MATHEMATICS LABORATORY AS DETERMINANT OF STUDENTS' PERFORMANCE IN MATHEMATICS IN ATIBA LOCAL GOVERNMENT AREA OF OYO STATE, NIGERIA

WAHAB, R. A.
Department of General Studies Education, Emmanuel Alayande College of Education, Oyo

Abstract

This study investigated Mathematics laboratory as determinant of students' performance in Mathematics in Atiba LocalGovernment Area of Oyo State, Nigeria. The descriptive survey design research was adopted for the study. Mathematics teachers in all the public senior secondary schools in Atiba Local Government Area of Oyo State constituted the population for the study and fifteen public secondary schools were randomly selected using simple random sampling technique. In each school, two Mathematics teachers were sampled using purposive sampling technique. A total of 30 respondents were used for the study. A self-designed instrument titled" Mathematics Laboratories and Students` Academic Performance Questionnaire (MLSAPQ)" was used to collect data for the study. The instrument had 3 sections. Section A was on biographical data of the respondents while section B and C contains 10 items each on the Mathematics Laboratories and academic performance of students in Mathematics. The questionnaire was validated by experts in Test and Measurement. The reliability of the instrument was established using test-retest method and this yielded reliability co-efficient of 0.75. The data collected were analyzed using frequency counts and ranking order analysis. The findings revealed Mathematics laboratory is a factor to be considered when it comes to students' academic performance in mathematics in public secondary schools in Atiba Local Government area of Oyo state. It was again revealed that inadequate teachers also a factor that leads to poor performance of students in Mathematics. It was recommended that Mathematics laboratory should be introduced by the Education ministry in public secondary schools. More qualified and experienced Mathematics teachers should be recruited into the public secondary schools and that there is need for regular training for Mathematics teachers through seminars, conference and workshops as these would improve their skills and enhance achieving educational objectives.

Keywords*: Mathematics, Laboratory, Students' Performance in Mathematics.*

Introduction

Mathematics as a universal subject has been described as the foundation of science and technology. The functional role of mathematics to science and technology is multifaceted and multifarious that no area of science and technology and business enterprise escapes its application (Okereke, 2006). Poor academic achievement in Mathematics among students in Nigeria has been a source of concern and research interest to educators, government, parents and other stakeholders. Educators have raised lots of arguments and justifications for improved

investment in education while at different times, blames and faults of students` low academic achievement have been placed at the door step of teachers, students, government, parents and of recent, principals of schools. Mathematics is the gate and key to sciences. It is a subject that enables a learner to have adequate understanding and interpretation of concepts in science and technology which brings about technology (Azuka, 2003) in Akanbi, Omosewo; and Nase (2018).

Consequently, low academic performance of students at the secondary school level portrays a bleak future for the country, if it is not properly handled with ultimate care today (Amuche, 2014). Parents and government have become dissatisfied with yearly results of West African School Certificates (WASC) whichhave been below 40% at the national and 30% at the state levels for students who passed with five (5) credits including English Language and Mathematics in the last decade (WAEC, Chief Examiners` Report, 2004- 2015; Muraina and Muraina, 2014). Supporting the above assertion, the annual results of Senior Secondary School Certificate Examination conducted by West African Examination Council (WAEC) according to Duruji, Azur and Oviasogie, (2014) have at various times justified the generalization of poor secondary school students` performance in different school subjects.

The National Policy on Education (Federal Republic of Nigeria, 2013), placed high premium and emphasis on qualitative science education. Qualitative science education could only be achieved when competent teachers are available. Teacher's effectiveness could be seen as a degree to which a teacher achieves the desired effects upon students. Thus, for a teacher to be competent, he must, therefore, possess the requisite knowledge and skills in the process of teaching (Ogunmakin, 2013) in Salami and Saliu-Sadiq. (2020). Teachers have various role to play in the process of teaching and learning and they need to be competent in their own area of specialization and also be able to apply different methods and strategies of teaching and understand the learning processes of students. The National Policy on Education (Federal Republic of Nigeria, 2013) rightly remarked that no education system may rise above the quality of its teachers (Akanbi, Omosewo; and Nase, 2018). For instance, the results of the 2014 Senior Secondary School Certificate Examination (SSCE) conducted by the West African Examination Council (WAEC) indicated an unabated trend of poor performance by the candidates.

