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EFFECTS OF INDIVIDUALIZED AND GROUP ALGEBRAIC BLOCKS ON UPPER BASIC STUDENTS' ACHIEVEMENT IN ALGEBRA IN GOMBE STATE, NIGERIA.

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ABSTRACT

The study investigated the effects of individualized and group algebraic blocks on upper basic students' achievement in mathematics in Gombe state, Nigeria. 30, 974 (12,071 male and 18,903 female) students were used as the population of the study. The sample comprised three intact classes with the control group made up of 82 students, individualized algebraic blocks strategy made up of 73 students while the group algebraic blocks strategy is made up of 78 students to get the sample size of 233 students using multistage random sampling technique. The design used was a quasi- experimental pre-test, post-test post post-test non-equivalent control design. Two research questions with correspondent hypotheses were used. The instrument used was Algebraic Achievement Test (AAT). Description statistics of mean and standard deviation were used to answer the research questions, while inferential statistics of ANCOVA was used to test the hypothesis at 0.05 level of significant. The findings among others revealed that students who were taught Algebra using individualized and group algebraic blocks instructional strategiesAchieved better than those taught using conventional method. The study therefore concludes that teaching students of Mathematics using individualized and group algebraic blocks instructional strategies improved students' academic achievement of knowledge in Algebra. Based on this finding, it is recommended among others that Mathematics teachers should be encouraged to develop and adopt the use of individualized and group algebraic blocks instructional

strategies in teaching Algebra. Government should endeavour to organize regular workshops to train Mathematics teachers on development and use of these strategies.

Keywords: *scaffolding, jigsaw I, strategy, retention, geometry*

INTRODUCTION

Mathematics is relevant to everyday life and can be seen as the pivot on which all other subject revolve. The growth and development of every country depends mainly on its technological advancement. Nations that desire to forge ahead scientifically and technologically cannot afford to toy with the mathematical knowledge of her citizenry (Iji,Ogbole & Uka,2014). Achievement in algebra can be defined as the knowledge and understanding students gain from experiences in algebra. Achievement is measured by the students' marks on the achievement test developed by the researcher. As important as this subject is, students are failing at alarming rate (Ogbu, Musa & Kurumeh 2016). According to the chief examiners (2017), majority of students were not able to manipulate algebraic fractions and did not understand questions in algebraic graphs and therefore they listed out algebra as one of the major areas of Students' weakness which has contributed immensely to their poor achievement in mathematics. This poor achievement in mathematics worries all, especially mathematics educators and stakeholders of mathematics education in Nigeria. Many attribute this, mainly to instructional methods and strategies adopted by teachers (mathematics Chief Examiner's Report, 2017).

The issue of inappropriate instructional methods and strategies in the teaching and learning of mathematics is vital, as these constitute what and how mathematics could be taught in schools. Instructional strategies adopted by the teacher could influence the affective, psychomotor and cognitive outcome of the learner. Some teachers do not use teaching methods and teaching aids that can stimulate students' interest. The widely used instructional technique in schools is lecture method. This is

characterized by predominance of teachers' task with no involvement of students in the process.

Algebra is a branch of mathematics dealing with symbols and the rules for manipulating those symbols. The symbols, written today as Greek and Latin letters represent quantities without fixed values known as variables. The field of algebra can be divided into secondary concepts called elementary algebra and more abstract study of numbers and equations called abstract algebra. However, the studies of Mata, Monteiro, Peixoto(2012) andZachariah, Komen, Muthaa, Nkonke(2012) show that many students' are left behind and struck in a revolving door of low achievement in algebra.

Algebraic blocks are concrete mathematical aids which have existed in a variety of forms for some considerable time. It consists of pieces of colored rectangular and square woods or plastics that can be used to represent constants and variables in algebra. Algebraic concepts according to their nature are abstract and therefore concrete aids are required to assist students in the process of conceptualization. Olkun and Tolkun(2004) observe that algebraic blocks strategy is a practical, learner-centered, minds-on and hands-on innovative method of teaching especially difficult and abstract concepts in mathematics. Algebraic blocks can be used individually in mathematics class to make concrete model of abstract mathematical ideas.

Individualized algebraic blocks is learning strategy in which each student manipulates the algebraic blocks individually to achieve the set goal.Baroody (2006) is of the opinion that students should be given the opportunity of thinking and manipulating objects bythemselves rather than the teachers and textbooks doing the thinking for them.He also stated that thekey idea behind the individualized instruction model is that learners will not only understand better the materials that are being presented, but that they will be able to effectively retain information for much longer.

