

IMPROVING SECONDARY SCHOOL STUDENTS' ACHIEVEMENT IN GEOMETRIC CONSTRUCTION USING INTERACTION PATTERN APPROACH

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Abstract

This study was designed to determine the extent Interaction Patterns can be used to improve on JS3 students' achievement in geometric construction. Two (2) research questions and three(3) null hypotheses guided the study. The study adopted a quasi-experimental design. Pretest-posttest, non-equivalent control group was used and was restricted to Ogidi Education Zone of Anambra State. Two Co-educational Secondary Schools were drawn for the study using simple random sampling technique. Two intact JS3 classes were randomly assigned to experimental and control groups in each of the schools. A sample of one hundred and fifty six (156)(male (77) and female (79)) JS3 students was used. The instrument for data collection was Geometric Construction Achievement Test (GCAT) which was validated by three experts in Department of Science and Computer Education, Enugu State University of Science and Technology, Enugu. GCAT was found to be reliable with the Kuder-Richardson (KR_{20}) coefficient of 0.84. Mean and standard deviation were used to answer the research questions while the hypotheses were analyzed and tested at .05 level of significance using Analysis of Covariance (ANCOVA). Experimental groups were taught using Interaction Patterns while control groups were taught the same topics using expository method. The result of the study revealed that use of Interaction Patterns in teaching geometric construction to secondary school students enhanced their achievement in geometric construction. The study also revealed that the use of interaction patterns had no statistically differential effect on male and female students' achievement. The study also revealed that there was no significant interaction effect on gender and method of instruction on the achievement of the concept taught during the study. The findings of this study have implications for mathematics teachers, mathematics curriculum planners and institutions that train mathematics teachers. It was recommended that seminars, workshops and conferences should be mounted by professional bodies, federal and state ministries of education on the use of interaction patterns for mathematics teachers, students and others. It was also recommended that teachers should adopt interaction patterns as instructional methods.

Introduction

Geometric construction is an aspect of mathematics and mathematics is a tool and language of science. From the societal perspective, mathematics competence is essential for the preparation of an informed citizenry and continuous production of highly skilled personnel required for industries, technology and science. Ukeje (1997) in acknowledging the importance and contribution of mathematics to the modern culture of science and technology stated that 'without mathematics, there is no science, without science, there is no modern technology and without modern technology, there is no modern society'. It is therefore worrisome seeing students' consistent poor achievement in this important subject. Okpala (2011), in the trend analysis studies on the achievement patterns in mathematics among Nigerian secondary school students in Anambra state clearly showed that from 2001 to 2010, there was a steady average of 1.18% annual decline in students A_1 to C_6 achievement grades in mathematics at the West African Senior School Certificate Examination (WASSCE). The dwindling of students' achievement in mathematics has become an issue of serious concern to Federal Government, parents, teachers and students themselves.

Studies on the factors responsible for the consistent poor achievement in mathematics have been identified as poor teaching methods and non-usage of correct instructional materials among others (Usman and Nwabuze,2011). What predominates in the Nigeria primary and secondary school classrooms is the teacher-centered approach. The dynamics of teaching is a crucial factor on how much students learn. Teachers establish the pattern of general conduct during lesson while students establish certain types of behaviour to coincide with this pattern. The combination of the instructional pattern and students' participation lead to a specific classroom environment characterized by specific interaction pattern (Kalu,2004). The predominant or regular way in which classroom interaction occurs is called the classroom interaction pattern. Therefore, classroom interaction pattern is the way in which messages are transmitted successfully between the teacher and the students to achieve the instructional objectives in the classroom (Metelo,2005).

According to Uzuegbunam, (1995) as cited in Ogbu (2000), the four major classifications of classroom interaction patterns include: teacher-student, student-student, teacher-material and student-material interaction patterns. Teacher-Student interaction pattern is an interaction between the teacher and individual students or group of students. Student-Student interaction pattern is where students react to each other's actions, attitudes and opinions during class lesson. Ogbu (2000) further classified student-student interaction pattern into co-operative, competitive and individualistic interaction patterns. Teacher-Material interaction pattern is when the teacher is manipulating instructional materials, machine and equipment for the purpose of skill learning or in order to stress a point or clarify some issues for the students. Student-Material interaction pattern is when students work on instructional materials, machines and equipment to solve practical problems or experiment with specimen or models. Anderson and Garrison (1998) expanded up the initial four categorizations of interaction patterns with the addition of teacher-teacher and content-content interaction patterns. Teacher-teacher interaction pattern extends the premise of a learning community and the benefits of a shared pool of knowledge and experience of teaching (Markewitz, 2007). As regards to content-content interaction, internet search engines are just one example of newer technologies that allow content to interact with content (Anderson, 2003b).

