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Role of Laboratory in Teaching and Learning of Mathematics in Adamawa State College of Education, Hong

hussaini buba gayus[1] vincent christopher[2] dahiru ahmadu[3]

Department of Adult and Non-formal Education Adamawa State College of Education, Hong[1]
Department of General Education studies Adamawa State College of Education, Hong[2]
Department of Adult and Non-formal Education Adamawa State College of Education, Hong[3]

Correspondence: hussainigayus@gmail.com[1] +2347066369100, +248022525566

Abstract

Evidence of poor performance in mathematics by student's in Adamawa state college of education, Hong. Point to the fact that the most desired technological, scientific and business application of mathematics cannot be overemphasized. This makes it paramount to seek for a strategy for teaching mathematics that aims at improving its understanding and performance by students. The investigation and the effects of using mathematics laboratory in teaching students in mathematics are specifically. To investigate the extent to which the use of mathematics laboratory will enhance the achievement of mathematics by students. To compare the achievement of male and female student taught with mathematics laboratory.

Key words: Mathematics Laboratory, Academic Achievement, Gender, Teaching Strategy, Hands-on learning

Introduction

Mathematics is the foundation of science and technology and the functional role of mathematic to science and technology is multifaceted and multifarious that no area of science, technology and business enterprises escapes its application (Okereke 2006). Ukeje, (1986) described mathematics as the mirror of civilization in all the centuries of painstaking calculation, and the most basic discipline for any person who would be truly educated in any science and in many other Endeavour. Despite the importance placed on mathematics researchers (Odili, 1986; Salau, 1995; Amazigo 2000; Agwagah, 2001; Betiku 2001; Obioma 2005; Maduabum and Odili 2006; Okereke 2006) had observed that students lack of interest in the subject and perform poorly in it. Ukeje (1986) observed that mathematics is one of the most poorly taught, widely hated and small understood subject in higher institutions, student particularly girls run away from the subject. The Examination, chief examiners (2019/2020) consistently reported candidates lack of skill in

answering almost all the questions asked in general mathematics , chief examiners (2019/ 2020) further observed that candidates were weak in geometry of circles and 3- dimensional problems. According to their reports most candidates avoided questions on 3-dimentional problem, when they attempt geometry questions only few of the candidates showed a clear understanding of the problem in their working. 2019/2020 also reported that candidate's weakness in Algebraic expression and word problems among others. Obioma (1985), Obodo (1993) and Okereke (2006) reported gender as a significant factor in mathematics achievement and Onwioduakit and Akimbobola (2005) reported it as a significant factor in physics achievement when physic students are taught with advance organizers. However, Okonkwo (1997) reported gender as non-significant when student are taught with tangram puzzle game. Okereke (2006) attributed students' poor performance to factors such as the society view that mathematics is difficult, shortage of qualified teachers, and lack of mathematics laboratory and lack 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 talked 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 student to formation of concepts out of experience with discrete objects. In this case the vague theories 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). Mathematics laboratory is a place where students can learn and explore various mathematical facts and theories using varieties of activities and material (Igbokwe, 2000). The use of mathematics laboratory helps to integrate theory and practical work in mathematics teaching and learning.

Ohuche (1990) advocated the need for moderately equipped mathematics laboratories. Ogunkunle (2000) itemized the advantages of using mathematics laboratory which include; i Avenue for experimentation through practical work.

ii Pool of storage of mathematical materials for easy access removing abstractness and increasing effective teaching and 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 draw the students to follow.

Statement of the Problem

Evidence of poor performance in mathematics by students in Adamawa state college of education Hong, prompt the researchers to embark on this study. This makes it paramount to seek for a strategy for teaching mathematics that aims at improving its understanding and performance by students. Evidence abounds (Srinivasa, 1978, Ogunkunle, 2000), that lack of mathematics laboratory techniques in teaching mathematics is one of the major factors that contribute to poor achievement in mathematic.

Aim and Objectives

The aim of this study is to bring the contributions of using mathematics laboratory on improving the understanding of Mathematics in Adamawa state College of Education Hong.

