Effects of 3-Dimensional Instructional Materials on the Teaching and Learning of Mathematics among Senior Secondary Schools in Minna Metropolis

Ramatu W. Gimba (Mrs.)
Department of Science Education
Federal University of Technology
Minna, Niger State

Abstract

The paper examined the effectiveness of 3-dimensional mathematics instructional models on learning some aspect of Geometry in Senior Secondary School in Minna, Niger State. Pretest – posttest experimental control group design was employed to facilitate data collection for the study. Two hundred (200) SSI students randomly selected from four(4) secondary schools in Minna. Ten(10) items multiple choice questions were administered to both groups before and after treatment. The data collected was analysed using group mean, standard deviation and t-test statistical techniques. The finding revealed POSITIVE EFFECTS of using 3-dimensional mathematics instructional models with higher post test experimental group mean score of 70.5 against the control group mean score of 30.75 and the grand mean score of 50.62. This enables the researcher to make appropriate recommendations on the effective use of instructional materials particularly mathematical instructional aids in teaching and learning of mathematics.

Introduction

Science is a process of acquiring, understanding and interpreting knowledge or body of knowledge for the development and progress of both individual and the nation. Therefore it becomes necessary then that the learning of science most be with the most easy and understandable techniques in order to achieve these objectives.

A scientist searches for the truth preserves the truth and experiments to establish the facts. There are some factors that inhibits improvement of technology and science, the major factor is mathematics. Mathematics make one to think and by thinking facts are established. The establishment of facts through thinking is science and the application of science is technology. Technologically sciences are a range of discipline embracing the traditional engineering branches. the Agricultural Science the modern discipline relating to spaces, computers and auto-machines. In view of these Harlen (1987) argue that since scientific and technological inventions provide wider power for extending human capacities to communicate, to travel, to create wealth, to destroy and also manipulate and control not only the environment but also the well being or otherwise of the living creatures within it. The study of science becomes very important.

The rise of the technological science come only with the creation of a community of practitioners separate from either the body investor or that of scientist but technology still find its root in mathematics. Mathematics is used in our day to day activities such as in the market, offices, banks, even in our homes we use mathematics to know the quantity of food to prepare and in other domestics activities. Ale (1985) said that mathematics plays an important role in the understanding of the foundation and structures of knowledge in science.

Mathematics also helps the understanding of inter-relationships between disciplines like chemistry, physics, biology, economics, geology, medicine, linguistic, archaeology and many others. There is hardly any profession or vocation where the knowledge of mathematics is not needed. For example, bricklayers, carpenters, doctors, pharmacists and so on. In respect of these Oguniyi (1986) stated that mathematics is applied to every human activity and virtually every profession, expresses some degree of numeracy. Mathematics is used in art, business, commerce, law, medicine, politics, religion, sociology and above all science and technology.

According to Ukoli (1985), technology can simply be defined as a means or ability by which man seeks to change or manipulate his environment and educational technology provide some of the ways for educationists to develop materials which will help them deliver their lessons in an easy and understandable manner in their areas of disciplines. Education is expected to be progressive, therefore teachers should be able to make possible, the realization of dream of the learner by making them recall quickly what has been previously learnt. Instructional materials are devices which presents a complete body of information and largely self supporting rather than supplementary in the teaching-learning process, they are any devices, process of equipment, sound production, graphic representations or illustration that help the learner to learn. These includes audio visual aids, visual aids and equipments used to improve the quality of instruction. Instructional materials have been used since primitive man mudded or draw pictures on sand or on the wall of a care. According to Abdullahi (2001) teachers can use instructional resources to arrest and sustain attention, present facts and information, teach concepts and principles, guide thinking and induce transfer of learning. Nyenaga (2002) pointed out that a teacher can capitalize on media capabilities to promote the learners perception, understanding, transfer of learning, reinforcement and retention of learnt medias.

Lassa (1986) further indicated that schools are still adapted to curricula which do not meet the needs of the students and the nation in general despite the frequent changes being made in the mathematics curricula. He also pointed out that teachers teaching the subject are not qualified to teach, most of them are N.C.E holders while some are not specialists in the subject. They are either physics or economics teachers and forced to teach the subject due to lack of the qualified once. They lack the techniques in teaching the subject which can be a contributing factor to students poor performance in mathematics. In order to have an effective teaching and learning of mathematics in our secondary schools teachers should be encourage to adopt the system of using mathematical instructional models (3-dimensional instructional materials) in teaching area and volume of cube and cuboid.

According to Gana (1997), the use of visual instructional models has significant effects on the performance of students in mathematics. He discovered that the higher the variety of visual instructional materials used the higher the performances. He further acclaimed that visual instructional model is a means of motivation that helps the students to (i) recall earlier learning (ii) provide new learning stimuli (iii) activate students' response. Modern instructional materials have evolved from primitive modelling models, motion pictures, television, teaching machine, visual and audio recording devices and so on. Experience and research studies have also proved that through appropriate use of these instructional materials any subject can be taught more effectively.

Bola (1987) highlighted the following as importance of instructional materials:

1). They give concrete representation to abstract ideas and provide a setting for the discovery of concepts.

