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Research Article

Mathematics and Computer Science Journal, ISSN: 2456-1053

Effect Of Multimedia Instructional Approach On Secondary School Students' Achievement In Mathematics

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ARTICLE INFO

ABSTRACT

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Abstract

The study investigated the effect of multimedia Instructional approach on secondary school students' achievement in mathematics in Owerri Municipal Council of Imo State. Quasi-experimental research design was used for the study adopting the pre-test, post-test non-equivalent control type. The population of the study consist of 3,266 senior secondary school two (SS11) students in Owerri Municipal Council. A sample of 165 students from two randomly selected secondary schools was used for the study. In each of the two schools selected, two intact classes were randomly selected and assigned experiment or control groups respectively. Experiment group was taught mathematics using multimedia instructional approach while the control group was taught using conventional "chalk and talk" approach. The instrument used for data collection was a 30 item researcher made objective questions titled "Mathematics Achievement Test"(MAT). It had reliability coefficient of 0.85 determined through Person's Product Moment Correlation coefficient method. The data generated was analysed using mean and standard deviation to answer research questions while ANCOVA was used to test hypotheses at 0.05 level of significance. The result showed that, Multimedia Instructional Approach enhanced students' achievement in mathematics across gender and ability levels. Based on the findings, it was recommended that mathematics teachers should be trained on the use of multimedia instructional approach in teaching and learning at the secondary school levels.

KEYWORDS:. ***Multimedia, Instructional, Achievement, Mathematics Students, Teaching***

Introduction

Mathematics as a subject is seen as the queen of all sciences and the fulcrum on which all science subjects revolve. Mathematics education is very useful in the development of creative thinking and self-confidence, it also contributes immensely in the development of

problem solving ability among students. According to Senthamaria-Kannan, sivapragasam and senthilkumar (2015) Mathematics with its special features and looks has wider applications in daily life and fields of study. The relevance of mathematics cuts across all professions in life.This has made it a compulsory requirement for admission into any degree of choice in our national universities and beyond.

The process of learning mathematics, has suffered a lot of challenges and this hasled to high failure rate in the subject. The number of failures in mathematics in high school level of examination is more as compared to that of other subjects because mathematics is a highly abstract subject (Senthamaria-Kannan et al, 2015). Teachers are not left out in this situation as they find it difficult to impact mathematical knowledge due to application of ineffective methods of teaching. National mathematics centre (2009) noted that poor performance in the promotion/public examinations in mathematics has more to do with teachers' method of teaching than the content of curricular of the school mathematics. Students who dislike mathematics have always linked their problem to the method of teaching (Bature&Bature 2005). One problem with mathematics teaching and learning is that, most teachers continue to keep faith with the old system of teaching that has nothing interesting or enjoyable to offer to the learners (Anaduaka&Okafor, 2013). Teachers of mathematics need to adopt innovative strategies which are student centered to develop their interest in the subject. These among others include, use of technology driven strategies such as multimedia instructional approach. The recent developments in educational technology call for a more holistic and pragmatic approach to the educational process. The new technologies have brought about changes in pedagogy and curriculum content and have resulted in increased academic productivity and teaching effectiveness. (Annie-Kauitha&Sundharavadivel, 2012).

Multimedia can be described as the combination of various digital media types, such as text, images, sound, and video, into an integrated multisensory interactive application or presentation to convey a message or information to an audience (Ogochukwu 2010)[1]. According to Neo and Neo (2009) multimedia provides a technology based constructivist learning environment where students are able to solve a problem by means of self-explorations, collaboration and active participation. Simulations, models and media rich study materials like still and animated graphics, video and audio integrated in a structured manner facilitate the learning of new knowledge much more effectively. The interactive nature of multimedia provides enhancement to traditional approach of teaching with more options for learners to adapt to individual leaning. Mayer (2001) noted that multimedia instruction imbibes verbal dimensions such as printed and spoken text and visual dimensions, such as pictures, graphs, illustrations, drawings, charts, photos, and animations. Multimedia resources help to increase students' awareness of learning concerns, enhance their understanding of the topic, and foster the depth of their understanding. Multimedia

instruction has been viewed positively over the traditional lecture-based instruction (Jonassen, 2000).

Several research findings have shown positive effects of multimedia instruction towards academic achievement. Beerman (1996) found that college students taught by interactive multimedia had greater long – term retention compared to students taught by traditional classroom methods. Senthamaria-Kannan e tal (2015) found that, the students learning with help of the multimedia program fared better in mathematics than the students learning through the conventional method. Abu-Yunis (2005) in a study using multimedia found a statistical difference in the average academic achievement of students in the experiment and control groups in favour of the experiment group. Obaid (2001),Abu-Nadar (2003) and Ibrahim (2003) in their various studies discovered that the application of multimedia instruction enhanced students' academic achievement and enhanced their interests. Sharman (2013) asserted that the use of multimedia in class draws the attention and interaction between students and teachers.