Group algebraic blocks strategy is the learning strategy in which students manipulate the blocks together on learning tasks with the goal of all participants benefiting from interaction, (Ojo & Ojo 2011). Psychologist

and Educationist agree that most young children acquire problem solving skills and hence think more mathematically about mathematical concepts in the company of more advanced users of the concepts. In groupalgebraic blocks learning, the teacher structures the classroom tasks in such a way that students are made to work in groups in other to achieve mathematical goal.

The study is anchored on Brunnertheory of cognitive development (1966) who believes that there are three stages of growth in which children come to represent the world.These are: Enactive stage - where holding, touching, moving and so forth is needed to provide experience of the concept with the object; Iconic stage - information is carried by imagery,that is, by visual and diagrammatic representations; Symbolic stage - language and written symbols areused.

Gender as avariable has over the years, received considerable attention in many studies on science in general and mathematics achievement in particular. There has been evidence of growing gender gap in educational achievement of students. Amadi (2015) states that poor achievement in secondary schools mathematics is more in female than the male students. Teachers should therefore use teaching strategy that brings out equality of achievement and retention in algebra aspect of mathematics. Having known that the impact of algebra can be felt in almost all disciplines and bearing in mind that teaching methods affect students' performance in mathematics, this study is therefore set to find out the effects,individualized and group algebraic blocks strategies could have on upper basic students' interest, achievement and retention in algebra.

Statement of the Problem

Algebra is often seen as a difficult aspect of mathematics by students, probably because it uses letters to represent numbers and so they cannot grasp its abstract nature. This has led to Nigeriansecondary school students viewing mathematics as difficult and abstract in nature because they have great difficulty in understanding, assimilating and retaining the mathematics concepts especially algebra taught to them in the classroom. Researches have shown that mathematicsteachers tend to useabstract

approach inteaching upper basic school algebra, students therefore cannot visualize their answers and usually see no relationship between algebra examples and their real world experiences. Therefore, the problem of this study is to find out the effect of individualized and group algebraic blocksstrategies on students'achievement in algebra.

Research Questions

The following research questions guide the study:

1. What are the mean achievement scores of students taught algebra using individualized algebraic blocks, group algebraic blocks and lecture method?
2. What are the mean achievement scores of male and female students taught algebra using individualized and group algebraic blocks?

Objectives of the Study

The main purpose of this study was to investigate the effect of individualized and group algebraic blocks on students' achievement. Specifically, the study was set to:

3. Determine if the use of individualized and group algebraic blocks to teach algebra enhanced upper basic one students' achievement in algebra.
4. Find out if the use of individualized and group algebraic blocks to teach algebra bridged the gap between the upper basic one male and female students' achievement in algebra.

Statement of Hypotheses

The following null hypotheses were tested at 0.05 levels of significance:

$H0_1$: There is no significant difference between the mean achievement scores of students taught algebra using individualized algebraic blocks, group algebraic blocks and lecture method.

$H0_2$: There is no significant difference between the mean achievement scores of male and female students taught algebra using individualized and group algebraic blocks.

METHODOLOGY

This study adopted a quasi-experimental research of pre-test, post-test, post-post-test, non-equivalent, non-randomized control group design. This represents two treatment group and one control group Scaffolding and Jigsaw and control group. All students in the three intact classes were pre-tested to determine their entry level behaviour or status. The experimental group received treatment on Scaffolding and Jigsawstrategies, while the control group did not receive any treatment. Also, all the groups were subjected to post-test to determine the effect of the treatment on students' retention and post-post-test (to determine the effect of the treatment on their retention ability). 30, 974 (12,071 male and 18,903 female) students were used as the population of the study. The sample comprised three intact classes with the control group made up of 82 students, individualized algebraic blocks strategy made up of 73 students while the group algebraic blocks strategy is made up of 78 students to get the sample size of 233 students using multistage random sampling technique. The design used was a quasi- experimental pre-test, post-test and post-post-test non-equivalent control design. Two research questions with correspondent hypotheses were used. The instruments used wasAlgebra Achievement Test (AAT). Descriptive statistics of mean and standard deviation were used to answer the research questions, while inferential statistics of ANCOVA was used to test the hypothesis at 0.05 level of significant. The choice of ANCOVA was because of the nature of the design of the study i.e. Quasi-experimental (specifically non-equivalent control-group design). This is because the design permitted the use of pre-test, which acts as covariate; therefore, ANCOVA helped to establish the homogeneity or equivalence of the three groups before treatment. Besides this, since intact classes were used for the study, ANCOVA also helped to increase the power of the test because of error that might have occurred because of non-randomization of the subjects of the study (i.e. Type1 error was reduced). Statistical Package for Social Science (SPSS-Version 22) was used to run the analysis.

