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Adequacy of Resource Materials and Students' Mathematics Achievement of Senior Secondary Schools in Southwestern Nigeria

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Abstract: The study looked at the adequacy of resource materials (mathematics laboratory) and its attendant effect on students' mathematics achievement in some selected secondary schools in Southwestern Nigeria. The study adopted the descriptive survey design and simple percentages were used in analysing the data. Three validated instruments (QMT, SMAS and MAT) were used in collecting data for the study. The subject of the study was made up of 1750 senior secondary school students and 123 Mathematics teachers selected from 2 secondary schools in each of the Senatorial districts in Southwestern part of Nigeria. The results showed that most of the teachers (75%) have a good perception of the need and importance of mathematics laboratory in the school, while few teachers (25%) do not perceive the need to have a mathematics laboratory in the school. The result also showed that students exposed to the use of mathematics laboratory performed better (65%) than students that were not exposed to it and the level of infrastructural facilities available in the schools were very poor. The study therefore, recommends that Mathematics laboratories be established in every school and more teaching aids be provided for effective students learning.

Key words: Resource materials, Mathematic laboratory, academic achievement, Southwestern Nigeria, senior secondary school

INTRODUCTION

Laboratory has been described as a room or a building specially built for teaching by demonstration of theoretical phenomenon into practical terms. With the laboratory experience, students will be able to translate what they have read in their texts to practical realities, thereby enhancing their understanding of the learnt concepts. Farombi (1998) argued the saying that seeing is believing is the effect of using laboratories in the teaching and learning of science and other science related disciplines as students tend to understand and recall what they see more than what they hear. Laboratory is very important and essential to the teaching of science and success of any science course is much dependent on the laboratory provision made for it. Lending credence to this statement, Ogunniyi (1982) said that there is a general consensus among science educators that laboratory occupies a central position in science instruction. It could be conceptualized as a place, where theoretical work is practicalized and practicals in any learning experiences involve students in activities such as observing, counting, measuring, experimenting, recording and carrying out fieldwork. These activities could not be easily carried out, where the laboratory is not well equipped. There is usually a strong move to emphasize the dependence of mathematics teaching on the existence of a well-equipped mathematics laboratory. In this study, Bajah (1980) found that the correlation between the laboratory adequacy and Chemistry achievement is significant. Ango and Silo (1986) asserted that laboratory work among others:

- Stimulate learners interests as they are made to personally engage in useful scientific activities and experimentation
- Affords the learner the basic skills and scientific method of solving problems
- Promotes long term memory of the knowledge obtained

MATERIALS AND METHODS

All these could be possible if the laboratory is adequate. With adequate resource materials, it is expected that there will be enough materials and equipment to go round the students at any given time of practicals. The establishment of a mathematics laboratory is one way of stimulating interest in learning mathematics. A mathematics laboratory is a place, where things can be stored, kept, counted, ordered, recorded, packed, unpacked, grouped, regrouped, arranged, rearranged, measured, joined and partitioned among numerous other activities. The students carry out their projects and other

activities in the laboratory. The Mathematics laboratory should be the focal points of all mathematics work in the school. It should be the calculating center of the school. The truth of abstractions is demonstrated in a concrete manner and the students, who are slow to comprehend abstractions appreciate them more readily and become interested in mathematics. The mathematics laboratory is a specially equipped room in a building, where mathematics lessons or activities hold on a regular basis or a corner of the regular classroom with tables and apparatus or a room containing a collection of teaching aids for students manipulation (Odili, 1990). It is also a remedial environment, where advantaged or disadvantaged, the poorest or the best gifted students may have active sensory experiences from which concepts emerge. It is a resource centre for the learning of mathematics. It is based on the principle of doing, learning by observation by proceeding from concrete to abstract. Some of the advantages of having a mathematics laboratory according to Ezike and Obodo (1991) include:

- It makes mathematics learning very interesting, meaningful and exciting
- It is a means of verifying a mathematical principle, law or theory
- It can be used to illustrate basic principles, laws or rules and development of such principles, laws or rules
- It is a means of practicing one or more of the cognitive and psychomotor skills like the ability to construct, measure, arrange, observe, classify and interprete data
- It provides opportunity for students to learn how to use cutters, turners, drill bits, mathematical set, paint, brush, models of solids and charts and other kinds of laboratory equipment in mathematics
- It encourages mathematical exploration and manipulation by students and keeps them alive and thinking, which also helps them to realize the applications of mathematics

When students are exposed to practical or practical activities, they are stimulated and after, develop confidence and ability in problem solving (Onwu and Moneme, 1986; Raimi, 1998). Adequate laboratory helps to provide a forum wherein the learner is given the exercise to subject his beliefs, idea, statements and theoretical proposition to tests. In the absence of adequate resources and equipment for practical activities, practicals can rarely be experienced by students at any level or frequency in the learning of science in general and Mathematics in particular.

