EFFECTS OF INSTRUCTIONAL MODELS ON THE PERFORMANCE OF JUNIOR SECONDARY SCHOOL STUDENTS IN GEOMETRY IN MINNA, NIGER STATE

By

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ABSTRACT
This study investigated the effect of instructional models on the performance of Junior Secondary Students in Geometry at Junior Secondary School in Minna, Niger State, Nigeria. It examined the significance of the post-test achievement scores of students taught using instructional models and the conventional method. The research was a pre-test post-test quasi-experimental control group design. The sample consisted of forty junior secondary school students drawn from two secondary schools within Minna metropolis. Stratified random sampling technique was used to select 40 students (20 males and 20 females). The Geometry Achievement Test (GAT) was pilot tested using test-retest method and the reliability score was 0.87. GAT was administered to students as pre-test and post-test before and after the treatment. The students' pre-test and post-test scores were analyzed using t-test statistics. The results indicated that the students taught using instructional model performed significantly better than their counterparts taught using the conventional method. However, there was no significant difference reported in the post-test performance scores of male and female students taught using instructional model and those taught with normal instruction. These findings indicated that geometry concept in mathematics could be taught and learnt better through the use of instructional models.

Keywords: *Instructional Models; Mathematics; Geometry; Junior Secondary School; Performance.*

Introduction

Teaching and learning of mathematics occupies an important status in the societal needs (Iqbal, 2004). Mathematics is central to many science related courses such as engineering, physics, computer science, medicine and so on. It is obvious that no student intending to study any disciplines can do without mathematics. Based on the importance of mathematics, the Federal Ministry of Education in the National Policy on Education (Federal Republic of Nigeria, 2004) made mathematics one of the core subjects to be offered by every student from the primary to pre-tertiary levels of education in Nigeria. In spite of the importance and popularity of mathematics among Nigerian students, performance at junior secondary school level had been poor (Gimba, 2006 & Iwendi, 2009). The desire to know the causes of the poor performance in mathematics has been the focus of researchers for some time now. It has been observed that poor performance in mathematics is caused by the poor quality of mathematics teachers, overcrowded classrooms, and lack of suitable and adequate instructional materials (Aboderin, 1997; Spencer, 2004, & Iwendi, 2009).

The basic geometry at junior secondary level serves as the background for understanding all branches of geometry at higher level. Research findings have confirmed that geometry is one of the topics among the abstract and complex aspects of mathematics, which the students find difficult to learn, and some teachers find difficult to teach without the use of instructional materials (Gimba, 2006, WAEC, 2005 & 2008).

The potential benefits of mathematical models cannot be underestimated in the contemporary world especially in the teaching of abstract concepts such as Geometry (Gana, 1997). In a review of empirical studies on instructional models, Araromi (1998) and Abimbade (1997) concluded that improvised instructional models enhance visual imagery, stimulates learning and assists the teacher to properly convey the topic content to the learner, to achieve better understanding and to perform well. Aboderin (1997) and Joshua (2007) found that the use of Pythagoras model for mathematics instruction and geometrical globe instructional model for teaching mathematics in senior secondary schools enhanced students' academic performance. Gimba (2006) found that the use of 3-dimensional instructional models to supplement conventional instruction produces higher achievement than the use of conventional instructional alone.

Gender issues have been linked with performance of students in academic tasks in several studies but without any definite conclusion. Some studies revealed that male students performed better than the females in science (Njoku, 2000) while others revealed that female students are better off than males (Anagbogu & Ezeliora, 2007). Some studies such as those of Bello (1990), Nsofor (2006), Yaki (2006) and Olowe (2010) did not find any form of influence being exerted by gender on students' academic performance in the sciences. Similarly, Spencer (2004) found no significant influence of gender on the achievement of college students in mathematics when they were exposed to mathematics courseware in online and traditional environment. Iwendi, (2009) found no gender differences in performance of males and females in senior secondary school mathematics. However, Gimba (2006) found that female students performed better than male students while exposed to 3-dimensional mathematics instructional materials. Therefore, the study on gender is yet to be conclusive.

