EFFECTS OF MATHEMATICS LABORATORY METHOD ON JUNIOR SECONDARY SCHOOL STUDENTS` ACHIEVEMENT IN ANGLES IN ONDO STATE

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Abstract

Poor performance of Junior secondary school students in mathematics is related to teaching and learning approaches that are not based on practical, activity-based, experimental and IT-supported methods, Mathematics laboratory method which is experimental, practical and activity-based, is therefore sought for, in reversing the trend of students' poor performance in mathematics, especially in Angles. The study investigated the Effects of Mathematics Laboratory Method on Students' Achievement in Teaching and Learning angles in Junior Secondary Schools in Ondo State. The study adopted a quasi-experimental design involving pretest posttest control group. The population consisted of all JSS III Public School Students in Akure South Local Government Area of Ondo State. The sample consisted of 100 students in two intact classes, the schools were purposefully selected based on the facts that they are coeducational schools for proper gender representation. Each from the two schools randomly assigned to one treatment and to the other, control group. Instruments used for data collection was Mathematics Achievement Test. (MAT) developed by the researcher.

The data were analysed using descriptive and inferential statistics. Findings revealed that the use of mathematics laboratory methods enhanced students' performance in mathematics. (T-cal =9.1; T-critical=1.944). The results also showed that no significant difference exists in the achievement of male and female students taught with mathematics laboratory methods. (T- cal =0.153; T-critical=1.929) at 0.05 significant level. The study recommended that Mathematics teachers should be encouraged to use mathematics laboratory methods in teaching mathematics, and that the Government should establish mathematics laboratories in all schools like other science subjects' laboratories, also that Seminars/workshops should be organized for mathematics teachers in secondary school on the use of mathematics laboratories.

Keywords: Mathematics; Laboratory; Angles; Experimental; Junior secondary school;

Introduction

Mathematics is the study of order, structure, and relationship that arose from measuring, estimating, counting, and describing object shapes. It deals with deductive and numerical computation, and as it has developed, its subject matter has become increasingly idealized and abstract. Mathematics promotes logical reasoning and mental rigor while also helping to establish mental discipline. (National council of teachers of mathematics 2000). Mathematics remains a pivotal subject in junior secondary school education due to its foundational role in science, technology, engineering, and further academic pursuits. Within the mathematics curriculum, geometry, particularly the concept of angles, is essential for developing spatial reasoning, logical thinking, and problem-solving skills. Despite its importance, achievement in angles by junior secondary school students in Nigeria has persistently remained low, often attributed to the inadequacies of conventional classroom teaching approaches that emphasize rote memorization over understanding and application. Due to the importance of mathematics in everyday life, the National Policy on Education (FRN,2013) placed it at the center of the

Nigerian school curriculum, made it a basic and compulsory subject taught from the Senior Secondary School Education level through primary education, demonstrating its importance in the advancement of science and technology in Nigeria.

Traditional teaching methods, such as the lecture–chalk and talk approach, characterize most mathematics classrooms in Nigeria. These teacher-centred strategies typically involve the presentation of definitions, formulas, and procedures with little opportunity for students to explore concepts experientially. As a result, learners tend to develop superficial understanding and limited ability to apply geometric reasoning to new problems, contributing to poor performance in topics like angles. This instructional deficiency is underscored by contemporary literature which highlights that geometry learning requires active mental and physical engagement to build meaningful conceptual understanding, yet conventional methods often fail to provide such opportunities.

In response to these documented challenges, mathematics educators have increasingly advocated for student-centered and experiential teaching approaches. One such strategy is the mathematics laboratory method, an instructional approach that emphasizes the use of manipulative, concrete models, visual aids, and structured activities to make abstract mathematical ideas accessible and engaging. The laboratory method aligns with constructivist learning theories which posit that students construct knowledge most effectively through exploration, experimentation, and guided discovery rather than passive listening.

Mathematics is emphasized because it is used in practically every area of human knowledge, including educational research, statistics, law, psychology, accounting, medical, engineering, and many others. Mathematical applications enhance business transactions between individuals and nations.