One educational variable that appears to be influencing students in the learning of mathematics is gender. The UNESCO (2007) report on Education for All, stated that females do better in mathematics and science related courses when males are not in the class, while males tend to achieve better than females in co-educational schools. In Nigeria and perhaps Africa, gender gap in mathematics is still very prevalent although findings on this issue are equivocal (Arigbabu and Mji,2004; Awofala, 2007). Abiam and Odok, (2006) found no significant relationship between gender and achievement in number and numeration, algebraic process and statistics and a weak significant relationship in geometry and trigonometry. The authors asserted that females in co-education schools, because of the presence of males apparently develop such faculty of power and synthesis that was formerly the exclusive attribute of the males. Therefore, this study intends to investigate the influence of gender on secondary school students' achievement in geometric construction.

Purpose of the Study

The purpose of this study is to determine the effect of classroom interaction pattern on

students achievement in geometric construction in Ogidi Education Zone of Anambra State. Specifically, the study sought to determine:

The effect of the classroom interaction pattern on the achievement of JS3 students in geometric construction in experimental and control groups,

The effect of the classroom interaction patterns on the achievement of male and female JS3 students in geometric construction in co-educational schools

Research Questions

The following research questions guided the study;

1. What are the mean achievement scores of JS3 students taught geometric construction using the interaction patterns (experimental group) and those taught using expository method (control group) ?
2. What are the mean achievement scores of male and female JS3 students in the experimental group ?

Research Hypotheses

The following null hypotheses were tested at 0.05 level of significance.

1. There is no significant difference between the mean achievement scores of JS3 students taught geometric construction using the interaction patterns (experimental group) and those taught using expository method (control group).
2. There is no significant difference between the mean achievement scores of male and female JS3 students taught geometric construction using the interaction patterns.
3. There is no significant interaction effect of group and gender as measured by the geometric construction achievement test (GCAT).

Methods

The design adopted was quasi-experimental research design. Specifically, the study used a pretest-posttest non-equivalent control group design. This design was considered appropriate for the study because intact classes were used. The study was carried out in Ogidi Education Zone of Anambra State, Nigeria. The target population was three thousand five hundred and seventy seven students (3,577) JS3 students in government owned secondary schools in Ogidi Education Zone (PPSSC, Awka, 2011/2012 academic session). The choice of JS3 was based on the fact that the topics for the study fall under JS3 mathematics curriculum. The sample for the study consisted of one hundred and fifty six (156) JS3 students from the twenty six government-owned co-educational secondary schools in Ogidi Education Zone. Purposive sampling technique was used to sample out two co-educational secondary schools. Furthermore, in each of the two schools, two JS3 intact classes were sampled out randomly and assigned to experimental and control groups also. The instrument used for data collection was Geometric Construction Achievement Test (GCAT) made up of 30 items. Some of the items were designed by the researcher while some were selected from the Basic Education Certificate Examination past question papers. The items were drawn using a table of specification to ensure adequate coverage of the content area covered in the study as well as maintain even spread across the different levels of the cognitive domain. GCAT was validated by three research experts, one in Measurement and Evaluation and the other two in Mathematics Education, all in Science and Computer Education Department of

Enugu State University of Science and Technology, (ESUT). GCAT was also trial-tested and the result obtained was used to calculate the reliability coefficient of 0.84 using Kuder-Richardson’s formula $20(K-R_{20})$.

Experimental Procedures

The researcher trained two mathematics teachers as research assistants for the period of two weeks on the content area and the use of GCAT. Before the experiment began, the GCAT was administered to the students as pretest. Thereafter, the treatment was administered for a period of six weeks. The experimental group in each school was taught geometric construction using Interaction Pattern while the control group was taught the same topics using Expository method. After six weeks of treatment, the GCAT was reshuffled and administered to the students as posttest. Mean and standard deviation were used to answer the research questions while Analysis of Covariance (ANCOVA) was used to test the hypotheses at 0.05 level of significance.

Presentation of Results

Research Question 1

What are the mean achievement scores of JS3 students in experimental and control groups?

Table 1: Mean achievement scores and Standard Deviation of experimental and control groups.

Group	N	Pretest		Posttest	
		Mean	SD	Mean	SD
Experimental	79	15.38	3.16	25.06	4.50
Control	77	14.34	2.62	17.68	3.17

From Table 1, it could be observed that, there was no major difference between the mean achievement scores of experimental and control groups in the pretest. However, experimental group obtained a higher mean score of 25.06 than the its counterparts in control group that achieved 17.68 as their mean achievement score. The mean gain for the experimental group was 9.68 while that of the control group was 3.34. This revealed that interaction pattern had greater potency at improving secondary school students’ achievement in geometric construction.

Research Question 2

What are the mean achievement scores of male and female JS3 students in co-educational schools in experimental groups?