Table 1: Students' Performance in WASSCE (May/June) in Oyo State between 2008 and 2018

Year of Examination	Number of Candidates	Number of Candidates with 5 credits (including English Language and Mathematics)	% of passes	% of failure
May/June 2008	61,332	5,608	9.14%	90.86%
May/June 2009	60,444	7,204	11.92%	88.08%
May/June 2010	65,330	8,757	13.40%	86.60%
May/June 2011	72,559	12,314	16.97%	83.03%
May/June 2012	75,179	16,049	21.35%	78.65%
May/June 2013	74,319	16,197	21.29%	78.21%
May/June 2014	77,685	14,904	19.19%	80.81%
May/June 2015	78,897	17,051	21.61%	78.39%
May/June 2016	40,934	8,457	20.66%	79.34%
May/June 2017	53,850	29,174	54.18%	45.82%
May/June 2018	65,340	24,742	37.87%	62.13%

Sources: Oyo State Government, Ministry of Education, Science and Technology, 2018 and WAEC Result Statistics 2016-2018.

Consequently, table 1 displays the low academic performance of students at the secondary school in English and Mathematics between 2008 and 2018. Despite low performance of students outcomes, there is a clear confirmation that there was improvement from 9.14% to 21.35% in 2008 to 2012; from 19.19 to 21.61% in 2014 to 2015 and 20.66% to 54,18% in 2016 to 2017. Also, there was low improvement in 2018as a result of some factors. However, the performance low again in 2018 when 37.87% was revealed. This further underscores the Federal government's effort not only to sensitize the nation to the importance of quantitative and qualitative teacher education but also to actually produce teachers who are highly motivated,conscientious and efficient. It is in an attempt to accomplish this goal that the Federal government decided that "all

teachers in the educational institution shall be professionally trained" and that colleges of education, institutes of education, national teachers' institute, polytechnics shall be charged with the responsibility of giving the most cherish professional training.

Similarly, Fajonyomi (2007) in Salami and Saliu-Sadiq (2020) stated that the success or failure of any educational program rests largely on the adequate availability of qualified, competent and dedicated teachers. This implies that the more experienced a teacher is, the more efficient and effective he becomes in teaching and the more his students understand his lessons and possibly perform better in the examination. Thus, learning becomes engaging as a result of using concrete materials. It was further stated that if the laboratory is not in place or not stocked with the needed apparatus, science teachers will not have materials toteach and guide the students. The absence of these materials may affect student's interest, enrolment and performance in science. Danjuma and Adeleye (2015) in Salami and Saliu-Sadiq, (2020) found that lack of effective utilization of laboratory apparatus and equipment was responsible for students' poor performance. Similarly, the best, the fair/average and the poor students have been noticed via these examinations. Also, Adesemowo (2005) asserted that poor academic achievement has also been observed in school subjects especially in Mathematics and English Language.

Bellingham (2007) defines laboratory as the physical facility designed and equipped for carrying out scientific experiments for students' practice, teaching or research. It was further puts that laboratory roomis a special instructional place designed or provided with special built-in equipment for pupils' participation in learning activities involving scientific or applied experimentation. It is a room or building equipped for scientific research and for conducting experiments especially under controlled condition. Mathematics laboratory according to Andrew (2006) means different things to different teachers. The mathematics laboratory is a specially equipped room in a building where mathematics lessons or activities hold on regular basis or a corner of a regular classroom with tables and apparatus or room containing a collection of teaching aids for student manipulation, it is a learning environment where many young minds decide that mathematics is more than practicing addition and subtraction that the teacher assigns.

