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Maximizing the Use of Mathematics Laboratory for Effective Understanding of Basic Science and Mathematics Concept

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Abstract
The study sought to investigate the maximal use of the mathematics laboratory for effective understanding of basic science and mathematics concepts. To achieve the purpose of this study, one null hypothesis was formulated. An experimental design was employed for this study. Fifty (50) SS2 students were obtained across six (6) senior secondary schools in Akamkpa local government area of cross river state. Using a simple random sampling technique they were divided into two groups of twenty five (25) students each. The first group was called the experimental group; these groups of students were taught basic science and mathematics concepts using the laboratory; the second group was called the controlled group; these groups of students were taught basic science and mathematics concept in a conventional or normal classroom. The instrument for data collection was a self-structured practical test questionnaire title: EFFECTIVE USE OF MATHEMATICS LABORATORY TEST (EUMLT).With reliability index of 0.87. The hypothesis was tested using the independent t-test analysis at $p>0.05$ level of significance, the result showed a mean score of 10.09 of the experimental group which was higher than the mean score of 8.02 for the controlled group. The analysis reveals that students who were taught mathematics and basic science using the laboratory were better than those who were not taught. Several recommendations were posed on the need for the use of mathematics laboratories in teaching and learning of basic concepts in our secondary schools.
Keywords : Laboratory, Basic concepts, mathematics , Basic science

Introduction

The use of sensory aids in the teaching of mathematics is of recent origin.
In fact, all the teachings have always involved the communication of ideas through the senses either orally through the medium of speech or usually by the use of written or printed materials. Textbooks, written materials, geometrical instruments and the black board have long been regarded as indispensable equipment for mathematics classes.

According to Kubir (2014), for many years, resourceful teachers have used models, instruments, drawings and other devices to stimulate interest and facilitate learning. Mathematics is essentially a subject where doing is more prominent than reading. That is why the use of equipment and mathematics laboratory is indispensable in order to even start the teaching and learning of this subject. Moreover, it is felt by a vast majority of people that mathematics is a dry and difficult subject, full of abstract things. The result is that students take very little interest in the use of laboratory equipment to create the necessary excitement in carrying out simple mathematical computations.

In addition to the personal equipment of the child, there are numerous special items or equipment which can be provided advantageously for general use in the mathematics laboratory. There is a rapid growth in the feeling that elementary mathematics can profit greatly by the introduction of laboratory work. This will in addition popularize the subject, apart from making it concrete and physical.

The mathematics laboratory is no longer a misnomer: it has become in many places an established medium of giving meaning and interest to the subject. Therefore, mathematics equipment should be made available through mathematics laboratory as much as possible and the expenses on such equipment should form a legitimate part of the school budget.

However, the effective utilization of the mathematics laboratory for understanding of basic science and mathematics concept has become a subject of discourse. The non-availability and non-utilization of laboratory equipment has made the teaching and learning of mathematics boring which inhibits students' interest in the subject and reduce understanding.

Theoretical Framework

Jean Piaget cognitive development theory.

Jean Piaget received his studies in zoology. Consequently, his theory has a distinct biological flavor. According to Piaget, human infants do not start out as cognitive beings. Instead, out of their perceptual and motor activities, they build and refine psychological structures, organized ways of making sense of experience that permit children to adapt more effectively to their external world. In the development of these structures, children are intensely active. They select and interpret experiences using their current structure, and they modify those structures so that they take into account more subtle aspect of reality. Because, Piaget viewed children as

discovering or constructing, virtually all knowledge about their world through their own activity, his theory is often referred to as a constructivist approach to cognitive development.

Piaget believed that children move through four stages of development which are the sensory-motor, pre-operational, concrete operational and the formal operational. Piaget had a major educational impact especially at the pre-school and early elementary school levels. One of which concerns the use of laboratory that involves the manipulative ability of the child towards discovery learning.

Ukeje (1986) posits that in a Piagetian classroom, children are encouraged to discover knowledge by themselves through spontaneous interaction with the environment. Instead of presenting ready-made knowledge verbally, teachers provide a rich variety of activities in the school laboratory designed to promote exploration.

The Mathematics Laboratory

The Concept

The mathematics laboratory is a place or a building where mathematics hands-on activities or practice-based experiences are taught. It is an open space preferably 14*14 metres where students stay to construct, assemble and organize materials used in the teaching and learning of mathematics. For effective teaching and learning of mathematics in schools, the use of concrete objects to explain abstract concepts must be emphasized and this can only be possible where equipments are available to aid or facilitate such process.

The Facilities

The mathematics laboratory must have the following facilities for effective students' usage;

Chalkboard: this is the first mathematical equipment in the mathematical laboratory; it is the minimum equipment which is sometimes regarded as the second tongue of the mathematics teacher. The teacher uses it to write statements, problems and their solutions, some points that need emphasis as well as draw relevant diagrams.

Concrete Materials: This type of materials include many concrete objects, such as beads, balls , frames, pebbles, sticks, seeds, weighing scales, measuring tapes, scissors, pins, abacus, cardboards, board pins, chart paper, graph paper etc. which are very helpful for demonstrating elementary mathematics concepts.