It is against this background that this study is proposed to investigate the effect of geometrical instruction models on the performance of junior secondary students in mathematics, in Minna, Niger State, Nigeria.

Research Questions

The following research questions were raised:

(i) Is there any difference in the performance of students taught geometry with instructional model and those taught without it?

(ii) Is there any difference in the performance of male and female students taught geometry with instructional model?

Research Hypotheses

(i) There is no significant difference between the mean score of students taught geometry with instructional model and those taught without it.

(ii) There is no significant difference between mean score of male and female students taught geometry with instructional model.

Research Design

This study was a quasi-experimental type, of pre-test post-test experimental and control group design. An experimental group and a control group were formed and the pre-test and post-test method of Champbell and Julion (1966) was used.

Population

The population for this study comprises of all junior secondary schools in Niger State. The target population was the second year junior secondary mathematics students (JSSII) in two local government areas in Niger State.

Sample and Sampling Techniques

Two co-educational schools were used for this study and assigned to experimental and control groups using simple random sampling technique. The sample consist of forty (40) class two junior secondary students drawn from two junior secondary schools within Minna metropolis. The sample was selected using stratified random sampling technique. The geometry instructional model (Experimental Group) consists of twenty (20) students and the conventional method group (Control Group) had twenty (20) students. The Experimental and Control Groups had 10 male and 10 female students each.

Research Instruments

The instruments for this research were the treatment instrument Geometry Instructional Model (GIM) and Geometry Achievement Test (GAT). The treatment instrument was the researchers constructed instructional models for teaching geometry in mathematics at junior secondary school level. The geometry instructional model was designed to provide visual information covering four topics on solid shape geometry (cuboid, cylinder, cube and cone) for second year junior secondary school class (JSSII). The instructional model was constructed using plywood to carve out the shapes of various geometrical objects. It was a three dimensional objects. The lesson was structured in such a way that students were allowed to touch and feel the objects. The instructional contents were taught followed by series of questions related to instructional content and then followed by a summary of the content. For validation, the geometry instructional models were given to two educational technology and mathematics experts to determine the appropriateness of the materials. Based on their suggestions, further improvements were made on the models.

The test instrument, Geometry Achievement Test (GAT) was a 40 item multiple-choice objective test with five options each (A-E) which were constructed by the researchers. The test content was based on a table of specification covering the six levels of cognitive domain of learning. GAT was validated by ensuring that all question items were derived from the content presented to the two groups, the face and content validity were also considered. For testing reliability the final draft of the instrument was administered once on another set of

20 students selected from the sample population. A reliability test using the Kudar Richardson Formula 21 (KR 21) revealed a reliability of 0.88 which was considered good enough for the research study.

Procedure for Data Collection

The Experimental and Control groups were subjected to the GAT as pre-test. Then, the students in the experimental group were exposed to geometry instructional model. The control group students were exposed to the conventional teaching method on the same content used for experimental groups. They were taught using conventional method. Each of the instructional mode lesson lasted for 40 minutes. The control group was taught using the same content (cuboid and its properties; cube and its properties; cylinder: area and its properties; cone and its properties) in four lessons of 40 minutes each. After four weeks of the treatment, GAT was administered as post-test for each of the groups. The scores obtained by the experimental and control groups on the pre-test and post-test were analyzed using t-test statistics. The level of the significance adopted for the analysis was $P \leq 0.05$. This level of significance formed the basis for rejecting or not rejecting each of the hypotheses.

Results

The scores of students in the two groups were analysed using t-test statistics. The analysis was done using the two research hypotheses stated for the study. The results of the analyses and discussions are as stated below.

Hypothesis One: There is no significant difference between the mean score of students taught geometry with instructional model and those taught without it.
To determine the effect of the instructional treatment, the students scores were analysed using t-test statistics and the result is as shown in Table 1.

Table 1: t-test comparison of the pre-test and post-test mean scores of Experimental and Control groups

Test	Group	N	df	Mean (x)	SD	t-value calculated	t-value critical	P
Pre-test	Experimental group	20		24.06	8.04			
			19			0.30^{ns}	2.000	0.05
	Control Group	20		23.58	12.32			
Post-test	Experimental group	20		73.25	17.34			
			19			3.60*	2.093	0.05
	Control Group	20		55.25	14.24			

ns: Not Significant
* Significant at $P \leq 0.05$.