In a nutshell, mathematics laboratory is a place where students have contact with real objects to facilitate easy learning. The researchers (Okigbo and Osuafor 2008, Manjunath 2008) recommended the use of Mathematics laboratory in the teaching of Mathematics. Laboratory teaching strategy is an activityperformed by an individual or a group of students for the purpose of making personal observations or processes, products or events. Laboratory work is considerably important because they provide the opportunity for students to perform various hands-on activities. There have been many studies reporting on the effectiveness of the laboratory instruction on students' understanding of science concepts. In laboratory teaching students are involved in the discovery of mathematical relations and properties.

In this method students are expected to do some thinking when they collect some apparatus, playgame conduct experiment or measure objects. Students are involved in exploration of mathematical applications by providing facility, which incorporates experiences and practices in the learning of Mathematics and in the study of its related application. One of the reasons for low and poor achievement in Mathematics is lack of laboratories in schools. The problem of ineffective teaching can be tackled through

planned and intelligent application of Mathematics laboratory. The teaching of mathematics with Mathematics laboratory will lead students to formation of concepts out of experience with concrete objects (Okigbo and Osuafor, 2008). According to (Ogunkunle, 2008) Mathematics laboratory displays mathematical information, it is an avenue for easy access, and it removes abstraction and increases effective teaching and learning.

The concepts of laboratory teaching strategy seek to improve the teaching and learning of Mathematics. According to Onuoha (2006) in Akanbi, Omosewo; and Nase, (2018), teaching science, technology and Mathematics without laboratories and workshops in which these subjects are practiced will never give a thorough grasps of the principles of these subjects. It was considered essential because it provides training in observation supply detailed information and arouses pupils'/students' interest. The teaching of Mathematics should deal with process and not just confine to transferring knowledge from the mind of the teacher to notebooks of students through the tip of a pen and for such a phenomenon change in Mathematics teaching, a right ambience is required and it is definitely Mathematics laboratory. The laboratory approach proposes that the experiment origin of Mathematics should be fully recognized.

This means that the students should be left to feel the significance of Mathematics to through some material. It is worthy also to note here that the laboratory experiments for Mathematics serve either of two purposes to apply mathematics already known (in the case of proving a particular theorem), or to formulate new mathematics problems for study. In any case, the real mastery experiment in the laboratory but requires mathematics drill. Obodo (2004) enumerates the merit of laboratory teaching as an instructional strategy in Mathematics: It relates learning to past experience and provides new experience where it is required. It also provides a non-theorizing environment conductive to learning and to progress at his/her own rate and provides interesting problem for the students to verify. Likewise, Utim (2006) in Akanbi, Omosewo; and Nase, (2018) strongly advanced Mathematics laboratory as it emphasis understanding and meaning rather than manipulation skills, demonstrates something in several different ways to heighten the learner's interest and deepen the learner's insight and encourages initiation and original thinking. Therefore, the teaching of any subject in an interesting way is subject to appropriate pedagogy. Based on the advantages of Mathematics laboratory, it is expected that teaching and learning of mathematics with a standard laboratory may help to reduce the abstract nature of the subject

Statement of the Problem

Over the years, the scenarios in general examinations has portray undesirable trend of poor academic performance in Mathematics among the candidates in these public examinations, it is also worrisome because candidates found it difficult to acquire the basic minimum requirements in major subjects particularly Mathematics for pursuing tertiary education in universities, polytechnics and Colleges of Education.

Previous studies have pointed to several factors such as environmental factors, parental factors, teachers' factors, school factors with little emphasis on Mathematics laboratory. The pathetic situation is that the students would not be gainfully engaged and would neither be in school, hence become "unadmitted students". This study thus examined mathematics laboratory as determinant of students' performance in mathematics in Atiba Local Government Area of Oyo State.

