Scope
Volume 16 Number 02 June 2026

Effectiveness of Roving Mathematics Laboratory on Senior School Students' Performance in Mathematics in Ijumu Lga, Kogi State, Nigeria

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Abstract: The study investigated the effectiveness of using roving Mathematics Laboratory in teaching Mathematics on senior secondary school students' achievement in mathematics in Ijumu local government area Kogi state, Nigeria. The study adopted quasi-experimental, non-randomized, non-equivalent, pre-test, post-test control group design. The sample is one hundred and seventy-six (176) senior secondary school two (SS2) students which were purposively selected from three senior secondary schools in Ijumu local government area of Kogi state. Two research questions and two hypotheses were raised as a guide to this study. Roving Mathematics Laboratory was used to teach geometry to the two experimental groups while the control group was taught geometry using the conventional method. An instrument called Mathematics Laboratory Test was used to collect data. The instrument was validated by three (3) senior lecturers of Mathematics Education and two experienced senior secondary school mathematics teachers. Test retest method was used to determine the reliability and Pearson's Product Moment Correlation was used to calculate the reliability coefficient which was 0.78. Descriptive statistics: mean and standard deviation was used to answer the research questions, while ANCOVA was used to test the hypotheses at 0.05 level of significance. The finding of the study among other reveals that students taught geometry using Roving Mathematica Laboratory achieved significantly better than those taught using conventional method irrespective of students' gender. Based on the finding of this study, it was recommended among other things that Mathematics teachers should be encourage to use Roving mathematics laboratory to teach geometry.

Keywords: Effectiveness, roving, mathematics laboratory, performance, students

Introduction

Where are all these mathematics theories used for in real-life situation? This have been questions we daily try to explain to our students both in secondary schools and tertiary institutions as mathematics teachers and lecturers. Many of the mathematician and mathematics educators tend to answer this question by telling their students stories, other will just tell you to crammed it and pass your examinations. But the truth is that our student deserve to know the practicability of every theorem, lemma, corollary, among others which is been taught in the classes. How could these be done?

Mathematics is life itself, life is mathematics. The creation of the world itself is mathematical in its entire nature. Morning, afternoon and night, summer and winter, up and down, life and death among others are all components of mathematics. Cooking requires huge components of mathematical procedures, eating likewise. There is practical nothing in the human endeavors which does not require mathematical application. When I mean nothing, I mean nothing.Mathematics can be described as the study of space, time, sequence, pattern, structures among others in solving human problems. Ogbu (2020) opined that the high level of development of mathematics was assumed to have been sparked by the need of the society and its competencies vital to everyone for meaningful understanding. Sani and Kajuru (2020) affirmed that Archimedes in the third century was asked to calculate the volume of the crown of a king using his knowledge of mathematics. The solution to this problem led to the formulation of Archimedes principles in physics.

The implication of the problem solved by Archimedes indicated that mathematics is used to solve real life problems. Anaduaka and Hassan (2017) viewed mathematics as the oldest of study in the history of mankind and the most central component of human thought. Mathematics sharpens the mind, develop logical thinking of an individual and enhances the reasoning ability, Sunday (2019) observed that everybody irrespective of human endeavor consciously and unconsciously use mathematics knowledge on daily basis. According to Samuel (2020), mathematics is the process which involves helping the student to clearly read, identify, express and represent problems themselves; and identify and recognize data in any given set of problems. Specifically, the process involves identifying the problem or set of problems with respect of given data; selecting the appropriate mathematical representations and procedures, computing the right solutions; interpreting the principles behind the solutions; and translating the ides into a coherent form.

Sunday (2019) viewed mathematics laboratory as a self-contained centre devoted to the display, arrangement, and the use of multi-sensory mathematics materials, activities and information.it is an individualized learning centre for mathematics remediation, reinforcement, and enrichment. It exist to foster mathematics awareness, skill building, positive attitudes and learning-by-doing. It provides practical experience in arithmetic, geometry, algebra, number theory, set theory, consumer mathematics, measurement, and

other area of mathematics. It provide a setting for individual or small groups of learners to explore, learn, and grow mathematically.

