another when laboratory teaching approach is used.

**Hypothesis Three:** There is no significant interaction effect of teaching strategy and gender on the academic performance of primary students in mathematics.

The outcomes of the two-way interaction between the strategies and the genders of the pupils are shown in Table 2, It demonstrates that there is no statistically significant interaction between the gender and the method on the students' mathematical performance ( $F(1,66) = 0.175$  and  $p < 0.05$ ). According to this finding, the mean performance of male and female students in the two tiers of mathematical techniques does not significantly differ from one another. The study concludes that there is no discernible association between gender and the laboratory teaching technique in basic mathematics students' academic performance.

### ***Discussion of Results***

The research findings indicate a noteworthy major influence of the laboratory teaching technique on the academic performance of primary students in mathematics. Demonstrating that the experimental group outperformed the control group in terms of academic performance. This result is in line with Asanre et al., (2018, 2021 & 2024) they also found out that an effective teaching method raises students' academic achievement in mathematics. Also, Malik et al (2021) asserted that compared to pupils exposed to the traditional method of instruction, those exposed to the laboratory teaching style performed noticeably better academically. This is evident in the mean score of experiment group to that of the control group, showing that pupils of Ijebu ode schools in Ogun State performed better when exposed to laboratory teaching technique. The results also demonstrated that gender had no discernible primary influence on the performance of pupils in mathematics. This suggests that there is no discernible difference in the math performance scores of male and female students when laboratory teaching approach is used. The result is in line with the result of researchers Okigbo and Osuafor (2018) discovered that there was no statistically significant difference in the performance of male and female students. Also, this result is consistent with the findings of Asanre et al. (2024) and Abiodun et al. (2022). that showed, the gender of students has no discernible impact on their competence in mathematics. This may be the result of their instructor's level of engagement with mathematical activities and the gender's degree of dedication to their math class. Finally, the results showed that students' academic performance in mathematics is not

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significantly impacted by the interplay between gender and the laboratory teaching technique. This result is in line with the studies by Asanre *et al.*, (2021, 2022) that discovered no treatment and gender relationship. Also, Additionally, Obafemi et al. (2023) found no evidence of a significant interaction between gender and therapy on pupils' academic performance.

#### 4. Conclusion

In light of the study's conclusions, it is determined that the laboratory teaching strategy effectively stimulates and sustains learners' interest in mathematics through active exploration and manipulation, leading to improvements in academic performance. Thus, laboratory teaching strategy enhance the mathematics performance of pupils in primary schools in Ijebu ode Local Government Area of Ogun State, Nigeria. Therefore, it is advised that mathematics instructors adopt laboratory instruction techniques in primary school classrooms. Additionally, school management should prioritize the provision of necessary laboratory equipment to support teaching processes, which is one of the restrictions seen in certain schools that prevented them from being utilized for the study. Furthermore, educational policymakers are urged to integrate laboratory teaching strategies into the school curriculum to ensure its widespread implementation and effectiveness in enhancing students' mathematical learning experiences and outcomes.

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