2). They are used for focusing attention on ideas and relating new ideas to previous experience.

3). They motivate the learner and provides a means of making independent investigations.

4). They can be used to provide for individual difference and to generate interest in a new topic.

5). They consolidate details that are related to generalizations being tough and thus enhance retentive.

6). They promote enjoyment of mathematics.

7). They discourage the cramming of formula.

In using instructional material the right type should be chosen. Also sufficient time should be given for students to establish the concepts involved. The size of the instructional materials should be adopted to the needs of the students or the objectives involved.

Student Performance in Mathematics

Mathematics is a highly situational subject in which various concepts and techniques depends on each other. The concepts of mathematics and all other disciplines in which mathematics is used as a tool requires a thorough understanding of basic operation with numbers.

Ejike (1988) states that preparation of students for university mathematics starts at the kindergarten. This is where recognition of shapes which is the beginning of geometry and counting of natural numbers 1,2,3,….. are learnt.

Poor performance of students in mathematics was assumed to be worldwide. Mathematics being one of the core subject and also the father of all science, a lot of students fail virtually in all subjects and particularly mathematics both in Primary School Leaving Certificates (PSLC) and Senior Secondary School Certificate Examination (SSCE). This is probably due to lack of proper mastery of the subject by the learner right from the very beginning or as a result of inadequate exposure or non explore to learning the subject in the practical or concrete way. Also it may be from the formation stage of development when the learner are quite likely to assimilate better, more quickly and effectively. It might be due to ineffective teaching methodology on the part of the teacher or due to ineffective use of instructional materials especially in senior secondary school levels, which is focus of this study.

Use of Instructional Materials

Teachers have to take cognisance of instructional materials in the teaching of any subject in both primary and secondary schools. When instructional materials are used carefully and in conjunction with some instructional materials, they help to foster understanding. It is generally accepted that the use of instructional models is an effective way of clarifying fairly difficult mathematics concepts with physical objectives. According to Obianwu (1994), instructional models includes all devices which can be used by teachers to represent a complete body of information in the teaching and learning process for a more effective instructions. Most people gain new impression more vividly through sensory experience than they do through reading or abstract reasoning.

Instructional materials facilitates repetition of an idea for example the use of 3-dimensional figures in treating area and volume can facilitate learning and make teaching to be meaningful and enjoyable. According to Atazah (1997) instructional models can improve the learning environment of student and present quickly and accurately facts or conditions that would take many words to describe and explain. In this respect, instructional models increase students being exposed and the ability to respond intelligently to such stimuli. They are believed to enhance understanding in the classroom since they provide ideas in many forms, which may be too difficult to explain with words.

In Nigeria the poor performance of students in Senior Secondary Certificate Examinations (SSCE) has called for a greater efforts on teachers in the teaching of mathematics. This is why the use of instructional materials should be emphasised to facilitates the teaching and learning of the subject. We are also of the opinion that easier procedures and means of teaching should be considered in any part of the country, in order to obtain a more adequate output. Emphasis has been laid on the need to use mathematics instructional models to improve the teaching of mathematics in our secondary schools. In full compliance, Ebwa (1987) stated on the need for the use of instructional models in schools so that Nigeria can progress technologically to promote children desire, to learn mathematics and teachers should use teaching aids to stimulate the students. This is validated by the saying called the Chinese proverbs (Andy Anologe, 1985) which says as following

If I hear, I forget

If I see, I remember

If I do, I know.

This is applicable to the teaching and learning of mathematics at any level of education.

Purpose of the Study

The aim of the study is to find out what extent students learn mathematics effectively through the use of mathematics instructional models at senior secondary level in Minna, Niger State.

Research Questions

This study attempts to address the following research questions:

1). Will there be any difference between the group of students taught with the use of mathematics instructional models and the groups taught without it?

2). Will there be any difference in the performance of mathematics between boys and girls taught mathematics using mathematics instructional models?

Hypotheses

From the research questions above the following has been hypothesised:

HO_1: There is no significance difference in the mathematics performance between the group taught with the use of mathematics instructional models and the groups taught without it.

HO_2: There is no significance difference in the mathematics performance between boys and girls taught using mathematics instructional models.

Significant of the Study

This study will enable the teachers of mathematics to appreciate the significance of mathematics instructional model in teaching and learning of mathematics, which will enhance better performance of learners of mathematics and other related subjects. Ebuwa (1987) states that for Nigeria to progress technologically, the use of teaching aids most be fully incorporated into the educational system. He therefore contended that teachers should take it as a responsibility to present such educational materials to stimulate the student because the wish to learn must come from students.

Research Design

The research design adopted for this study in pretest-posttest experiment control group design. The schools selected for the research involve two(2) mixed schools (co-education schools) and two(2) single schools (one boys school and one girls school). The single schools were used as the experimental groups which were taught with the use of instructional materials. The other two schools are the control groups. They were taught the same topic as the experimental group but without using instructional material.

Research instrument

Research instrument employed for the study to determine the effect of mathematics instructional models in teaching and learning of mathematics as secondary level is Mathematics Achievement Test (MAT) comprising of 10-item multiple-choice questions.