Table 2 : Mean Achievement scores and Standard Deviation of male and female JS3 students in the experimental groups.

Gender	No. of students	Pretest		Posttest	
		Mean	SD	Mean	SD
Male	40	16.09	2.77	25.90	3.64
Female	39	15.34	3.43	24.21	3.17

In Table 2, for the experimental groups, the mean pretest for the male was 16.09 and 15.34 for the female students. This showed that the background level of knowledge of geometric construction was almost the same before the treatment. Furthermore, the mean posttest scores for the male students was 25.90 with standard deviation of 3.64. The mean gain was 9.81 for

the males and 8.87 for the females. This showed that male students slightly achieved higher than their female counterparts, all in experimental group.

Hypotheses Testing

Table 3 : Analysis of Covariance (ANCOVA) of Students' Achievement Scores.

Source	Sum of squares	df	Mean square	F	Sign of F	Decision at 0.05
Corrected Model	3543.345	8	442.918	213.772	.000	
Intercept	183.892	1	183.892	88.754	.000	
Pretest	1226.243	1	1226.243	591.840	.000	
Group	1584.927	1	1584.927	764.958	.000	S
Gender	.342	1	.342	.165	.685	NS
Group*Gender	.103	1	.103	.050	.824	NS
Error	304.572	147	2.072			
Total	75401.000	156				
Corrected Total	3847.917	155				

S=Significant, NS=Not Significant at 0.05 level of probability.

The data in Table 3 were used in testing hypotheses 1, 2 and 3.

Hypothesis 1 :

There is no significant difference between the mean achievement scores of JS3 students taught geometric construction using the interaction patterns (experimental group) and those taught using expository method (control group).

From Table 3, the F-calculated of 764.958 obtained has an associated probability of 0.000. This probability value of 0.000 was compared with 0.05 and it was found to be significant because 0.000 is less than 0.05 ($0.000 < 0.05$). The null hypothesis of no significant difference in the mean achievement scores of the experimental and control groups was therefore rejected and inference drawn, that the experimental group significantly achieved higher than the control group in geometry contents taught.

Hypothesis 2 :

There is no significant difference between the mean achievement scores of male and female JS3 students taught geometric construction using the interaction patterns.

Table 3 also showed that the probability value of 0.685 was obtained for F-cal = 0.165 on mean achievement scores of male and female students of the experimental group. This associated probability value of 0.685 was compared with the already set alpha level of 0.05 ($0.05 < 0.685$). The implication of this is that null hypothesis of no significant difference in the mean achievement scores of male and female students was not rejected. This means that the mean achievement scores of male and female students in GCAT was not statistically significant at 0.05 level of significant.

Hypothesis 3 :

There is no significant interaction effect of group and gender as measured by Geometric Construction Achievement Test (GCAT).

From Table 3, the probability value of 0.824 was obtained for F-cal = .050 on interaction effect of group and gender on achievement in geometric construction. The associated probability value of .824 was compared with already set alpha level of 0.05 ($0.824 > 0.05$). The null hypothesis of no significant interaction of group and gender was not rejected. Therefore, the interaction effect on group and gender on achievement mean scores

of the students in geometric construction was not statistically significant at 0.05 probability level ($F_{\text{cal}} = 0.050$, $F_{\text{crit}} = 0.824 > 0.05$).

Discussion

One of the findings of this study revealed that the students in the experimental group obtained higher mean POST GCAT scores than those in the control group. This was confirmed by the ANCOVA result which showed that experimental group significantly achieved higher in the geometric content taught than the control group. The finding supported Okoye (2011) who asserted that teaching is a complex work that requires not only knowledge of the subject but also many other functions which include; lesson preparation, presentation, skill of classroom management, communication and evaluation skills. Evidently, the result implicated a strong relationship between instructional strategy and achievement in geometric construction.

It was also found that the mean achievement scores of male and female students in the experimental group differ slightly in favour of the male. However, the mean achievement scores of male and female students in GCAT was not statistically significant. This finding contradicted that of Kurumeh and Iji (2009); Odogwu (2002); Orji (2000) who separately found that, there were significant differences in mean achievement scores of male and female students in favour of males.

Finally, the findings on interaction effect of gender and instructional method as measured by GCAT showed no significant interaction effect on students' achievement in geometric construction. This is in accordance with Ezema (2002) who found no significant interaction effect between gender and instructional method on students' achievement and interest in quadratic equation. The finding is at variance with that of Obi, Agwagah & Agah (2014) who found significant interaction effect of Origami and gender in teaching geometry.

Conclusion

Based on the findings of this study, the researcher drew the following conclusion:

The use of interaction patterns approach significantly enhanced students' achievement in geometric construction when compared with expository instructional approach.

It was also concluded that gender does not play significant role on students' achievement in geometric construction.

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