No matter how excellent and attractive a teaching learning approach is, it only becomes relevant and important if practical activities are built into the daily teaching learning experience of students. To maintain and arouse the interest of students in this perspective, the teacher should be effectively involved in order to transform knowledge and facts to the learner for a good performance in any examinations.

To what extent has laboratory been able to achieve these objectives? Odulaja and Ogunwemimo (1989) said that the teacher assumes a position of dispenser of knowledge with the laboratory serving the function of drill or verification. They further explained that at the other extreme, the teacher assumes the position of guide to learning and laboratory as a place, where knowledge is discovered. However, there are growing evidences that teachers do not exhibit behaviours, which are complementary to achieving the stated objectives. These objectives include improving on:

- Method of teaching practical work
- Inadequacy or absence of well-equipped laboratories
- High enrolment of students
- Inadequacy of resources for teaching and learning practical work
- Quality and quantity of teachers

In their opinions, Salisu and Ismaila (1999) and Onosoga (1996) and Okegbile (1999) asserted that practical work has the basic important role in the teaching and learning of science. They further posited that practical activities have motivation and propelling effect on students, enhancing their understanding of science concepts and phenomena.

Nwachukwu (1984) discovered in her survey of resources for the teaching and learning of Biology in some new secondary schools in Lagos that there was a general inadequacy of resources. She also found among other things that:

- Out of 80% of the old schools that had laboratories, none had a well-equipped laboratory
- About 40% of the schools had no laboratory at all, while the remaining 60% had rooms labeled laboratory without adequate apparatus.

She concluded that teaching of Biology practicals would be difficult and that the students learning experiences would be limited.

Gilbert (1994) and Hodson (1996) also lent credence to the significance of practical work in the learning of science. In their submission, they identified six major significance of practical work in promoting effective learning of science thus:

- Motivating students by stimulating interest and enjoyment
- Teaching laboratory skills
- Assisting concept acquisition and development
- Developing and understanding of scientific inquiry and developing expertise in conducting inquiries
- Encouraging social skills development
- Inculcating the so-called scientific attitudes

Okoli (1995) reported that laboratories have become shelves of empty bottles of chemicals, while writing on the situation in the secondary schools today. While delivering a research entitled in search of indices for measuring the standard of education a need for a shift in paradigm Adeyegbe (2005) listed laboratory adequacy as one of the factors that affect the learning outcomes of students. In terms of academic achievement, Soyibo and Nyong (1984) have shown that schools with well-equipped laboratories have better results in the certificate examinations than those that are ill-equipped. Corroborating this, Gana (1997) reiterated that students instructed entirely by the laboratory methods had higher attitudinal scores but lower achievement scores than students instructed entirely by the traditional lecture or textbook mode.

From the fore-going, it can be inferred that practical activities motivate students and are a major attraction for them to study science particularly Mathematics. Not only this, it can also be deduced that without adequate laboratory equipment and resources, there is little or no practical activity that could take place and consequently any meaningful achievement in Mathematics by the students will be a mirage. These several claims by researchers on the relationship of laboratory with student achievement necessitated this research.

Research questions: The following questions were answered:

- What is the level of infrastructural facilities available in the schools?
- What is the perception of Mathematics teachers towards Mathematics laboratory programme in the school?
- Do the Mathematics students possess mathematical materials for studying Mathematics?
- Will the mathematics laboratory programme improve students achievement in mathematics and attitude towards mathematics?

Participants: The participants for the study comprised of 1750 senior secondary school students and 123 Mathematics teachers from 36 senior secondary schools drawn from the six states in the Southwestern part of Nigeria.

Instruments: Two instruments were used for data collection. These instruments are Questionnaire for Mathematics Teachers (QMT), Students Mathematics Attitudinal Scale (SMAS) and Mathematics Achievement Test (MAT).

Questionnaire for Mathematics Teachers (QMT): The QMT was developed by the researcher. It consists of Section A, which is made up of 10 questions dealing with the name of the school, age, gender, qualification, years of experience, number of students in the mathematics class of teachers, number of periods of teaching mathematics in a week. Section B consists of 14 items, which deal with the attitude of teachers towards the teaching of mathematics and has the options Strongly Agree (SA), Agree (A), Disagree (D) and Strongly Disagree (SD) and rated on the four point Likert Scale; Section C has 7 items, which deal with the perception of teachers towards mathematics laboratory programme in schools. The instrument was validated and the Cronbach alpha value obtained was 0.67.

Students Mathematics Attitudinal Scale (SMAS): This is an attitudinal scale developed by the researcher and it is made up of statements relevant to mathematics. It is made up of two sections (A and B). Section A solicits for personal information about students like school, gender, age and local government area. Section B consists of forty items. The statements were rated on a four point Likert scale of Strongly Agree (SA), Agree (A), Disagree (D) and Strongly Disagree (SD). Scoring will be 4, 3, 2,1 for SA, A, D, SD, respectively for positively worded items, while negatively worded items ratings was reversed. The SMAS was validated with calculated Cronbach alpha value of 0.75.