Population Sampling

The total population of all students in SSI from the four (4) selected schools was six hundred (600), the sample for the study was two hundred students (200) both male and female which are randomly selected from the four (4) selected secondary schools in Minna, Niger State.

Method of Data Collection

The data for the research was obtained from the result of both pretest and protest consisting ten (10) items administered. The administration of the test and teaching were conducted by the researcher with the help of some teachers in the schools. Two groups each comprising fifty (50) subjects from each of the four selected schools in Minna given a total of two hundred (200) subjects from the four schools. Pretest and posttest were administered to both groups, they were scored base on one hundred percent (100%). The score formed the data for testing hypothesis for the study. The result obtained from these tests were used to determined which of the two method is more effective.

Method of Data Analysis

The result from the pretest and posttest mathematics score of the students is presented in the tables below. The statistics used for the analysing the data collected were:
1).   Mean
2).   Standard Deviation (SD) and
3).   Two sample t-test

Table 1: Comparison of the mean scores on the pretest of the experimental and control groups

Group	N	Df	X	SD	t-value	t-value
Experimental group (E)	100	98	25.00	9.42	Calculated	Critical
Control group (C)	100	98	22.13	9.22	1.45^{-NS}	1.991

NS–Not significant at 0.05 level.

From the table the results indicates that in the pretest mathematics that there is no significant difference between score in both experimental (E) group and control (C) group before treatment was administered. The two groups are on equal level before treatment. Therefore there is no significant difference in their entry behaviour.

HO_1:   There is no significant difference in the mathematics performance between the groups taught with the use of mathematics instructional models and the group taught without it.

Table 2: Comparison of the mean scores on the protest experimental and control groups

Group	N	Df	X	SD	t-value	t-value	
Experimental group (E)	100	98	70.50	15.62	Calculated	Critical	
Control group (C)	100	98	30.75	10.53	25.62**	1.991	0.05

Significant at 0.05 level.

The t-value calculated (25.62) is higher than the t-value critical, then indicates that there is significant difference between the Experimental (E) group and the control (C) group. This evidently shows that experimental (E) group on which treatment was administered had higher protest mean score of 70.50 compared to the control (C) group with the mean score of 30.75. since the calculated t-value of 25.62>the t-value critical of 1.991. therefore HO_1 was rejected. These shows that the performance of the sample population can be viewed as being significantly associated with the treatment administered to them.

HO_2:   There is no significant difference in the mathematics performance between the boys and girls taught using mathematics instructional models.

Table 3: T-test comparison of posttest mean scores of male and female groups mathematics students in the experimental group.

Group	N	Df	X	SD	t-value	t-value	P
Male	50	48	60.75	5.92	Calculated	Critical	
Female	50	–	85.50	6.05	15.76*	1.991	0.05

Significant at 0.05 level.

The results from table 3 shows that there is significant difference between the male and female mathematics students performance.

Female group had the higher postmark of 85.50 as against 60.75.

Discussion of Results.

Based on the research question which state that will there be any difference between the group taught with the use of mathematics instructional models and the groups taught without it. Hypothesis one was rejected meaning that there is significant difference between the performance of students taught with mathematics instructional model and those without it. The finding of the study is in agreement with Gana (1997) who stated that the use instructional models has significant effect on the performance of students in mathematics. He

discovered that the higher the variety of instructional materials used the higher the performance.

Based on the second research question which state' that will there be any difference in the performance of mathematics between boys and girls taught mathematics using mathematical instructional models? Hypothesis two was also rejected because girls performed better than boys in Mathematics Achievement Test (MAT). This finding is in contrary to the finding of Benthan 1964, Gambari 2004, Sobamowo 2006 who found that there was significance difference in the performance of boys and girls taught physics and mathematics with computer. Also in contrary to Bethan (1964) findings which states that boys perform better than girls in subject that require mathematics calculation and science while girls perform better than boys in art subjects and language.

Conclusion

In spite of all effort by teachers, educators and administrators, government, parents and sundry to arrest the perennial problem of general poor performance in mathematics particularly at Secondary School Certificate Examination (SSCE) levels. It has been discovered from this study however that the use of mathematics instructional model in teaching solid geometry will go along way to raise standard of performance. This has shown that instructional materials have positive effect on learning of mathematics on the defined group. It also revealed the gender difference in mathematics at this level of education is very high.

Recommendations

All colleges of education and institutions for teachers training should process curriculum that embraced promotion of educational technology courses with emphasis on the importance of instructional technology materials, in teaching mathematics.

- ❖ Governments and school authorities should sponsor teachers for workshops, seminars and so on, on the effective use and improvisational materials.
- ❖ Government should provide enough funds so that all the required equipment and facilities that would make teacher training possible is made available to teachers training institutions.
- ❖ Teachers should be exposed to new innovation so that they can keep abreast with the latest idea, skill and experience especially in the use and maintenance of modern teaching equipments and facilities.
- ❖ The government and community should assist in providing all the necessary teaching facilities through financial assistance and improvisation.
- ❖ Considering the poor state of country's economy, teachers should not wait for original learning materials for use in the teaching of the subject, but employ improvisation of equipment.

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