The economic and technological state of the nation Nigeria, requires individuals who are armed with critical thinking skills and problem solving abilities which are embedded in the study of mathematics. Therefore, there is need to apply innovative strategies in teaching and learning of mathematics.

Statement of the problem

The need for improved students' achievement in mathematics towards a reflective Nigeria society calls for use of modern technologies as against the traditional method of teaching which is responsible for students' lack of interest and poor achievement in the subject. Therefore the study was carried out to investigate the effect of multimedia instructional approach on students' achievement in mathematics in secondary schools.

Purpose of the study

The main purpose of the study is to investigate the effect of multimedia instructional approach on secondary school students' achievement in Mathematics. Specifically, the study determined, whether:

- students' taught Mathematics using multimedia instructional approach will differ in their achievement from those taught conventionally.
- male and female students taught mathematics using multimedia instructional approach will differ in their achievements.
- low and high achieving students taught mathematics using multimedia instructional approach will differ in their achievements.

Research questions

The following research questions were drawn for the study.

1. What is the difference in mean achievement scores of secondary school students taught mathematics using multimedia instructional and those taught using conventional approaches?
2. What is the difference in mean achievement scores of male and female secondary school students taught mathematics using multimedia approach?
3. What is the difference in post-test mean achievement scores of low and high achieving secondary school students taught mathematics using multimedia approach?

Hypotheses

The following hypotheses guided the study

1. There is no significant difference between the mean achievement scores of secondary school students taught mathematics using multimedia instructional and conventional approaches.
2. There is no significant difference between the mean achievement scores of male and female secondary school students taught mathematics using multimedia instructional approach.
3. There is no significant difference between the mean achievement scores of low and high achieving secondary school students taught mathematics using multimedia instructional approach.

Methodology

The quasi–experimental design was applied in carrying out the study adopting the pre-test, post-test non-equivalent control type to determine the effect of multimedia instructional approach on students' achievement in mathematics.

The population of the study comprised of 3266 senior secondary II students in 9 governments owned secondary schools in Owerri Municipal Council of Imo State. Two secondary schools were selected for the study through random sampling technique.

The two schools selected were coeducational schools. In each of the schools selected, two intact classes were randomly selected and assigned to Experiment or control groups. A total sample of 165 senior secondary school II students were used for the study, these comprised of 75 males and 90 females. The experiment groups had 81 students (47 females and 34 males) while the control groups had 84 students (43 females and 41 males)

The instrument for data collection was a researcher made 30-item objective test questions titled "Mathematics Achievement Test"(MAT). It was drawn from the topic longitude and latitude which was taught the students. The construction of the test instrument

was guided by a table of specification. The instrument was validated by two Mathematics education and a measurement and evaluation experts. Their inputs were given consideration in restructuring the questions. To determine the reliability of the instrument, it was administered on a group of 20 students outside the study group but with the same characteristics. This was done within 2 week interval through test – retest method. A reliability coefficient(r) of 0.85 was derived through Pearson's Product Moment Correlation coefficient formula this was acceptable for the study.

The two groups were administered with a pre-test to ensure equity in their cognitive backgrounds. The experiment groups were taught by their regular maths teacher trained on the mode of multimedia instruction applied in the process. A mathematics software (JavaScript) on longitude and latitude was projected on the board for the students after the normal introduction of the topic. The teacher guided them through step by step tutorial on the features of longitude and latitudes. Also, solution to problems on distance, bearing and animation of globe showing longitude and latitudes was directed on the board. The students were allowed to ask questions, make inputs and were cleared at points of need. They were also allowed to identity features of the topic as projected on the board. The software had the ability to reverse the solutions related to problems on distance and bearing relaying the steps for the students to follow. They were also allowed to present problems which were solved by the software and compared with their book solutions. The control groups were taught the same topic by their regular mathematics teacher through the conventional "chalk and talk" approach which was only teacher centred. The process lasted for two weeks after which a post-test was administered on both groups using a rearranged version of the pre-test instrument.

The generated data were analysed using mean and standard deviation to answer research questions while the hypotheses ware tested using ANCOVA statistical tool and tested at 0.05 level of significance.

Results

Research Question I: What is the difference in mean achievement scores of secondary school students taught mathematics using multimedia instructional and conventional approaches?

Table 1: Summary of students mean achievements.

Group	Test	N	Mean	SD	Mean Gain	Diff. in Mean Gain
Expt.	Posttest	81	59.40	15.53		
	Pretest		38.54	12.22	20.86	20.29
Control	Posttest	84	40.13	13.42		

Pretest	39.56	12.45	0.57

Table I shows that the experimental group had a mean achievement gain of 20.86 while the control group had 0.57 this gave a difference of 20.29 difference in favour of the experiment groups.

Research Question 2: What is the difference in mean achievement scores of male and female secondary school students taught mathematics using multimedia instructional approach?