Mathematics Achievement Test (MAT): This test was developed by the researcher in order to assess the level of acquisition of mathematical concepts of the students. It covers the main topics of mathematics taught in SS2 up to the third term of the school year. It consists of 40-item multiple choice questions with 4 options A-D and was based on three cognitive levels knowledge, understanding and application. The test items were scored manually. Each correct answer attracted one mark, while a wrong answer was scored zero. The level of achievement of a student was taken to be the student's total test score. Kuder-Richardson formula KR-20 was used to determine the reliability coefficient. The value obtained was 0.74. The average difficulty index obtained was 0.45, which shows that the instrument was neither too difficult nor too simple.

RESULTS AND DISCUSSION

The results are presented according to how the questions are raised.

What is the level of infrastructural facilities available in the schools?: The level of infrastructural facilities available in the school in terms of teaching aids was very low especially in Mathematics (5%) as compared to other science-based courses like Chemistry (25%), Physics (19%), Biology (36%) and Introductory Technology (15%). Other facilities that can aid learning like chalk-board, textbooks, dusters, chalk, maps, Blackboard rulers and Mathematical instruments were not adequately available in most of the schools visited. Many of the schools do not have the Blackboard Mathematical Instruments in their store for use by Mathematics teachers during Mathematics lessons. This showed that the levels of infrastructural facilities available in these schools were not adequate for effective learning of Mathematics and this has very grave consequences on the performance of students in Mathematics. These results are contrary to the opinions of Ezike and Obodo (1991) about the advantages of having a Mathematics laboratory in the school.

What is the perception of Mathematics teachers towards Mathematics laboratory programme in the school?: Most of the teachers (75%) have a good perception of the need and importance of Mathematics laboratory in the school, while few teachers (25%) do not perceive the need to have a mathematics laboratory in the school. These few teachers believed that with the provision of adequate Mathematics textbooks for the teachers and students, mathematics learning can effectively take place and the students' performance will be very high.

Do the Mathematics students possess mathematical materials for studying Mathematics?: Results from the schools used for the study revealed that most of the students (65%) had no Mathematical instruments, while some students (25%) had incomplete Mathematical instruments, while only few students (10%) had complete mathematical instruments with them. Many students (60%) had no Mathematics textbooks, while the few that had were having defaced textbooks. The results showed that majority of the students do not have Mathematical materials necessary for studying mathematics and this can lead to poor performance in the subject. When students are equipped with the right Mathematical materials, the learning of mathematics becomes very practical. The possession of Mathematics textbook by the students will help the teacher to give take home assignment to students to practice at their own pace and this will help to concretize the already learnt concepts in the class.

Will the mathematics laboratory programme improve students achievement in mathematics and attitude towards mathematics?: Results of the study revealed that students exposed to the use of Mathematics laboratory performed better (65%) than those students, who were taught without the use of Mathematics laboratory (35%). This could be due to the fact that teaching mathematics by making the students to conduct practicals to investigate theorems assisted them in understanding the concepts better. This in turn helped them to be able to solve mathematical problems better. Also, the mathematics laboratory sessions made mathematics learning very exciting, interesting and meaningful to the students as this was discovered by the way students were eager to use the instructional materials to carry out the practical, their actions during the practicals and their discovery at the end that after all, theorems are not abstract but real to life. This finding supports the claims of Odili (1990), who maintained that the mathematical laboratory should be the focal point of all mathematical work in the school. The result further corroborates the view of Adeniran (2006) that laboratory instructional strategy gives a new approach to Mathematics learning because it provides a non-threatening, realistic and concrete approach to learning of Mathematics as opposed to the difficulty encountered in learning the formal, abstract treatment of the typical textbook. The result of this study also agreed with that of Oyedeji (2000), where he discovered that students taught with Mathematics Laboratory Instructional Strategy performed significantly better than the control group in geometry. Findings of this study also agreed with Etukudo and Utin (2006), who carried out a study on the effect of laboratory and discussion methods of teaching on students performance in Mathematics at the secondary school level.

The reason for better performance and positive attitude toward Mathematics could be because students were exposed to concrete objects in learning Mathematics. Mathematics laboratory instructional strategy enabled the students to verify and discover several geometrical properties using models, paper cutting and folding techniques. Another reason might be because Mathematics Laboratory Programme provided opportunity for individual participation in the process of learning.

CONCLUSION

It provides scope for greater involvement of both mind and the hand, which facilitated cognition. Mathematics Laboratory Programme enables the teacher to demonstrate, explain and reinforce abstract

mathematical ideas by using concrete objects, model, charts, graphs, pictures and posters etc. All these have the potential of increasing students attitude towards the study of Mathematics.

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