Earlier studies (Ukeje, 1986; Amazigo, 2000; Agwagah, 2001) identified negative attitudes and poor teaching of mathematics. Recent studies have also confirmed that students' interest and performance in mathematics remain low, particularly at the secondary school level (e.g., Akinoso, 2018; Yusuf & Afolabi, 2019; Abakpa &Iji, 2021). Empirical evidence from recent Nigerian studies demonstrates the potential of laboratory-based instruction to improve student outcomes in geometry and related mathematics topics. For example, Ajai, Ogungbile, and Nguuma (2024) found that students taught geometry using laboratory-based instructional methods achieved significantly higher geometry scores than those taught using conventional approaches, indicating the value of hands-on learning experiences in enhancing conceptual understanding. Similarly, research in Rivers State revealed that mathematics laboratory-based instruction not only improved students' performance in plane geometry but also enhanced retention of learned concepts compared to traditional methods.

Despite these positive findings, the implementation of mathematics laboratory strategies remains limited in many Nigerian schools, including those in Ondo State, due to factors such as inadequate facilities, insufficient teacher training, and entrenched reliance on traditional pedagogies. This persistent gap suggests that students in Ondo State may not be receiving the kind of engaging, activity-based instruction that could improve their understanding and achievement in angles. Consequently, there is a compelling need to investigate how the mathematics laboratory method affects student achievement in this critical geometric topic within the local context. Such research can provide evidence-based insights to inform instructional policy, teacher professional development, and resource allocation aimed at improving mathematics learning outcomes in junior secondary schools across the state.

WAEC Chief Examiners revealed in 2011 that “candidates were unable to use Circle theorem to find unknown angles”. According to the preliminary results released by WAEC 2018, 94,607 candidates

(30.09%) obtained D7-E8 in Mathematics. Also “the applicants' failure to convert story problems into mathematical statements posed the biggest barrier”. He advised teachers to take note of the candidates' shortcomings and create effective teaching strategies for mathematical concepts and abilities. Also, the teaching and learning of mathematical themes should not be overlooked, but rather be given equal focus in order to equip students with problem-solving skills.

Excerpts from the chief examiners' reports on the Basic Education Certificate Examination (BECE) in Ondo State are:

1. In 2013, he reported that there has been no discernible improvement in current candidate performance over previous years. One of the remedies proposed by him in 2015 was that concept be adequately taught and demonstrated to the candidates.

2. In 2021, he proposed that teachers should employ activities in teaching and engage students in teaching concepts and problem solving.

According to Yelina (Retrieved, May 2016), the low performance of students in mathematics has been a source of worry for all stakeholders and policymakers in the Nigerian education system. As a result of this discovery, the WAEC Chief Examiners (2021) advised that there should be adequate infrastructure aids to make the instruction genuine and that students be involved in more practical work than theoretical work. (West African Examinations Council.(2010, 2011, 2012 &2018).Chief Examiners' Report. Lagos):

Teaching and learning of certain concepts in mathematics, particularly Angles, in junior secondary school using Mathematics Laboratory Method will make the teaching more practical and create a lasting imprint on the learners' brains.

An angle is a shape generated by two rays or lines that meet at a

common point. (Solabomi 2019). The word "angle" is derived from the Latin "angulus," which means "corner." The common terminal of the two rays is referred to as the vertex, and the two rays are known as the sides of an angle. It is not necessary for the angle in the plane to be in Euclidean space. Diahedral angles are those created by the intersection of two planes in Euclidean or another type of space. The symbol "∠" represents the angle. Degrees are commonly used to express angles. A "protractor" is a useful geometrical tool for measuring angles in degrees.

There are numerous types of angles, based on these angles and lines, are further categorized into a wide range of categories, including complementary angles, alternate exterior angles, vertical angles, alternate interior angles, and many more.