Table 1 shows that the students in the Experimental Group and Control Group in the pretest were at the cognitive level with mean score of 24.06 and standard deviation of 8.04

for Experimental Group as against a mean score of 23.58 and standard deviation of 12.32 for Control Group. This gives t-value calculated as 0.30 and t-critical of 2.00 at 0.05 significant level: ($t = 0.30 < 2.00$ at 0.05 level). This shows that there was no significant difference in the performance of students in the two groups during the pre-test. The two groups were found to be equivalent before the treatment commenced.

However, in the post-test analysis the calculated t-value (3.60) is greater than the critical t-value (2.093) ($t = 3.60$, $df = 19$, $P < 0.05$ level). This indicates that there was significant difference between the mean scores of the experimental group (73.25) and the control group (55.25) at 0.05 significant levels. Consequently, it could be deduced from the study that the use of geometry instructional model had improved the performance of students in geometry. Therefore, hypothesis 1 was rejected.

Hypothesis 2:
There is no significant difference between mean score of male and female students taught geometry with instructional model and those taught without it.

Table 2: t-test comparison of the post-test mean scores of male and female students in the experimental group

Variable	N	df	Mean (x)	SD	t-value calculated	t-value critical	P
Experimental group	10		76.00	15.30			
		9			0.71	2.262	0.05
Control Group	10		70.50	18.77			

Ns – Not significant at P > 0.05.

Table 3 reveals that there was no significant difference between the post-test scores of male and female students taught geometry with instructional model at 0.05 level of significance ($t = 0.71$, $df = 9$ $P > 0.05$). The null hypothesis was therefore not rejected. The performances of the male and female taught geometry in the experimental group were equally enhanced by the use of geometry instructional model during teaching and learning process.

Discussion of Results

The result in Table 1 indicates that there was a significant difference in the geometry achievement of students taught with geometry instructional model. The students taught with geometry instructional models performed better in the Geometry Achievement Test than those taught with conventional method.

The findings confirmed the assertion of Abimbade (1997) who said that instructional model enhances visual imagery, stimulates learning and assists the teacher to properly convey the topic content to the learners, to achieve better performance. It agreed with the earlier findings of Aboderin (1997), Gimba (2006) and Joshua (2007) who reported that the use of Pythagoras model for mathematics instruction, 3-dimesional instructional model for mathematics and geometrical globe instructional model for teaching mathematics at senior secondary schools enhanced students academic performance.

From the result in table 3 there was no significant difference between the performances of male and female students who were taught geometry using geometry instructional model. The male and female students performed equally well. The result is in agreement with the findings of Bello (1990), Nsofor (2006), Yaki (2006) and Olowe (2010) who reported that biology instructional model affects male and female student equally when taught biology using instructional model. It also agrees with Spencer (2004) who found no significant influence of gender on the achievement of college students in mathematics when they were exposed to mathematics courseware in online environment. However, it contradicts the opinion of Njoku (2000) who asserted that girls perform poorly relative to boys in science subjects. Thus, it can be deduced that the use of geometrical instructional models enhanced the performance of both male and female students.

Conclusion

From the findings, the following conclusions were drawn: Students taught geometry using geometrical instructional models performed better than those taught by the conventional method. Gender had no influence on the performance of students in geometry when they were taught using geometry instructional models.

Recommendations

Based on the findings of this study, the following recommendations are made.

(i) Geometry instructional model was found effective as a teaching-learning strategy for geometry instruction as compared to conventional method of instruction therefore, teachers should employ instructional model for teaching geometry concept.

(ii) The male and female students were affected positively and equally by the use of geometry instructional model therefore, mathematics teachers should employ this strategy to improve female students' performance in mathematics especially in geometry.

(iii) It is an interesting and useful experience to improvise by using local resources for teaching some units of mathematics at junior secondary school level, therefore, it is recommended that mathematics teachers should improvise instructional material to teach abstract concepts in mathematics in order to improve students performance in the subject.

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