

# EFFECTIVENESS OF TEACHING MATHEMATICS USING MATHEMATICS LABORATORY ON STUDENTS MATHEMATICAL ACHIEVEMENTS IN TERTIARY INSTITUTIONS

By

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## Abstract

*This study investigated the effectiveness of teaching mathematics using mathematics laboratory on students' mathematical achievements in tertiary institutions. The population consists of forty (40) NCE III students of mathematics department of Federal College of Education, Okene who attended and wrote MAT 324 examinations in 2014/2015 session. The population was randomly separated into two groups of twenty (20) students in a group; which one group was used as experimental group (EG) and the other as control group (CG). Ten (10) students were sampled out from each of the groups using systematic sampling technique. The instrument used to collect data for this study was the MAT 324 examination questions of 2014/2015 session. Statistical analyses were based on t-test and chi-square ( $\chi^2$ ) at 5% level of significance. It was revealed that students who were opportune to be taught mathematics using mathematics laboratory performed better than their counterparts who were not privileged to be taught mathematics using this technique of teaching. It was therefore, recommended that mathematics lectures should be encouraged through training and workshops on the use of learning resources in the laboratory to effectively use the learning materials for mathematics teaching.*

The problem of poor performance in mathematics as a subject is global and it is a serious concern to parents and education stakeholders. As a case in Nigeria, other researchers have confirmed low performance in mathematics at both the Senior Secondary certificate examination (SSCE) and placement examination like Unified Tertiary Matriculation Examination – UTME (Ukeje, 1991 & Okonkwo, 2005). This problem is made worse in developing countries by the existing digital divide, poverty and other problems unique to the third world especially Nigeria. Mathematics being a compulsory subject up to pre-university level especially in social science and science oriented subjects is given less attention as it deserves. As a result, despite the importance

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placed on mathematics, researchers (Salau, 1995; Amazigo, 2000; Agwagah, 2001; Betiku, 2001; Obioma, 2005; Maduabum and Odili, 2006; Okereke, 2006 Okigbo and Osuafor, 2008) had observed that students lack interest in the subject and perform poorly in it.

Ale (2012), testified to this, that lack of interest in mathematics and mass failure in mathematics at school certificate level will go along-way to hinder Nigeria from achieving its transformation agenda without promoting the study of sciences through mathematics. Mathematics is a model for thinking, for developing scientific structure, for drawing conclusion and for solving problems. It is a subject that deals with facts. As a result, Olademo (1990) opined, “this subject-mathematics should be given much consideration and let no man think of it as abstract or as untrue”. As posited by Balogun et al (2002), “Mathematics instruction is a training of logical thinking. It is a means of solving many problems. It is confronted with finding solutions to problems that have not been provided by a similar type. Its greatest virtue is its flexibility and the high esteem at which it is held as a tending discipline is partly due to its illustrious pedigree”. To this end, Adenegan (2003) highlighted Mathematics importance under four broad functions- utilitarian, cultural, social and personal functions.

Okereke (2006) attributed students’ poor performance to factors such as the society view that mathematic is difficult, shortage of qualified teachers, lack of mathematics laboratory and lack of incentive. The abstract nature of mathematics should be reduced through demonstration and practical methods. Agwagah (1997) observed that the problem of ineffective teaching can be tackled through planned and intelligent application of the mathematics laboratory. Thus Agwagah recommended the use of laboratory approach to the study of mathematics. The method of drill and verbal recitation makes learning boring and lacks motivation for further learning. Srinivasa (1978) had earlier recommended the use of mathematics laboratory in teaching mathematics. According to Srinivasa, this will lead the students to formation of concepts out of experiences with discrete objects. In this case the vague theories and imaginary objects take real shape and the students understand better and perform better. It is important therefore to consider strategies that may help to improve the performance, with the view of considering their effect on teaching and learning of mathematics. Such strategies include the use of mathematics laboratory (Ogunkunle, 2000).

As defined by Adenegan (2003), the mathematics laboratory is a unique room or place, with relevant and up-to-date equipment known as instructional materials, designated for the teaching and learning of mathematics and other scientific or research work, whereby a trained and professionally qualified person (mathematics teacher) readily interact with learners (students) on specified set of instructions. The use of

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mathematics laboratory helps to integrate theory and practical work in mathematics teaching /learning. Ohuche (1990) advocated the need for moderately equipped mathematics laboratories. Ogunkunle (2000) itemized the advantages of using mathematics laboratory which include: display mathematical information, avenue for experimentation through practical work, pool of storage of mathematical materials for easy access, removing abstractness and increasing effective teaching /learning. Based on the advantages of mathematics laboratory, it is expected that teaching and learning of mathematics with mathematics laboratory may help to reduce the abstract nature of the subject and leads to improve performance in mathematics.