The Objectives are to;

1. Investigate the extent to which the use of mathematics laboratory will enhance the achievement of mathematics students.

2. Compare the achievement of male and female mathematics student taught with mathematics laboratory.

Significance of the Research

The researcher sees that it is important to carry out an investigation in to the effect of mathematics laboratory (Instructional Materials) in the teaching of mathematic in Adamawa state

college of education, Hong. Because instructional materials help in understanding Mathematics, it is an effective process in teaching and learning processes in schools.

Research Questions

- To what extent does the use of mathematics laboratory affect the achievement of mathematics students.

- Are there any significant differences between the achievement of male and female mathematics students taught with mathematics laboratory?

The Role of the Laboratory in Science Teaching

Several research reviews were studied in an attempt to identify trends in science education research related to the use of the laboratory as an instructional method in science. These reviews included the three produced by Francis D. Curtis (1931, 1931, 1938) as well as the three companion volumes produced by Boeing (1969), Swift (1969), and Lawler (1970). In addition, reviews published in the journal Science Education, as well as in special publications produced by personnel in the U.S. Office of Education, were analyzed.

Research on the Laboratory, 1900-1950

Francis D. Curtis, who as responsible for the early reviews of research in science education, published an article in The Science Teacher in 1950 in which he made a plea for the retention of individual laboratory work. This article is of interest for several reasons. It was written about science education research but directed to classroom teachers rather than to science education researchers. Also, it provided an overview of the problem as seen by an individual who had been involved in doing research swell as in reviewing it.

Curtis wrote that the idea that secondary school students should do laboratory work came from the scientific movement' and was influenced by college practices at the turn of the century. Increased school enrollment was also a factor. Enrollment in high schools increased so rapidly that, beginning about 1902, one high school was built every day for at least 30 years. Increase number of students meritless than economical to do individual laboratory work, so demonstrations were substituted, this increase in School enrollment came at about the same time

as there is the educational research movement. People began studying there native merits of individual laboratory and demonstration methods. The first such science education by Wiley, was published. In the next nine years, 13 such studies were published. Data from these studies were interpreted as indicating that the demonstration method was as effective as the individual method for learning. However, college and university teacher supposed the trend toward substantial reduction in laboratory work. Educational research was criticized for the limited number of studies, the small number of subjects involved, in adequate statistical treatment, the general lack of reporting of the techniques used, and the aim.

The Use of the Laboratory in Science Teaching

Journal articles, research reports, papers presented at professional association meetings, and abstracts from Dissertation Abstracts International were the sources of information used for this portion of their view. As other reviewers have found, the majority of the research was of the doctoral dissertation variety. Several of the journal articles were also based on dissertation search, resulting in duplication in there porting. The educational levels involved were primarily secondary school and college, with only a few of the studies reporting the involvement of elementary school pupils.

Rather than arbitrarily taking the five categories of objectives for laboratory teaching listed by Shulman and Tamir (1973) (i.e, skills, concepts, cognitive abilities, understanding the nature of science, and attitudes), there view undecided to look at the dependent variable identified in the studies to see if these might form natural clusters. Not surprisingly, since some of the same studies were reviewed by Shulman and Tamir for the" Second Handbook of Research on Teaching" (1973) as were analyzed for this publication, the clusters identified resemble the five categories listed earlier in this paragraph.

Investigators appeared to look at the influence of the laboratory on

(1) Achievement.

(2) Attitudes.

(3) Reasoning, critical thinking, scientific thinking, cognitive style which could be termed" cognitive abilities".

(4) Understanding science.

(5) Science processes.

(6) Laboratory skills or manipulative skills.

(7) Interests.

(8) Dogmatism.

(9) Retention in a science course; and

(10) The ability to do independent work.