Result

Research Question 1: What are the mean achievement scores of students taught algebra using individualized algebraic blocks, group algebraic blocks and lecture method?

Table 1: The mean scores and standard deviation in AAT of students in individualized algebraic blocks, group algebraic blocks and lecture method.

Teaching strategy	No of Students	Type of Test	Mean	Standard Deviation
Individualized	73	pre- test	28.73	10.47
		Post- test	51.32	9.48
Group 78	Pre-test	25.53	9.62	
		Post-test	49.329.14	
Lecture method 82	pre-test	25.70	9.70	
		Post-test	39.28	9.40

Table 1 shows the mean scores and standard deviations of the students in the experimental and control groups. The mean scores of students taught with individualized strategy were 28.73 and 51.32 in pre-test and post-test respectively and standard deviation of 10.47 in pre-test and post-test of 9.48 in the AAT. The students taught using group strategy had mean scores of 25.53 and 49.32 in pre-test and post-test respectively, with standard deviation of and 9.62 in pre-test and 9.14 in post-test. For students, who were taught using lecture method, their mean scores were 25.70 and 39.28 and standard deviation of 9.70 and 9.40in pre-test and post-test respectively. Students taught with individualized algebraic blocks strategy had highest mean score while those taught with lecture method had lowest mean score. The standard deviation scores for the pretest and posttest were not at much variance implying that the efficacy of the treatment is sustainable.

Hypothesis one: There is no significant difference between the mean achievement scores of students taught algebra using individualized algebraic blocks, group algebraic blocks and lecture method.

Table 2: ANCOVA results in AAT of students in individualized, Group and lecture methods.

Source	Type III sum of squares	df	Mean square	F	Sig	Remark
Corrected Model	9060.103[a]	3	3020.034	39.236	0.000	S
Intercept	40454.786	1	40454.786	525.582	0.000	S
Group	5939.234	2	2969.617	38.581	0.000	S

Pre-test	2444.317	1	2444.317	31.756	0.000 S
Error	17703.435	230	76.971		
Total	531336.000	233			
Corrected Total	26763.538	232			

S = Significant at $P < 0.05$

Table 2 shows the summary of the one way Analysis of Covariance (ANCOVA) result on students'achievement scores in AAT. The result indicated that the noted difference between mean achievement scores of the three groups is significant at 0.05 alpha levels. This is from the fact that $F_{(1,230)} = 38.581$ and $P = 0.000 < \alpha = 0.05$. The null hypothesis that there is no significant difference in the mean achievement scores of students taught using individualized, group algebra strategy and lecture method was therefore rejected showing that difference exist. Hence the need for further analysis using Bonferroni multiple comparison which is based on estimated mean.

Table 3: Bonferroni multiple comparison of mean achievement scores of students in individualized, Group and lecture methods.

(I)Group	(J) Group	Mean Difference (I-J)	Std Error	Sig.[b]	95% Confidence Interval for Difference Lower Bound	Junior Bound
IAB	GAB	0.953	1.436	1.000	-2.509	-4.416
	Control	11.049	1.418	0.000	7.630	14.468
	IAB	-0.953	1.436	1.000	-4.416	2.509
GAB	Control	10.096	1.388	0.000	6.749	13.442
	IAB	-11.049	1.418	0.000	-14.418	-7.630
Control	GAB	-10.096	1.388	0.000	-13.442	-6.749

The mean difference is significant at $P < 0.05$ alpha level.

Table 3 shows Bonferroni multiple comparisonsof mean achievement scores of students in individualized, Group and lecture method. The mean difference between individualized and group algebraic blocks is not significant at 0.05 alpha level since $p = 1.000 > \alpha = 0.05$. The mean difference between individualized and control is significant at 0.05 alpha level. For the fact that $p = 0.00 < \alpha = 0.05$. The mean difference between

group and control group is significant at 0.05 alpha level, since $p = 0.00 < \alpha = 0.05$.

Research Question 2: What are the mean achievement scores of male and female students taught algebra usingindividualized and group algebraic blocks?

Table 4: Mean achievement scores and standard deviation in AAT of male and female students in individualized and group algebraic blocks strategies.