To fully fulfill the aims of education in Nigeria and benefit from its contribution to the national economy, the government should take the necessary steps to ensure that instruction is practical, activity-based, experimental, and IT assisted (NPE, 2013).

According to this study, effective mathematics instruction should be an embodiment of a method such as Mathematics Laboratory Method, which is practical, immersive, activity-based, and IT supported.

In a mathematics laboratory, students can demonstrate and explore mathematical ideas and use a variety of tools and activities to test mathematical statements and theorems.

Mathematics Laboratory Method is a process for stimulating students' efforts and encouraging them to create discoveries. These exercises can be carried out by either the teacher or the pupils in order to investigate, learn, create curiosity, and establish a positive attitude toward mathematics. Students' attitudes, interests, and performance of male and female students may be affected by such activity-based learning. The utilization of a mathematics laboratory aids in the

integration of theory and practice in mathematics teaching and learning. Several Benefits of using mathematics laboratory method as stated by some authors includes

Ngayubwiko & Andala (2024) Found that the use of mathematics laboratories promotes skills development, including critical thinking and application of mathematical concepts, through hands-on activities.

Kunwar (2023) Reviewed the importance and impact of mathematics laboratories and highlighted benefits such as clarifying abstract concepts, increasing student engagement, improving reasoning and attitudes toward mathematics.

Malik, Akudo &Arikewuyo (2021/2025) Demonstrated that mathematics laboratory facilities enhanced students' achievement, supporting the practical benefits of lab-based instruction over traditional methods.

Adenegan (cited in Gandhi, 2023) Listed specific functions/benefits of a mathematics laboratory, including:
learning abstract concepts through concrete experience
stimulating interest and positive attitudes
developing creative problem-solving skills
accommodating individual differences in learning pace and style.

The Mathematics Laboratory Method has been found to be the most effective teaching strategy for this particular subset of mathematical subject matter since it is more of activity and application-focused. The use of mathematics laboratories helps to remove abstractness, improve effective teaching/learning, and integrate theory and actual work in mathematics teaching and learning. It is also a teaching method in which students work informally, walk around, discuss, and select their own material method of solving a problem, assignment, or task. It is predicated on doing and learning.

Based on the benefits of mathematics laboratories, it is anticipated that using mathematics laboratories method to teach and learn a topic like angle which is abstract in nature, will help to reduce the abstract nature and encourage students to follow.

The primary goal of this study is to look into the impact of adopting the mathematics laboratory method on the academic achievement of students in Angles at junior secondary school in Akure South Local Government Zonal Education Area in Ondo State.

The study specifically looked at:

(1) Effect of mathematics laboratory Method on students' achievement in Angles at Junior Secondary School level.

(2) Effect of Mathematics laboratory Method on male and female students achievement in Angles at Junior Secondary School level.

To guide this study, the following research questions were raised:

(1) What are the achievements of students in Angles before and after exposure to Mathematics Laboratory Method and conventional method?

(2.) To what extent does gender influence the mean achievement scores of the students taught Angles in Mathematics using mathematics laboratory method?

The following hypotheses guided this study, They were tested at 0.05 significance level:

H_o1: There is no significant difference between the mean achievements scores of students taught mathematics using Mathematics Laboratory Method and those taught using conventional method

H_o2: There is no significant difference between the mean achievements scores of male and female students taught mathematics using the mathematics laboratory method

It is hoped that this study will be beneficial to the following people, The students, Teachers, student teachers, government and the society.

1. Students

The findings of this study will benefit students by improving their understanding of angles through hands-on and activity-based learning. The mathematics laboratory method allows students to manipulate concrete materials, which helps to reduce abstraction in geometry and makes learning more meaningful. This approach is expected to increase students' interest, motivation, and active participation in mathematics lessons, thereby leading to improved academic achievement and better problem-solving skills.

2. Teachers

Teachers will benefit from this study as it will expose them to an effective and practical instructional strategy for teaching angles. The results will guide mathematics teachers on how to integrate laboratory activities into classroom instruction to enhance students' comprehension. It will also encourage teachers to move away from teacher-centered methods and adopt learner-centered approaches that promote creativity, interaction, and critical thinking.