Several investigators looked at more than one dependent variable. The idea seemed to be that if a population were available to be sampled and" treated" in some manner, it was wise to study as many variables as this is contradiction to some of the earlier research on the laboratory in which the reviewer's expressed disappointment that only one or two factors were studied per investigation. One of the objectives of that lead to carry out this study, whether explicitly stated in the introductory section or, works to identify those studies in which positive results were found. "Positive may be interpreted to meaning support of the use of the laboratory and at a level of statistical significance. In order to maintain some degree of objectivity, those investigation seen which the results favored some condition other than the use of the laboratory will also be reported. There seems to be little to gain in scrutinizing and describing, in this study, those idea in which no magnificent differences were recanted. Results will be discussed as they relate to the dependent variable being considered so the reader will find the same author being cited in more than one portion of this section of the review if he/she examined more than one dependent variable.

Criticisms of the Laboratory

Criticisms of the laboratory may be grouped in to administrative and educational areas. Within the administrative area are the criticism and concerns that the use of the laboratory involves

expenditures of both time and money. Money is needed for both facilities and equipment. Time is needed to make proper use of them. The concerns voice the historical perspective portion of this publication continues to be heard into the present day. Providing double periods for science classes so laboratory work can be done involves scheduling problems for administrators and problems in perception of teacher load if teachers in other disciplines do not fully understand the various aspects of laboratory teaching in science.

Higher institutions usually have the resources to offer science courses for those students planning to major in science in university and another set for those who will not go to university or who will not major in science if they do go. As a result, high and middle school science courses usually have a science for the citizen emphasis while high school science, possibly except for biology, becomes more tailored for the university bound student. However, high school science teachers are realistic enough to admit that all their students are interested in science careers and that the emphasis in the science class and laboratory.

Laboratory Manipulative Skills

Two studies (Knox, Horton) that do not qualify as 'recent' research contained reports on investigations of the variable of manipulative skills. These are reported in the second volume of the Curtis' Digests, 'first published in 1931 and reprinted in 1971.

Within the last two decades sever all more researchers have looked at manipulative skill development. Dorrance (1976) found the laboratory meth to be superior to other methods in the acquisition of manipulative kills by corn community college students enrolled in biology. Allison (1973) also worked with college students enrolled in an introductory chemistry course, and reported that the inquiry laboratory experiences were significantly more effective than the structured approach in increasing laboratory performance skills.

Other investigators worked with secondary school students. Sherman (1969) investigated the relative effectiveness of the methods using laboratory -type activities in teaching Introductory Physical Science (IPS) a direct manipulative approach and an indirect non-manipulative approach. Eighth grade students of average and high ability were involved in the study. The experimental group saw a series of 2x2 colored slides so far sequence of laboratory activities which the control group performed in their classes. Sherman looked for changes in critical

thinking abilities, understanding of science, and academic achievement of knowledge and skills in IPS, and the development and expression of science. The only significant difference the found was that the control group, using the direct manipulative approach, was significantly superior in selected laboratory skills demonstrated by their perform ancon a laboratory skills test Sherman constructed.[Information on this well-designed study is available as a dissertation abstract, as are port from the Wisconsin Research and Development Center (1968), and as an article in School Science and Mathematics (Pella and Sherman, 1909).

Problems of Research on Teaching Methods

Mc Keachie, writing in a chapter in the" Hand book of Research on Teaching" (Cage ,ed., 1963) ,was concerned with discussing research on teaching at the college and university level. His comments are equally relevant for research, at the elementary and secondary levels involving instruction. Mc Keachie said, determining which of two teaching methods more effective looks like a simple problem. Presumably, all that is necessary is to teach something by one method and then to compare the results with those obtained by teaching the same thing by another method. Unfortunately, there are pitfalls which enthusiasts for one method, or another are likely to overlook. Mc Keachie identified, five such pitfalls:

1) Taking a course taught by a new method may generate excitement or hostility. The Hawthorne effect influences teachers as well as students. The treatment rarely lasts for more than one semester. What happens after the excitement fades?

2) There is a problem of establishing suitable control group. Can one individual teach using two different methods and not have some aspect of one method influence the other? Is it possible to get another individual to participate as a teacher and use the method the study imposes?