Group	Gender	No of	Type of	Mean		Standard	Students
Test			Deviation				
IAB	Male	38	pre-test	21.18	5.29		
			Post-test	24.03	4.48		
	Female	35	Pre-test	18.29	2.88		
			Post-test	21.11	4.28		
GAB	Male	38	pre-test	21.45	5.23		
			Post-test	26.84		4.75	
	Female	38	Pre-test	17.65	3.02		
			Post-test	26.95	5.64		

Table 5 shows the mean achievement scores and standard deviation in AAT for male and female students in individualized and group strategies. The male students in individualized strategy had mean pre- achievement scores of 21.18 and mean post- achievement scores of 24.03 with standard deviation of 5.29 in pre-test and 4.48 in post-test while the female students had mean pre- achievement scores of 18.29 and mean post- achievement scores of 21.11 with standard deviation of 2.88 in pre-test and 4.28 in post-test. Also the male students in group strategy had mean pre- achievement scores of 21.45 and post- achievement scores of 26.84 with standard deviation of 5.23 in pre-test and 4.75 in post-test while the female students had mean pre- achievement scores of 17.65 and mean post- achievement scores of 26.95 with standard deviation of 3.02 in test and 5.64 in post-test. Male students taught using individualized strategy had mean achievement scores higher than female students taught using individualized strategy. Female students taught using group strategy had mean achievement scores higher than the male students. The standard deviation scores for male and female in both groups were not at much variance implying that the efficacy of the treatment

Hypothesis two: There is no significant difference between the mean achievement scores of male and female students taught algebra using individualized and group algebraic blocks.
Tables 6 and 7 provided the test for this hypothesis

Table 6: ANCOVA result in AAT of male and female students in individualizedalgebraic blocks strategy.

Source	Type III sum of squares	df	Mean square	F	Sig	Remark
Corrected Model	2625.600[a]	2	1312.800	23.665	0.000	S
Intercept	10444.193	1	10444.193	188.274	0.000	S
Gender IAB	17.238	1	17.238	46.979	0.579	NS
Pre-test	2606.087	1	2606.087	0.311	0.000	S
Error	3938.616	71	55.473			
Total	201494.000	74				
Corrected Total	6564.216	73				

S = Significant at $P < 0.05$
Table 6 shows the ANCOVA results of male and female students in AATin individualized algebraic blocks. The result reveals that the noted difference between the male and female students is significant at 0.05 alpha level since $F_{(1,71)} = 46.979$ and $P = 0.579 > \alpha = 0.05$. The null hypothesis was therefore not rejected indicating that there is no significant difference in the mean achievement scores of male and female students taught algebra using individualized strategy.

Table 7: ANCOVA result in AAT of male and female students in group algebraic blocks strategy.

Source	Type III sum of squares	df	Mean square	F	SigRemark
Corrected Model	1466.323[a]	2	733.161	11.085	0.000 S
Intercept	16869.610	1	16869.610	255.051	0.000 S
Gender GAB	1417.810	1	1417.810	21.436	0.000 S
Pre-test	263.327	1	263.327	3.981	0.050 S
Error	4960.665	75	66.142		
Total	196163.000	78			
Corrected					

Total	6426.987	77

S = Significant at $P < 0.05$

Table 7 shows the ANCOVA results of male and female students in AAT in group algebraic blocks. The result reveals that the noted difference between the male and female students is significant at 0.05 alpha level. This is from the fact that $F_{(1,75)} = 21.436$ and $P = 0.000 < \alpha = 0.05$. The null hypothesis was therefore rejected indicating that there is significant difference in the mean achievement scores of male and female students taught algebra using group strategy.

Findings

The results of the study revealed the following:

1. There was a significant difference in mean achievement scores of students taught using individualized and group algebraic blocks strategy.
2. There was a significant difference in mean achievement scores of male and female students taught using group algebraic blocks strategy in favour of male students.

Conclusion

The findings of this study have shown that group algebraic blocks strategy has significant effect on students' interest, achievement and retention more than individualized algebraic blocks strategy and lecture method. However these results imply that the learning approach which is mainly conventional employed by mathematics teachers in teaching might have been partly responsible for the persistent under-achievement of students in mathematics. The implications of this findings hinge on the development of better teaching strategies for teaching of mathematics.

Recommendations

Based on the findings of this study, the following recommendations were made:

1. Mathematics teachers should adopt the use of group algebraic blocks strategy in teaching algebra aspect of mathematics in order to enhance students' achievement.
2. Mathematics teachers should use blocks as instructional material while teaching some abstract topics like algebra to enhance students' achievement in mathematics.

3. Curriculum planners should include group algebraic blocks as a major method for teaching algebra topics when planning mathematics curriculum.
4. Teachers should be educated throughworkshops and seminars on how to use algebraic blocks and on how to implement group learning strategy in schools at all.

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