3. Student-Teachers

Student-teachers will benefit from this study by gaining practical knowledge of innovative teaching methods that can be applied during teaching practice and in their future careers. The study will help them understand how to effectively teach abstract mathematical concepts such as angles using concrete instructional materials, thereby enhancing their teaching competence and confidence.

4. Government

The government will benefit from the findings of this study by gaining empirical evidence on the effectiveness of the mathematics laboratory method in improving students' performance. This information can assist education policymakers and curriculum

planners in reviewing and strengthening mathematics curricula. The study may also justify increased funding for the provision of mathematics laboratories, instructional materials, and teacher training programs in secondary schools.

5. Society

The society will benefit from this study through the production of students who are better grounded in mathematical concepts and logical reasoning. Improved mathematics education contributes to the development of problem-solving skills needed for scientific, technological, and economic advancement. In the long run, this will help in producing a more numerate and skilled workforce capable of contributing meaningfully to national development.

Research Method

A quasi-experimental design involving pretest posttest control group was employed in this study. A 2×2×2 factorial design was used as shown below

Representation of Research Design

GROUPS	PRE TEST	TREATMENT	POSITION
EXPERIMENTAL	O_1	X	O_2
CONTROL	O_3	C	O_4

O_1 and O_3 are pretest score of the experimental group and the control group respectively O_2, and O_4 are the post-test score of the experimental group and the control respectively. X is the treatment for the experimental group (laboratory method)
C = treatment for the control © group

The population of this study comprised all the Junior Secondary School students in class three (JSS III) in Ondo State public secondary school.

A representative sample of all students in JSS III in Ondo State, a fraction of the population was studied in two secondary schools

within Akure South Local Government. The schools were purposefully selected based on the facts that they are coeducational school for proper gender representation and to be far apart from each other so as to avoid interference and have compensate class size. A total of hundred students were selected for the study in two intact JSS III classes, out of the various arms of JSS III. One arm of 50 JSS III students was randomly selected from each of the co-educational school. One class was assigned to treatment group A, fifty in number (22 males and 28 females) and the other class was assigned to control group B, fifty in number (22 males and 28 females)

Mathematics Achievement Test (MAT) was utilized as the study's instruments. This consists of 25 multiple objectives items with option A-D adapted from Ondo State Basic Education Certificate Examination (BECE) past questions for both pre-test and post-test.

Face and content validity of the Instruments were done by the researcher supervisor, three mathematics education specialists and two experienced secondary school mathematics instructors.

The test items were adapted from previous Ondo State Basic Education Certificate Examination Council (BECE). They are the past questions administered by the Ondo State Ministry of Education Examinations Board. It has a 0.73 Spear man rank correlation coefficient.

The instruments for the study were faced and content validated to validate the items in terms of

* Clarity of instruction to respondents
* Appropriateness and adequacy of the instrument in measuring what they were supposed to measure

The instruments were trial tested on 25 junior secondary school students from a secondary school which was a representative sample of students outside the population.

The coefficient of internal consistency for the instrument (MAT) was calculated using Kunder Richardson formula (20) and the value yielded 0.75.

The Laboratory was designed with a typical laboratory structure and all necessary fixtures and apparatus, including Geoboard, graph board, Pythagoras triple triangle, Skeletal globe, Abacus, closed and open cylinders, cones, conic sections, rectangular and triangular pyramids, cube, cuboid, graphic calculator, computer system, construction kits, mathematical sets, kits, and so forth. These were reviewed by three experts in mathematics education to ensure its usefulness and accuracy as a model of a real mathematics laboratory.

There were three stages involved in this research: the administration of pre-test, the intervention stage and the posttest stages. The first week was for the administration of pretest. In the pretest stage, the MAT, were administered on the experimental group A and the control group B to ascertain equivalent ability and self-concept at the entry level of the experiment.