3) Conditions involved in the treatment may interfere with normal results.

4) Biased sampling may occur in that people who sign up for the treatment are likely to be different from those who elect the traditional course.

5) Researchers need to consider the statistical methods used to analyze the results. One should be careful to avoid concluding that one method is more effective than the other when these methods do not differ significantly.

The Use of the Laboratory

Tamir (1976) describes four major rationales for the extensive use of the laboratory in science teaching

1) Science involves highly complex and abstract subject matter which students who are not at the formal operations level of cognitive development grasp more readily if they interact with concrete objects arid have opportunities for manipulation.

2) Proponents of enquiry argue that student participation in the actual collection of data and the analysis of real phenomena is an essential component of enquiry, laboratory experiences are needed for the development of skills with a wide range of generalize able effects, and students enjoy laboratory activities and consequently become motivated and interested in science.

Research Design and Reporting

Many of the readers of this study will be familiar with the l3 criticisms of science education research which Curtis stated in the second volume of his "Digests" (1971b) and which were repeated by Jacobson (1974) in his paper entitled "Forty Years of Research in Science Education." For those few who are not familiar, the criticisms were:

i. Failing to state the problem.

ii. Assuming the equivalence of experimental groups without taking adequate steps to ensure this equivalence.

iii. Securing equivalence of groups upon assister than that in terms of which results are measured.

iv. Failing to isolate the experimental factor.

v. Delimiting too rigorously the teaching methods under investigation.

vi. Assuming the definitions of teaching methods under investigation to be standard (i.e. commonly accepted);

viii. Failing to report the technique insufficient detail.

Research Methodology and Procedure

In this research effort has been made to describe the method and procedure use in carrying out this research work. These methods include some population research instrument, percentage scale was used for the research.

Population of the Study

The populations of the researcher constitute One hundred (100) questionnaires to each selected schools to fill in the questionnaire, the filled in questionnaire should be return to the researcher from hand to hand.

Sample and Sampling Techniques

Although, there are several sampling techniques use in research, but for the case of this research study, simple random sampling techniques is applied to select some selected schools.

Instrument Pac's Collections

In collection of the necessary information required for this research or, a questionnaire is used. This instrument formed the main source of collecting the information. The questionnaire is set related to the focus of the study each question is followed by four options to which is responder will respond by making the desired option, this will enable the researcher to obtained factual and valid information. One hundred (100) copies of questionnaire were produce fifty (50) for each school which consist of filling fifty (50) questionnaire set by the researcher to collect the information from the various schools.

The researcher distributed One hundred (100) questionnaires to each selected schools to fill in the questionnaire. The filled in questionnaire should be return to the research from hand to hand as he goes round the school to fill and give I back. This is done in such a way to avoid possibility of loss of filled question are.

Method of Data Analysis

The instrument to be used in data analysis is percentage (%). After gathering all the important (factual and result) data for the study, the research analyzed and interpreted the findings by calculating the observed frequency and the expected frequency.

Data Analysis and Presentation

Data collection from the administered questionnaire was analyzed and presented for interpretation. The total number of the questionnaire distribution was presented in a tabular form and analyzed using simple percentage for easy interpretation.

Data Presentation

Table 1: Response made to the notice lack of mathematics teachers.

RESPONSE	FREQUENCY	PERCENTAGE (%)
Yes	79	79
No	21	21
Total	100	100

The table above showed that 79% of the respondent noticed the effect of lack of mathematics teacher. While 21% did not. Implication of this mathematics teacher depends on the nature of the school.

Table 2: Responses Made to the Notice of Shortage of Laboratories Instrument.

RESPONSE	FREQUENCY	PERCENTAGE (%)
Yes	85	85
No	15	15
Total	100	100

The table showed that 85% of the respondents notice shortage of lab instrument. While 15% did not. It implies that scarcity of teachers.

Table 3: Responses Made on Good Laboratories Management.