Mathematics laboratory is a place where learners are exposed to explaining difficult mathematical concepts and verify mathematical facts, formulae and theorems/results through a variety of activities. It helps students creates mathematical awareness, skill-building and positive attitudes toward the subject and above all, ideas of learning by doing (Esangbedo, 2014). This implies that, it is a very tool for effective teaching and learning of mathematics which will help to sustain students' interest and performance in mathematics. Salman (2002) opined that teaching of mathematics must be practical, exploratory and experimental which could easily be carried out in the mathematics laboratory.

The Central Board for Secondary Education (CBSE) (2011) identified ways by which mathematics laboratory can be useful to the learning of mathematics in secondary schools, viz:it provides an opportunity to students to understand and internalize the basic mathematical concepts through concrete objects and solutions; it provides greater scope for individual participation in the process of learning and becoming autonomous learners; its enables the students to verify or discover several geometrical properties and facts using models or by proper cutting and folding techniques; and helps the students to build interest and confidence in learning the subject since its provides an opportunity to exhibit the relatedness of mathematical concepts with everyday life. In addition, the mathematics laboratory provides scope for greater involvement of both the mind and the hand which facilitate cognition.

There are four types of mathematics laboratory but this study focused on roving/mobile mathematics laboratory. The mobile or roving mathematics is the type of laboratory that exist where the school does not have a space or an empty classroom to use as a mathematics laboratory. The materials are carefully itemized and placed in the containers for easy packing by the teachers where the container for each concept has all the necessary materials that student can use to discover things by themselves. Then all containers are than put on a larger movable cart, and a schedule is created to allow easy accessibility. The teacher who gets the cart at a certain period can quickly can bring out his container and produce a mathematics laboratory. Alan (2012) viewed mathematics laboratory as an activity-centered instruction where the child is placed in a problem-solving situation and self-exploration and discovery provides a solution based on his/her experiment, needs and interest of the learner. Some researchers have found out that mathematics laboratory improves students' performance significantly in mathematics (Farayola, 2014, Badaru, 2015; Sunday, Akanmu, Salman & Fajemidagba, 2016).

The use of instructional strategies has varying implications for both teachers and students' characteristics such as students' gender. Gender is a socially ascribed attribute, which differentiate feminine from masculine. A number of studies has verified the influence of

gender on mathematics achievement on students.this has led to divergent views on the influence of gender on the students' performances in mathematics (Sunday, etal 2023). Several studies have revealed contradictory results on the correlation between students' gender and their performance in mathematics. While some studies indicated that there is no statistical significant difference in the students' performance in mathematics based on gender (Samuel & Sunday, 2024; Sunday etal, 2024).

While Ganley and Lubienski (2016) were of the view that this difference could be as a result of female students been a 'good girl' in the school by doing strictly only the things the class teacher asks them to do. Hence they don't try out other creative or risky things that could enhance their problem-solving skills in mathematics. The authors further recommended additional research on gender difference in other to have more comprehensive empirical evidence on gender and students performance in mathematics.

Research Questions

1. What is the difference in performance of students taught mathematics using roving mathematics laboratory and those taught using conventional method?
2. Does differences exist in the performance of male and female students taught mathematics using roving mathematics laboratory?

Research Hypotheses

HO1: There is no significant difference in the performance of students taught mathematics using roving mathematics laboratory and those taught using conventional method.

HO2: There is no significant difference in the performance of male and female students taught mathematics using roving mathematics laboratory.

Methodology

The quasi experimental design was adopted for this study. This involve pre-test and post-test been administered to both experimental and control groups before and after treatment. The population of this study 4,567 senior secondary school students in Ijumu local government area of Kogi state. The sample consisted of 174 senior secondary school two (SS2) students which were purposively selected and participated in the study. The Mathematics laboratory Test (MLT) was the instrument used to collect the data which were analysed. The instrument was validated by three (3) senior lecturers of Mathematics Education and two experienced senior secondary school mathematics teachers. Test retest method was used to determine the reliability and Pearson's Product Moment Correlation was used to calculate the reliability coefficient which was 0.78. The difficulty index of MLT 0.53. The collected data was analysed using mean, standard deviation for answering research questions and ANCOVA was used to test the research hypotheses at 0.05 level of significance.

Results

Research Question One: what is the differences in the performance of students taught mathematics using roving mathematics laboratory and those taught with conventional method

HO1**:** There is no significant differences in the performance of students taught mathematics using roving mathematics laboratory and those taught with conventional method.