In the intervention stage, Group A (n = 50) were taught Angles using a Mathematics laboratory designed lesson plan in the mathematics laboratory, while Group B (n = 50) were taught the same topic but in a conventional lecture classroom using conventional lesson plan. The treatment took one period per week for a period of four weeks. In the sixth week, posttest which was the same MAT were administered on the groups to determine the effect of the intervention on their performance. To control the teacher quality variable, the researcher trained the teachers who taught in both groups.

The data collected from pre-test and posttest were used in determining the mean and standard deviation, to answer the research questions, while t-test analysis was employed for testing the hypothesis at 0.05 levels.

Results

Research Question 1: What are the achievements of students in Angles in Mathematics before and after exposure to Mathematics Laboratory Method and conventional method?

Table 1: Mean Achievement of students taught Angles using mathematics laboratory method and the control

	N	SD	POST-TEST MEAN	SD	MEAN GAIN
Experimental	50	4.91	17.78	3.48	8.14
Control	50	5.28	9.72	5.21	2.01
Mean Differences	1.93		8.06		

Table 1 revealed the results of MAT administered on students. It could be observed from the table that, the pre-test, experimental group taught with mathematics laboratory method had a mean of 9.64 with a S.D. of 4.91 while the control group taught with conventional method had a mean of 7.71 with a S.D. 5.28. Similarly, in the post test, the experimental group had a mean of 17.78 with a S.D. of 3.48 while the control group taught with conventional approach had a mean of 9.72 with a S.D. of 5.21. The mean difference between the groups in pre-test is 1.93 while that of post-test, is 8.06. The difference within the pre-test and post-test groups for the control is 2.01 While the difference within the pre-test and post-test groups for the experimental is 8.14 Therefore, there was a great difference in the mean achievement of students taught mathematics using the mathematics laboratory method, and those taught using conventional approach. This clearly implied that mathematics laboratory method is more effective.

Research Question 2: To what extent does gender influence the mean achievement scores of the students taught Angles in Mathematics using mathematics laboratory method?

Table 2: Mean mathematics achievement scores of male and female students exposed to mathematics laboratory method

Gender	N	MEAN	SD
Male	22	17.86	3.197
Female	28	17.71	3.740
Mean difference		0.15	

Table 2 revealed the achievement scores of students by Gender on MAT. The male students taught angles in mathematics using mathematics laboratory method had a mean of 17.86 with the S.D. of 3.197 while their female counterpart had a mean score of 17.71 with a S.D. of 3.740. The mean difference between the male and female students is 0.15 in favour of the Males. This implies that Gender had little or no influence on students' Academic performance in Angles in Mathematics

Ho1: There is no significant difference between the mean achievements scores of students taught mathematics using Mathematics Laboratory Method and those taught by conventional method?

Table 3: t-test Analysis showing the achievement of students exposed to mathematics laboratory method and the control

Group	N	Mean $\bar{x}$	Standard Deviation	Df	t-cal	t-critical Value	Decision
Experimental	50	17.78	3.48	98	9.10	1.94	Rejected
Control	50	9.72	5.21				

Table 3 revealed, the achievement scores of students who were taught mathematics with laboratory method and conventional approach.

The number of students in the experimental group is 50 and the control group is also 50. The mean of experimental group is 17.78 with a standard deviation of 3.48. For the control group is 9.72 with a standard deviation of 5.21. The T- calculated value is 9.1 and T-

critical value is 1.944. The degree of freedom is 98 and has significant level of 0.05. The t- calculated value which is 9.1 is higher than the t-critical value which is 1.944 at 0.05 significant level. This implies that there is a significant difference between the achievements scores of students exposed to Mathematics Laboratory Method and those taught by conventional method. Therefore, the hypothesis is rejected.

$H_0$2: There is no significant difference between the mean achievements scores of male and female students taught mathematics using Mathematics laboratory method

Table 4: t-test Analysis showing the achievement of male and female students exposed to mathematics laboratory method

Gender	N	Mean $\bar{x}$	Standard Deviation	Df	t-cal	t-critical Value	Decision
Male	22	17.86	3.20	48	0.15	1.93	Fail to
Female	28	17.71	3.74				Rejected

Table 4, showed the achievement of male and female students exposed to mathematics laboratory method.