Research Questions

The following research questions were raised and answered in the study:

(i) Do we have adequate Mathematics laboratories in public secondary schools in Atiba Local Government Area of Oyo State?

(ii) What are the benefits of Mathematics laboratories in public secondary schools in Atiba Local Government Area of Oyo State?

(iii) What are the consequences of inadequate Mathematics laboratories on students' academic performance in public secondary schools in Atiba Local Government Area of Oyo State?

Methodology

The study adopted the descriptive survey design research. Mathematics teachers in all the public senior secondary schools in Atiba Local Government Area of Oyo State constituted the study's population. Fifteen public secondary schools were randomly selected using simple random sampling technique. In each school, two Mathematics teachers were sampled using purposively sampling technique. A total of 30 respondents were used for the study. A self-designed instrument titled" Mathematics Laboratories and Students` Academic Performance Questionnaire (MLSAPQ)" was used to collect the data for the study. The instrument had 3 sections. Section A was on biographical data of the respondents while section B and C contains 10 items EACH .on the Mathematics Laboratories and academic performance of students in Mathematics. The questionnaire was validated by experts in Test and Measurement. The reliability of the instrument was established using test-retest method and this yielded reliability co-efficient of 0.88. The data collected were analyzed using frequency counts and ranking order analysis.

Answering the Research Questions

Research Question 1: Do we have adequate Mathematics laboratories in public secondary

schools in AtibaLocal Government Area of Oyo State?

Table 2: Adequacy of Mathematics Laboratories in Schools

S/N	Items	SA	A	D	SD	M	Rank
1	Using Mathematics laboratories is expensive	2	5	1	22	2.30	5
2	Rate of failure is high without Mathematics laboratories	16	7	4	3	3.20	3
3	We have adequate Mathematics laboratories in my school	25	3	1	2	3.04	4
4	Inadequate Mathematics laboratories cause failure among students	14	12	1	3	3.86	1
5	Mathematics laboratories is students' friendly	17	5	6	2	3.30	2
	Average Weighted Mean= 3.14						

Table 2 presents respondents' views on the adequate Mathematics laboratories in public secondary schools in Atiba Local Government Area of Oyo State with weighted mean to each item. The highest ranking was revealed in items 4, with mean of 3.86, respondents' opinion was that Inadequate Mathematics laboratories cause failure among students. This indicates that Mathematics laboratories promote success (performance) among students. The lowest ranking with mean of 2.30 was found in item 1. The respondents' opinion was that Using Mathematics laboratories is expensive. It means that Mathematics laboratories is significant to students' academic performance in public secondary schools in Atiba Local Government Area of Oyo State which is in line with the opinion of Okigbo and Osuafor (2008) that one of the reasons for poor and low achievement in Mathematics as a key and required subjects is lack of Mathematics laboratories in our schools.

Research Question 2: What are the benefits of Mathematics laboratories in public secondary schools in Atiba Local Government Area of Oyo State?

Table 3: Benefits of Mathematics Laboratories in Schools

S/N	Items	SA	A	D	SD	M	Rank
1	Mathematics laboratories enhance creativity among students	20	5	4	1	10.4	2
2	Using Mathematics laboratories help students' imagination	12	7	8	3	8.8	5
3	Practical is demonstrated in Mathematics laboratories	28	1	1	-	11.7	1
4	Mathematics laboratories promote critical thinking	11	10	6	4	9.0	4
5	Mathematics laboratories promote students'inquisitiveness	20	5	1	4	10.1	3
	Average Weighted Mean = 5.00						