Table 1

Mean performance scores and standard deviation of students' taught mathematics using Roving mathematics laboratory and those taught with conventional method.

Variable	pre-test			post-test		
Method of teaching	N	Mean	SD	Mean	SD	Mean gain
R-maths Lab	51	3.37	1.98	13.35	3.42	9.98
Conventional Method	46	3.37	2.09	4.54	2.05	1.17

In table 1, the mean performance scores of the students taught Mathematics using Roving/Mobile Mathematics laboratory was 13.5 and mean gain score of 9.98, while students taught with the conventional method had a mean performance score of 4.54 with a gain score of 1.17. This implies that the students taught mathematics using Roving/mobile mathematics laboratory performed better than their counterparts that were taught with the conventional method.

Table 2

Analysis of covariance of the mean performance score of students taught mathematics using roving mathematics laboratory

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	1984.050	2	992.025	139.603	.000	.748
Intercept	1315.263	1	1315.263	185.090	.000	.663
Pretest	107.090	1	107.090	15.070	.000	.138
Groups	1876.296	1	1876.296	264.041	.000	.737
Error	667.971	94	7.106			
Total	10818.000	97				
Corrected Total	2652.021	96				

The result in Table 2 showed that the mean performance score of students taught mathematics using Roving/Mobile Mathematics Laboratory differed significantly. This was indicated by the calculated F-value of 264.04 with p=.00 which is less than 0.05 set as level of significance. Therefore, the null hypothesis of no significant difference in the mean performance score of students taught mathematics using Roving/Mobile mathematics laboratory and those taught with conventional method was rejected. This indicates that there is statistical significant difference in the mean performance scores of both groups, as Roving/Mobile Mathematics Laboratory increased students' performance in mathematics than the conventional method. (F (1,94) =264,<.05).

Research Question Two: Does differences exist in the performance of male and female students taught mathematics using roving/mobile mathematics laboratory?

HO2: There is no significant differences in the performance of male and female students taught mathematics using roving/mobile mathematics laboratory.

Table 3

Analysis of covariance of the mean performance score of male and female students taught mathematics using Roving/Mobile mathematics laboratory

Source	Type III Sum Of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	40.321	2	20.161	5.235	.010	.212
Intercept	601.722	1	601.722	156.261	.000	.800
Pretest	11.143	1	11.143	2.894	.097	.069
Gender	23.123	1	23.123	6.005	.079	.083
Error	150.179	39	3.851			
Total	3225.000	42				
Corrected Total	190.500	41				

The result in Table 3 showed that with respect students' performance, an F- value of 0.40 with p=0.08 and is greater than 0.05 level of significance. The null hypothesis is of no significant difference in the mean performance scores of students taught mathematics using Roving mathematics laboratory on the basis of gender was not rejected. This shows that there is no statistical significant difference in the mean performance scores of male and female when taught mathematics using Roving mathematics laboratory (F(1, 39) =6.01, p<.05).

Summary of Findings

1. The Roving/Mobile Mathematics Laboratory enhance students' performance significantly than their counterpart taught using conventional method.
2. The Roving Mathematics Laboratory enhance both male and female students' performance equally significantly without any gender bias.

Discussion of Results

This study reveals that students performed significantly better than their counterparts when taught geometry using roving mathematics laboratory. This could be as a results of hands-on experience that the roving mathematics laboratory brings which helps to sustain students' interest in geometry using various manipulatives. The finding of this study is agreement with the results of Sunday, etal (2025) whose study showed that Digital mathematics laboratory enhance students' performance in mathematics significantly without any form of gender bias. The findings of this study is related to that of Akanmu, etal (2016) whose study indicated that students gender do not affects their performance in geometry when taught using laboratory components.

Conclusion

Based on the finding of this study it was concluded that Roving mathematics laboratory helped students to perform significantly better in mathematics as its provides hands-on experience which enables the students to demystify abstract geometric concepts by making it more real and engaging.

Recommendation

Based on the findings of this study it was recommended that:

1. Teachers of mathematics should endeavor to use roving/mobile mathematics laboratory to enhance proper understanding of geometry.
2. Schools who could not afford the space and cost of a standard mathematics laboratory should be encouraged to use the roving mathematics laboratory to enhance students' performance in mathematics.

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