Yara & Otieno,( 2010) asserted that the abstract nature of mathematics should be reduced through demonstration , practical methods and use of teaching/learning materials like relevant textbooks; classroom/laboratories; stationeries/teaching aids,; textbooks and trained teachers. Agwagah (1997) observed that the problem of ineffective teaching can be tackled through planned and intelligent application of the mathematics laboratory. In order to enhance learners' mastery and meaningful learning of mathematics, it is necessary to reduce to the bearable minimum its level of abstraction with the use of instructional materials. Adenegan(2010) testified to this that instructional materials, when properly used in the teaching and learning situation, can supply concrete bases for conceptual thinking, high degree of interest for students in making learning more permanent. According to Oyekan (2000), "instructional materials are those things that can facilitate effective teaching and pleasant learning that is teaching aids through which learning process may be encouraged and motivated under the classroom situation". These enhance the teaching learning process when adequately and appropriately used.

Thus, this paper focuses on the effectiveness of teaching mathematics using mathematics laboratory on students' mathematical achievements in tertiary institutions.

### **Statement of the Problem**

It has been observed that most efforts to improve students' performances in mathematics are usually at the primary and secondary school levels of education. Mathematics students at the tertiary institutions are less attended to most especially in the area of teaching methodology used in mathematics classes. As a result, the performances of these "expected matured" students are not better either. Ojonubah (2009) stated that mathematics achievement scores of most mathematics students in almost all schools in Nigeria today can be describe as persistently low. Thus, using mathematics laboratory in teaching mathematics may be effective in improving the students' performances in tertiary institutions. This is the main problem under study.

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### **Purpose of the Study**

1. To establish if there is significant difference in the performance of students taught using mathematical laboratory and students taught without mathematics laboratory.
2. To determine whether the number of students who passed or failed mathematics is independent of the instructional strategy used.

### **Hypotheses**

On the bases of the purpose of the study, the following research hypotheses were raised:

$H_{01}$ : There is no significant difference in mathematics mean performances of group of students taught using mathematics laboratory and the group of students taught without mathematics laboratory.

$H_{02}$ : The number of students who passed or failed mathematics (MAT 324 – Abstract Algebra) examination is independent of the instructional strategy used.

### **Research Method**

The research design used for this study is descriptive survey. This is because, the research tends to investigate the impact of mathematics laboratory on mathematics performance of the students.

### **Population and Sample**

The population for this study consisted of forty (40) NCE III students of mathematics department of Federal College of Education, Okene who attended and wrote MAT 324 examination in 2014/2015 session. The population was then randomly separated into two groups of twenty (20) students in a group; which one group was used as experimental group (EG) and the other as control group (CG). Ten (10) students were then sampled out from each of the groups using systematic sampling technique.

### **Instrument**

The instrument used to collect data for this study was the MAT 324 examination questions of 2014/2015 session. The examination questions were moderated by the departmental external moderator. The examination consisted of five (5) questions to answer three (3) according to National Commission of Colleges Education (NCCE) examination laid down rules and regulations.

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### **Procedure for Data Collection**

The two (2) groups of students were independently taught MAT 324 for a period of one semester; one group using mathematics laboratory and the other group without mathematics laboratory. The group taught using mathematics laboratory is the experimental group and the second group taught without mathematics laboratory is the control group.

At the end of the semester, the students wrote the same examination on MAT 324. The students examination scripts from the two groups were marked and recorded by the course lecturer (the researcher); and then moderated by the same external moderator. The mean achievements in the course were separately computed for the two groups which were used for the data analysis.

### **Data Analysis**

Analysis of data collected was based on statistical tools, t-test and chi-square ( $\chi^2$ ) at significant level of 5%.

### **Results**

**H<sub>01</sub>:** There is no significant difference in the mathematics mean performance of group of students taught using mathematics laboratory and the group of students taught without mathematics laboratory.

**Table 1:** t-test result of difference in mathematics mean performances of group of students taught using mathematics laboratory and the group of students taught without mathematics laboratory.