Table 2: Summary of mean achievements of male and female students

Group	Test	N	Mean	SD	Mean Gain	Diff. in Mean Gain
Male	Posttest	34	59.69	15.52		
	Pretest		38.51	12.42	21.18	
Female	Posttest	47	59.82	15.56		0.99
	Pretest		38.63	12.50	20.19	

Table 2 shows that, the mean achievement gain of males in the group is 20.18 while the female is 20.19, this gave a slight mean difference of 0.99 in favour of the males in the experiment group.

Research Question 3: What is the difference in post-test mean achievement scores of low and high achieving secondary school students taught mathematics using multimedia, instructional approach?

Table 3: Summary of post-test achievement of low and high achievers

Group	Test	N	Mean	SD	Mean Diff.
High Achievers	Post-test	30	60.24	15.63	
Low Achievers	Post-test	51	58.65	15.26	1.59

Table 3 shows that, high achieving students in the experiment group had mean score of 60.24 in the post-test while low achieving students had 58.65, this gave a mean difference of 1.59 in favour of the high achieving students.

Research hypotheses

4. There is no significant difference between the mean achievement scores of students taught mathematics using multimedia instructional and conventional approaches.

5. There is no significant difference between the mean achievement scores of male and female students taught mathematics using multimedia instructional approach.
6. There is no significant difference between the mean achievement scores of low and high achievers taught mathematics using multimedia instructional approach.

Table 4 addresses hypotheses 1, 2, and 3

Table 4: Summary of ANCOVA analysis on Achievement

Source	**Type in sum of squares**	**DF**	**Mean square**	**F**	**Sig.**
Corrected model	26640.797	6	4440.133	75.353	.000
Intercept	1078.154	1	1078.154	18.297	.000
Covariate	2008.091	1	2008.091	339.553	.000
Method	**461.316**	**1**	**461.316**	**7.829**	**.006**
Sex	**137.027**	**1**	**137.027**	**2.325**	**.129**
Achievers	**47.924**	**1**	**47.924**	**.813**	**.369**
Method sex	9.681	1	9.681	.164	.686
Method Achievers	110.425	1	110.425	1.874	.173
Error	9310.112	158	58.925		
Total	509025.000	165			
Corrected Total	3590.909	164			

$H0_1$: Table 4 shows that, the calculated f-value for method is 7.829 which is greater than the table value (3.847) also p-value of 0.006 is less than α-value 0.05. Based on the result, the null hypothesis is rejected and the alternative accepted. This implies that, there is a significant difference between the mean achievement scores of secondary school students taught mathematics using multimedia instructional and conventional approaches.

$H0_2$: Table 4 shows that, the calculated f-value for sex is 2.325 which is less than the table value (3.847), also p-value of .129 is greater than $\propto$ - value 0.05. Based on the results, the null hypothesis is upheld which implies that no significant difference exists between the mean achievement scores of male and female students taught mathematics using multimedia instructional approach.

$H0_3$: Table 4 shows that, the calculated f-value for achievers is .813 which is less than the table value (3.847), also p-value of .369 is greater than $\propto$ - value 0.05. Based on the result, the null hypothesis is upheld which implies that no significant difference exists between the mean achievement scores of high and low achievers taught mathematics using multimedia instructional approach.

Discussion

The finding of the study revealed that, students in the experimental group taught mathematics using multimedia instructional approach had a better mean achievement scores than their counterparts taught using conventionally through "chalk and talk". This implies that multimedia instructional approach has a better penetrating power in terms of students understanding and interests towards mathematics than the conventional approach. The strategy also has the ability to liberalize the study of mathematics as it gave room for every student's participation. The result is in line with the findings of Abidoye (2005), Ogochukwu (2010),Senthamarai–Kannan et al (2015) who variously found that multimedia instructional strategy enhanced students' academic achievement.

The study also showed that mathematics achievement of male and female students exposed to multimedia instructional approach was similar and showed no statistical difference. This is suspected to be as a result of equal learning opportunity which the strategy brought into play. The result is in tandem with that of Abidoye (2015), Ofodu (2010) and Abidoye and Oguniyi (2012) which showed that the performance of male and female students exposed to multimedia instructional package were similar and not significantly deferent.

Finally, the study revealed that high and low mathematics achievers never differed significantly in their achievement as a result of their exposure to multimedia instructional approach. This result is in agreement with the findings of Bouck and Flanagan (2009) which noted that Technologies offer level playing field for students with learning differences.

Conclusion

The study investigated the effect of multimedia instructional approach on secondary school students' achievement in mathematics. The results of the study showed that multimedia instructional approach enhanced secondary school students' achievement in mathematics across gender and learning abilities.

Recommendations

Based on the findings of the study, the following recommendations are made:

1. Mathematics teachers should be granted in service training in the area of multimedia application in teaching and learning at the secondary school level.
2. The Government should provide ICT facilities in secondary schools to enable mathematics teachers use them in teaching to enhance students' achievement.
3. Mathematics teachers in secondary schools should be technologically proficient as to be able to apply the facilities in their teaching process.

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