The mean of male students is 17.864 and standard deviation is 3.197. while that of female is 17.716 with the standard deviation of 3.740. The t- calculated value is 0.153 and the t- critical value is 1.929. The degree of freedom is 48 and has significant level of 0.05. it was observed that the t-calculated value of 0.153 is less than the critical value 1.929 obtained at 0.05 level of significance. This is an indication that there is no significant difference in the achievement of male and female students exposed to mathematics laboratory method. Therefore the hypothesis is accepted.

Discussion

Results of Research question one which is the achievements of students in Angles in Mathematics before and after exposure to Mathematics Laboratory approach and conventional Method as

shown on table 1 revealed that students taught with mathematics laboratory method in Angles had higher mean gain scores than their counterpart taught with conventional method. This was in favour of the mathematics laboratory group. This clearly showed that students taught angles in mathematics with mathematics laboratory methods achieved more than those taught without mathematics laboratory. This may be as a result of students' active participation in Mathematics Laboratory class which could be an attention inducer and a powerful motivator when employed. Meanwhile the conventional method did not cater for learning of manipulative skills. This finding is supported by Rajendra Kunwar (2023), Adenegan (2023), Moses (2019) karthika (2015), where they highlighted the advantages of using mathematics laboratory in teaching to include, learning abstract concepts through concrete experiences, stimulating interest and positive attitudes, providing opportunity for student to understand and internalize the basic mathematical concepts. In this way the students achieved better.

Results of research question two which is the extent to which gender influences the mean achievement scores of the students taught Angles in Mathematics using mathematics laboratory method, on table 2 revealed that the mean difference between the male and female students is 0.15 in favour of the Males. This implies that Gender had little or no influence on students' achievements in Mathematics. This finding is in agreement with the reports of Olasehinde and Ololaye, (2014); and Jane and Janet, Retr. July, (2016) that no significant difference in mathematics achievement between males and female's student

Ho_1: There is no significant difference between the mean achievements scores of students taught mathematics using the Mathematics Laboratory Method and those taught by conventional method? The results analyzed and presented on table35 revealed that the t- calculated value which is 9.1 is higher than the t-critical value

which is 1.944 at 0.05 significant level. This implies that there is a significant difference between the achievements scores of students exposed to mathematics Laboratory Method and those taught by conventional methods. This is an indication that the Mathematics Laboratory Method is effective in teaching mathematics. Constructive teaching method is activity-based, practically oriented and student-centered, the result is confirmed by the reports of Blogspot (2018), Samanta and King (2018) and FRN (NPE, 2013), who all advocated that the activity-based method should be used in teaching mathematics because the activity-based method makes the teaching of mathematics practical and experiential.

Ho_2: There is no significant difference between the mean achievements scores of male and female students taught mathematics using the Mathematics laboratory method. The findings of this study, as analysed on table 4 revealed that Mathematics Laboratory Method favour male students more than their female counterparts, as the result yielded mean difference of 0.15 in favour of the male students. These findings support the reports of (Fennema, 2000; Muthukrishna, 2010; Olosunde and Olaleye, 2010; and Unodiaku, 2013), that boys performed better than girls in mathematics tests. Doherty (2004) also reported that Males students' performance in science is higher than those of females due to the fact that girls lack confidence in their ability to study science and perceive it as masculine activity. In his view, meaningful learning can only take place when there is active interaction between the learner and the subject matter with some serious reconstruction of meanings. However, this mean difference of 0.15 was tested and found not significant ($P \leqq 0.05$). Some researchers also reported that females performed better than males in mathematics achievement (Hydea and Merzb 2009; Ozofor, 2001; and Unodiaku, 2015). Other studies showed that girls have reached parity with boys in mathematics achievement tests (Hydea &Mertzb, 2009; and Aja &Imoke, 2015). Based on these inconsistency report there is need for further