<i>Group</i>	<i>n</i>	<i>mean</i>	<i>s.d</i>	<i>df</i>	<i>t<sub>cal</sub></i>	<i>t<sub>table</sub></i>	<i>Remark</i>
<i>EG</i>	<i>10</i>	<i>60.0</i>	<i>4.5</i>	<i>18</i>	<i>7.37</i>	<i>1.73</i>	<i>S</i>
<i>CG</i>	<i>10</i>	<i>48.7</i>	<i>9.3</i>				

Table 1 review that the difference between the MAT 324 examination mean scores of the group of students taught using mathematics laboratory and the students taught without mathematics laboratory is significant at  $\alpha = 0.05$ ; since  $t_{cal} = 7.37 > t_{\alpha/t} = 1.73$ . Thus, H<sub>01</sub> is rejected. We can then conclude that mathematics mean achievements of the group of students taught with mathematics laboratory is significantly greater than the group of students taught without mathematics laboratory.

**H<sub>02</sub>:** The number of students who passed or failed mathematics (MAT 324) examination is independent of the instructional strategy is used.

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**Table 2:** Number of students who passed or failed mathematics (MAT 324) examination in 2014/2015 based on instructional methods.

<i>Group</i>	<i>No. Passed</i>	<i>No. Failed</i>	<i>df</i>	$X^2_c$	$X^2_t$	$\alpha$	<i>Remark</i>
<i>Maths Laboratory</i>	10	0	1	5.0	3.84	0.05	S
<i>Other teach. methods</i>	6	4					

S = Significant

Table 2 showed that the calculated  $\chi^2 = 5.0 > \text{table } \chi^2 = 3.84$ . This means that the test value is significant at  $\alpha = 0.05$ . Thus, we reject the  $H_{02}$  and conclude that the number of students who passed or failed mathematics (MAT 324) examination depend on instructional method adopted by the course lecturer.

### **Findings**

1. Mathematics laboratory is capable of improving students' mathematics achievements when used in teaching the students.
2. The number of students who passed mathematics positively depends on the use of mathematics laboratory in teaching the students.
3. The mathematics mean achievement of the group of students taught with mathematics laboratory is significantly greater than the group of students taught without mathematics laboratory.
4. Mathematics laboratory is capable of helping students to develop positive interest and attitudes towards problem solving in mathematics.

### **Discussion**

It is obvious from the findings of this research that students who were opportune to be taught mathematics using mathematics laboratory performed better than their counterparts who were not privileged to be taught mathematics using this technique of teaching. This research also revealed that the number of passes increases with the use of this technique. These research findings are in agreement with the findings of Srinivasa (1978), Agwagah (1997) and Ogunkunle (2000) where they stated that students achieved better in mathematics when mathematics laboratory is used in teaching mathematics to them than otherwise.

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This is true, since using mathematics laboratory in teaching mathematics provide opportunity for students to understand and internalize the basic mathematical concepts; which have a holistic advantage of better students' achievements. Supporting this, Mstem in Emaikwu (2012) reported that teaching method affects the response of students and determines whether they are interested, motivated and involved in a lesson in such a way as to engage in learning. According to Okwudishu (2011), mathematics laboratory offers the benefits of reinforces course content, develops team building skills, enhances learners self esteem, promotes participatory learning, allows for creative problem solving, and promotes the concept of discovery learning. Others benefits are that it energizes and invigorates the participants, strengthens learners bond, offers variety that accommodates diverse learning styles, allows practical application of course content, enhances communication with diverse learning, offers an enjoyable and exciting learning environment, helps improve learners retention and motivation, provides an avenue for learners recognition and reward, and promotes fun. Contrary to traditional approach, the researcher noted that, in mathematics laboratory technique: both the teacher and student are active in the teaching and learning processes, the students discover the formulae and concepts in mathematics under the guidance of the teacher and retention and recall of concepts are enhanced. The outcome of these is better achievements; since the students exposed to such benefits hardly forget.

**Conclusion**

The concept of mathematics is not news any longer to lecturers of tertiary institutions. Rather, the problem of human factor of not accepting to replace old ideas with the new ones and lack of adequate knowledge are issues to be considered if mathematics laboratory is to be used as expected in the teaching of mathematics. Therefore, a drive towards good knowledge of effective utilization of the learning materials in the laboratory could boost and encourage lecturers of mathematics to integrate mathematics laboratory for mathematics teaching.

**Recommendations**

Mathematics lectures should be encouraged through training and workshops on the use of learning resources in the laboratory to effectively use the learning materials for mathematics teaching.

Mathematics lecturers should therefore, minimize the traditional methods of teaching mathematics and as much as possible inculcate mathematics laboratory in the teaching of mathematics.

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Mathematics laboratory should be made compulsory for the accreditation of mathematics departments in all institutions of higher learning.

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