RESPONSE	FREQUENCY	PERCENTAGE (%)
Yes	69	69
No	31	31
Total	100	100

The table below showed that 69% of the respondents said that lack of insufficient well-trained teacher causes students failure. While 31% were not aware that lack of good laboratory management cause students' failure.

Table 4: Responses Made on the Shortage Laboratories Equipment.

RESPONSE	FREQUENCY	PERCENTAGE (%)
Yes	73	73
No	27	27
Total	100	100

The table showed that 84% of the respondents noticed the lack of lab equipment. While 16% agree on the teacher faults.

Table 5: Responses Made on the Idea of Teaching Materials.

RESPONSE	FREQUENCY	PERCENTAGE (%)
Yes	64	64
No	26	26
Total	100	100

The table showed that 73% of the respondents teaching material While 26% have not agree on that teaching material.

Instrument and Validation

The researchers used the Mathematics Achievement Test (MAT) as an instrument. Also Designed Mathematics Laboratory (DML) and the lesson plan were used as instrumental tools for the study.

MAT: This is a ten-item achievement test constructed by the researchers based on the NCE III mathematics syllabus in plane geometry and algebraic expressions. The test was in essay form written to cover the areas of knowledge, comprehension, and application levels. The same MAT was used for pretest and posttest treatment but the color of the paper for posttest was changed from white to yellow. The validity of the items was assessed by three mathematics education experts and two experienced secondary school mathematics teachers. The instrument was trail tested with 40 students in a school not participating in the study but within the same area of study. The Kunder Richardson Formula (21) was used to establish the coefficient of internal consistency for the instrument (MAT) and the value is 0.75.

DML: The Laboratory was designed to have a typical Laboratory building with necessary fittings and equipment which include Geoboard, Graph Board, Pythagoras triple triangle, skeletal globe, Abacus, close and open cylinders, cone, conic sections, Rectangular and triangular pyramid, cube, cuboids, graphic calculator, computer system etc. this was looked into by three mathematics education experts to ensure its suitability and representation of a true mathematics laboratory.

Lesson Plan: The plan was written in two forms. Plan that used the DML as a teaching material for the teaching the treatment group 'A'

Ordinary lesson plan used in conventional classroom for group 'B'

Discussion of Result

Results of research question one showed that students taught mathematics with mathematics laboratory achieved more than those taught without mathematics laboratory. This was tested in hypothesis one which revealed that significant differences exist between the achievements of students taught mathematics with mathematics laboratory and those taught with lecture method. This was in favour of mathematics laboratory group. This finding is supported by Srinivasa (1978), Agwagah (1997) and Ogunkunle (2000) where they highlighted the advantages of using mathematics laboratory in teaching to include providing opportunity for students to understand and internalize the basic mathematical concepts. In this way the students achieved better than otherwise. The result from research question two showed that boys had a mean gain of 26.8

while girls had a mean gain of 28.9. This was tested in hypothesis two. Result from the hypothesis showed that there was no significant difference in achievement of male and female mathematics students taught with mathematics laboratory.

This finding is in line with the findings of Okonkwo (1997) who reported that student's gender has no significant effect on their achievement when taught with tangram puzzle game. However, the findings disagree with the finding of Obioma (1985), Obodo (1993) and Okereke (2006). They reported gender as a significant factor in achievement when mathematics is taught with certain strategies/techniques.

Onwioduokit and Akinbobola (2005) also reported gender as significant factor in physics achievement when taught physics with pictorial and written advance organizers.

Conclusion

Based on the findings in this study, the following conclusions were drawn:

- Students taught with mathematics laboratory achieved better than those taught without it.
- There exists no significant difference in achievement of male and female mathematics students taught with mathematics laboratory.

Recommendations

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

- Mathematics teachers should use mathematics laboratory in teaching mathematics.
- Government should establish mathematics laboratory in all schools like other science subjects laboratories Seminars/worships should be organized for mathematics teachers in high institution on the use of mathematics laboratory.
- Mathematics student teachers should be trained on the use of mathematics laboratory in the mathematics methodology class.

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