enquiring to clarify the notion

Conclusion

This study investigated the effect of the Mathematics Laboratory Method on junior secondary school students' achievement in Angles in Ondo state. Based on the findings of the study, it can be conclusively stated that the Mathematics Laboratory Method is a more effective instructional strategy for teaching Angles than the conventional method of instruction. Students who were taught using the Mathematics Laboratory Method demonstrated higher academic achievement, indicating that active engagement with concrete materials, practical activities, and hands-on experiences significantly enhanced their understanding of angular concepts.

The superior performance of students exposed to the Mathematics Laboratory Method suggests that learning mathematics through exploration, manipulation of instructional materials, and guided discovery promotes deeper conceptual understanding and retention of knowledge. Unlike the conventional method, which is largely teacher-centered and abstract in nature, the laboratory method encourages students' active participation, critical thinking, and problem-solving skills. This makes abstract concepts in geometry, such as angles, more meaningful and easier to comprehend for junior secondary school students.

Furthermore, the findings revealed that there was no significant difference between the achievement of male and female students taught using the Mathematics Laboratory Method. This indicates that the method is gender-friendly and provides equal learning opportunities for both male and female students. The absence of gender disparity in achievement implies that when students are exposed to learner-centered and activity-based instructional approaches, gender differences in mathematics performance are minimized.

In conclusion, the Mathematics Laboratory Method is an effective, inclusive, and equitable teaching approach for improving students' achievement in Angles at the junior secondary school level. Its ability to enhance academic performance while eliminating gender bias underscores its relevance and suitability for mathematics instruction. Therefore, the adoption of the Mathematics Laboratory Method in teaching geometry, particularly Angles, is strongly recommended as a viable means of improving students' understanding and achievement in mathematics.

The following recommendations were made based on the finding of this study:

Recommendations

Based on the findings of this study, the following recommendations are made:

Adoption of the Mathematics Laboratory Method in Schools

Mathematics teachers at the junior secondary school level should adopt the Mathematics Laboratory Method in teaching Angles and other geometry topics. Since the method has been shown to enhance students' achievement more than the conventional teaching approach, its regular use will promote better understanding and improved performance in mathematics.

Provision of Mathematics Laboratory Facilities and Materials

School administrators and government education agencies should ensure the provision of well-equipped mathematics laboratories in junior secondary schools. Instructional materials such as protractors, angle models, cardboard cut-outs, geometrical instruments, charts, and others manipulative should be made readily available to support effective implementation of the laboratory method.

Training and Retraining of Mathematics Teachers

Teachers should be trained and retrained through workshops, seminars, and in-service programme on how to effectively use the Mathematics Laboratory Method. Emphasis should be placed on

activity-based teaching, guided discovery, and the proper utilization of laboratory materials to enhance students' learning outcomes.

Incorporation into Curriculum and Teaching Guidelines
Curriculum planners and education policymakers should integrate the Mathematics Laboratory Method into the junior secondary school mathematics curriculum and instructional guidelines. This will encourage teachers to move away from purely teacher-centered approaches and adopt learner-centered strategies that foster active participation.

Encouragement of Gender-Inclusive Teaching Practices
Since the study revealed no significant difference in the achievement of male and female students taught with the Mathematics Laboratory Method, teachers should be encouraged to use this method to promote gender equity in mathematics classrooms. Equal participation of both male and female students during laboratory activities should be emphasized.

Monitoring and Supervision of Instructional Practices
School supervisors and inspectors should monitor the teaching of mathematics to ensure that innovative methods such as the Mathematics Laboratory Method are properly implemented. Regular supervision will help sustain effective teaching practices and improve students' achievement in mathematics.

Further Research

Researchers should conduct further studies on the use of the Mathematics Laboratory Method in other areas of mathematics and at different educational levels. Future research may also examine its effects on students' attitude, interest, and retention in mathematics to provide a broader understanding of its educational benefits.

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