Pictures and Charts: Pictures of mathematicians, history of mathematicians, chart showing contributions of mathematicians, biographies of mathematicians are very helpful in inspiring students and can be placed in the mathematics laboratory

Models: Various mathematical models which will offer opportunities for students to explore and investigate should be placed in mathematics laboratory

Statement of the Problem

Mathematics teaching and learning in today's school is text book dominated. (Igbokwe, 2000). It is concerned primarily with the manipulation of symbols and figures which most often takes the child largely away from the real world of the child. Endless repetition, meaningless memorization and general lack of interest are other few reasons that cultivate negative attitudes towards mathematics.

Taking into consideration the national aspirations and expectations reflected in the recommendations of the national curriculum framework (NCF) developed by NCERT, a number of steps to make teaching and learning of mathematics at school stages activity based and practice oriented have been emphasized.

Mathematics laboratory is a place rich in manipulation of materials to which children have ready access to handle them, perform mathematical experiments, play mathematical games, solve mathematical problems, puzzles and set up mathematical experiments for the purpose of discovering some mathematical principles, patterns or processes. These activities may be carried out by the teacher or the students to explore, learn, stimulate and develop favourable attitude towards mathematics. More involvement of students in laboratory work helps in satisfying the creative and constructive urges of students.

Evidence of poor performance in mathematics by secondary school students point to the fact that the most desired technological, scientific and business application of mathematics cannot be sustained. This makes it necessary to seek for a strategy for teaching mathematics that aims at improving its understanding and performance by students (Srinvasa, 2001; Ogunkunle, 2000).

However, despite the mathematical implication of the use of the mathematics laboratory, several teaching and learning process have been carried out exclusively without recourse to the mathematics laboratory, thereby making the subject difficult to learn and full of abstract experiences, reducing students' interest in the subject. This study however looks at maximizing the use of mathematics laboratory for effective understanding of basic science and mathematics concepts.

Purpose of the Study

The purpose of this study is to find out how effective use of mathematics laboratory can enhance understanding of basic science and mathematics concepts.

Research Question
In order to guide the research, the research question was stated thus: how does effective use of mathematics laboratory influence understanding of basic science and mathematics concepts?

Research Hypothesis
The null hypothesis for the study is as follows;
H0: effective use of mathematics laboratory does not significantly influence understanding of basic science and mathematics concepts.

Research Design
The experimental research design was employed in this study; the dependent variable is understanding of basic science and mathematics concepts while the independent variable is effective use of mathematics laboratory.

Research Instrument
The research administered a self-structured practical test questionnaire title: Effective Use Of Mathematics Laboratory Test (EUMLT) and validated the items by giving them to experts in mathematics education for content and construct validity, the reliability of the instrument using the test retest method, the computed reliability coefficient using split-half method was 0.87.

Sample
Fifty (50) SS2 students were selected across six (6) senior secondary schools in Akamkpa local government area of Cross River State. Using a simple random sampling technique, they were divided into two groups of twenty five (25) students each. The first group was called the experimental group; these groups of students were taught basic science and mathematics concepts using the laboratory; the second group was called the controlled group; these groups of students were taught basic science and mathematics concept in a conventional or normal classroom. After the instruction, the researcher administered the instrument (questionnaire test) to both groups of students to ascertain their level of understanding of basic science and mathematics concepts.

Data Analysis Techniques
The mean score and standard deviation were first computed, the researcher then computed the t-test of 2.01*. This is found to be greater than the critical t-value of 1.860 at 0.05 level of significance.
Table 1.0 shows t-test analysis of students' effective use of the mathematics laboratory and understanding of basic science and mathematics concept

Variables	N	X	SD	T-VALUE
Experimental group	25	10.09	3.23	2.01*
Control group	25	8.02	2.10	

Significant at $p<0.05$ level, df=48, Critical t-value = 1.86

Result
According to the above table of analysis, effective use of mathematics laboratory has been accounted to enhance understanding of basic science and mathematics concepts.

Interpretation
The result in the table above reveals that the calculated t-value of 2.01* is greater than the critical t-value of 1.86 at 0.05 level of significance with 48 df. With this result, the null hypothesis was rejected which means that the use of mathematics laboratory significantly maximize the understanding of basic science and mathematics concepts.

Summary and Recommendation
Effective use of mathematics laboratory in the teaching and learning of basic science and mathematics have been seen to highly improve understanding. Mistakes teachers make in trying to deliver basic concepts in a conventional classroom without reference to practical and physical manipulation of materials to enhance understanding; this mistake should be worked upon by mathematics teachers.

Salau (1995) agrees that students' proficiency can be improved when provided with the opportunity to understand and internalize the basic mathematical concepts through concrete objects and situations and provide the students the opportunity to exhibit the relatedness of mathematical concepts with everyday life.

Thus, this study recommends that emphasis should be laid on the teaching and learning of mathematics in the laboratory; schools should ensure the provision of the basic materials needed in the laboratory in order to enable the teachers explain and show visually how several abstract thoughts are related in real life situations.

Also, the government should establish mathematics laboratory in all schools like other science subject laboratories.

Effective training on the use of the mathematics laboratory should be carried out in order to equip the mathematics teachers with the required knowledge.

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