Table 3 presents respondents' views on benefits of Mathematics laboratories in public secondary schools in Atiba Local Government Area of Oyo State with weighted mean to each item. The highest ranked weighted mean was items 3, with mean of 11.70 with respondents' opinion that Practical is demonstrated in Mathematics laboratories while the lowest ranked weighted mean of 8.8 was found in item 2. The respondents' opinion was that using Mathematics laboratories help students' thoughts (reasoning). It means that Mathematics laboratories has gingered the students' academic performance in Mathematics in public secondary schools in Atiba Local Government Area of Oyo State which is in line with the opinion of Adedayo & Owolabi, (2014) and Akanbi, Omosewo, and Nase, (2018) that Mathematics teaching in secondary schools should develop essential scientific skills in the learners capable of infusing into them creative mind to enhance their technological applications. It thus requires that adequate laboratory facilities needed be provided for effectiveteaching and learning.

According to Uhumuavbi and Okodugha (2014), the use of laboratory as a method of teaching science helps the students to develop manipulative skills. It leads to better retention of information and also the development of favorable attitudes towards school subjects. The students during the use of laboratory are active participants who acquire more knowledge by performing experiments.

Research Question 3: What are the consequences of inadequate Mathematics laboratories on students' academic performance in public secondary schools in Atiba Local Government Area of Oyo State?

Table 4: Inadequate Mathematics Laboratories on Students' Academic Performance

S/N	Items	SA	A	D	SD	M	Rank
1	Without Mathematics laboratories, students' imagination is very low.	24	-	1	-	2.30	5
2	Without Mathematics laboratories, criticalthinking become lower	22	4	2	2	3.20	3
3	Without Practical demonstration in laboratories, some topics become complex in the ordinary class	25	3	2	-	3.04	4
4	Inadequate Mathematics laboratories enhance students' mass failure	20	8	1	1	3.86	1
5	Poor Mathematics laboratories reduce students' inquisitiveness	15	5	4	6	3.30	2

Table 4 presents respondents' views on consequences of inadequate Mathematics laboratories on students' academic performance in public secondary schools in Atiba Local Government Area of Oyo State with weighted mean to each item. The highest ranked weighted mean was items 4 with mean of 3.86 with respondents' opinion that Inadequate Mathematics laboratories enhance students' mass failure. Also, the lowest ranked weighted mean was items 1, with mean of 2.30. The respondents' opinion that Without Mathematics laboratories, students' imagination is very low. It means that Mathematics laboratories is a factor to be considered when it comes to students' academic performance in Mathematics in public secondary schools in Atiba Local Government Area of Oyo State this is in line with the opinion of Akanbi, Omosewo and Nase, (2018) that learning becomes engaging as a result of using concrete materials. Furthermore, they stated that if the laboratory is not in place or not stocked with the needed apparatus, the science teacher will not have materials to teach and guide the students. The absence of these materials may affect student's interest, enrolment, and performance in science. Similarly, Danjuma and Adeleye (2015) found that lack of effective utilization of laboratory apparatus and equipment was responsible for students' poor performance.

Conclusion

It is expected that Mathematics teaching in public secondary schools should develop essential scientific skills in the learners capable of infusing into them creative mind to enhance their skills and technological applications. It thus requires that adequate Mathematics laboratory facilities needed to be provided for effective teaching and learning. In addition, the use of laboratory as a method of teaching science helps the students to develop manipulative skills. It leads to better retention of information and also the development of favorable attitudes towards school subjects. The students during the use of laboratory are always active and do acquire more knowledge by performing experiments and familiar with observing, inferring, classifying, measuring and data interpretation. It is expected that necessary

attention should be paid to Mathematics laboratory facilities inclusion in the learning of Mathematics in public secondary schools justfor the better performance of students in Mathematics

Recommendations

Based on the findings of the study, the following recommendations were made that:

- Mathematics laboratories should be introduced by the Ministry of Education in public secondary schools in Atiba Local Government Area of Oyo State.
- More qualified and experienced Mathematics teachers should be recruited into the public secondaryschools in Atiba Local Government Area of Oyo State.
- There is need for regular training for Mathematics teachers through seminars, conference andworkshops.

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