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Effect of Cooperative Learning on Junior Secondary School Students' Mathematics Academic Performance in Biu Emirate, Borno State, Nigeria

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Abstract

The paper focused on the effect of cooperative learning and lecture method of teaching on Junior secondary students' mathematics academic performance in Biu Emirate, Borno state, Nigeria. The design of the study was quasi experimental, nonequivalent control and experimental groups. To guide the study three objectives was raised. The study sample was Junior secondary school (JSS) three students which was selected from government junior secondary schools in the study area using purposive random sampling of intact classes. The Instrument used for data collection in the study will be mathematics achievement test adapted from Junior Secondary School Certificate Examination (JSSCE) general mathematics past questions papers. Mean and independent t-test were used to analyze the data. Findings of the study will be importance to teachers, students, school administrator educationist and researchers. The findings of the study revealed that cooperative learning improves students' academic performance in Mathematics and minimizes gender differences in students' academic performance, in learning Mathematics. Recommendations among others includes: mathematics teacher should use cooperative learning teaching method to encourage students maximized their learning in mathematics, particularly, at the junior secondary school level in rural or urban areas.

Keywords: Cooperative Learning, Mathematics, Academic Performance

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Introduction

Mathematics is a tool and language of commerce, engineering and sciences that help us to recognize patterns and understand the world around us (Cardiff University, 2006). The study of mathematics can develop the imagination and train learners in clear and logical thought which may then be applied to make crucial contributions to our understanding and appreciation of the world, and our ability to find and make our way in it. In Nigeria, the importance of mathematics to nation building may be responsible for making it compulsory in secondary school curriculum as one of the cores subject to be offered by all students (Benjamin and Clement, 2012). This is to enable children acquire mathematical skills needed to cope with life challenges, and to give them background to further their education (National Policy of Education, FRN, 2014). According to Salman (2012), some practical usefulness of mathematics are found in areas like application of numbers to measure, estimation and approximation to check economic wastage in everyday life, logic to enhance intellectual development, statistics and computing to solve numerical problems and analyzing statistical data.

Despite the important role mathematics plays in the society, there has been persistent poor performance of students in the subject in both internal and external examinations in Nigerian secondary (Nasrun, 2016). The low performance of students in mathematics in the country has been attributed to inadequate teaching and learning resources, negative attitude of teachers/learners towards the subject and poor instructional techniques (Salman, 2012; Galdi and Likita, 2014). The poor performance of students in mathematics examinations may also be connected to the fact that, mathematics teaching in the country still follows the traditional pattern which does not promote students' interest nor achievement in the subject (Achor *et al.*, 2012). The traditional teaching method used in our classrooms was passive and less interaction that promote high anxiety levels, self-doubt, selfishness, aggression and cheating among students (Oloyede, *et al.*, 2012).

Gender differences in students' performance in mathematics had been a global concern and some researchers have been undertaken on it in many parts of the globe. Although, some of these researchers have identified gender differences while others have no significant gender differences in mathematics performance. The American Psychology Association (2010) reports that girls around the world are not worse at mathematics than boys even though boys are more confident in their mathematics abilities and those girls from where gender equity is more prevalent are more likely to perform better on mathematics assessment tests. In Nigeria, Michael *et al.*, (2012) found out that there exist significant gender performance differences in favour of males. Josiah and Adejoke (2014) found no significant relationship between gender and achievement in mathematics. According to Ajai and Imoko (2015) gender difference in mathematics achievement was as a result of factors such as classroom interactions, students' attitudes, interest and self-esteem, teachers' gendered attitude, curricular materials, beliefs, social and cultural norms.

Statement of the Problem

The researcher observed that teachers in the study area still uses the traditional method and students performed poorly in mathematics examinations. Also, most students had the opinion that mathematics is a difficult subject and it is for male and not female discipline. The gender stereotypes and the disadvantages identified in the traditional method of teaching mathematics require educators/ teachers to find effective teaching strategy which should be innovative and learners- based in order to improves students' performance in mathematics examination. According to Ajai and Imoko (2015) innovative teaching strategy makes pupils communicate effectively, cooperate with others and engage them in self-learning. Teaching and learning approaches such as experimental, inquiry and group work learning attracts the attention of many educators and constitutes a better alternative to the traditional learning methods (Ajai and Imoko, 2015). In an attempt to seek a teaching strategy that will makes students learning of mathematics interactive and develops positive attitude toward learning mathematics, the researcher investigated the "effect of cooperative learning strategy on Junior Secondary School Mathematics students 'academic performance in Biu Emirate, Borno State, Nigeria".

Objectives of the Stud

The objectives of the study are to determine:

- i. Effect of cooperative learning strategy and lecture teaching method on academic performance of students in mathematics at Junior Secondary School (JSS) level in Biu Emirate,
- ii. Effect of cooperative learning strategy on male and female students' academic performance in mathematics at Junior Secondary School level in Biu Emirate.
- iii. Effect of cooperative learning strategy on students' academic performance of rural and urban Junior Secondary School level in Biu Emirate

Literature Review

Cooperative learning is a teaching strategy that involves a small group of students working together to improve both individual and group member learning. The cooperative is a group work learning strategy model developed by Kagan (1994) to improve students' achievement. The method involves placing students in groups and each person is given a number (from one to the maximum number in each group). The teacher poses a question and students "put their heads together" in their group to figure out the answer. The teacher usually calls a specific number to respond as spokesperson for a group. According to Kagan (1994), in cooperative learning students work together in a group and holds each student accountable for learning the material. This strategy ensures that each member knows the answer to the problems or questions asked by the teacher. This is because no one knows which number will be called; all team members must be

prepared. The characteristic of this group work learning is that teacher only points out a student by mentioning one of numbers that represents his or her group to present the result of his or her group work. It also, enhance individual accountable in group discussion and individual interdependence in group, hence it can improve students' creativity in accomplishing group task. According to Maonde and Waode (2016), cooperative learning model enhance high ability level students to helps low level students that makes them to be more enthusiastic in apprehending problem and its answer. Therefore, the model gives chance to students to share ideas, consider the correct answers, encourages students to arouse their spirit of working as well as encourages individual and group accountability.

The study is based on Vygotsky's theory of socio-cognitive development. Vygotsky's theory of socio-cognitive development states that cognitive development comes from social interaction from guided learning within the Zone of proximal development of children and their partners construct knowledge (Vygotsky, 1978). According to Vygotsky (1978), much important learning by the child occurs through social interaction with skillful tutor or knowledgeable others (teachers, peers or adults). The zone of proximal development is a region of child's immediate potential for cognitive growth which is bounded on lower end by that which the child can accomplish on his own and on the upper end by that which he can accomplish with the help of a more knowledgeable others (Vygotsky, 1978). According to Mcleod (2007), Zone of proximal Development (ZPD) refers to difference between what a child can achieve independently and what he can achieve under guidance or encouragement from skilled partner. Vygotsky (1978) believed that children develop cognitively when they were exposed to tasks or situations in the upper end of ZPD, empowered in authentic situations (activities), and learn through interactions with others. Also, he believed that the ZPD is a dynamic system that is always undergoing change. That is as the child learns and develops the zone of proximal development moves, indicating the mastery of some tasks (at the lower end of the zone) and the appearance of other tasks that can now be accomplished with significant help (at the upper end of the zone). Vygotsky (1978) viewed that interaction with peers as an effective way of developing skills and strategies, and he suggested that teachers should use cooperative learning exercises where less competent students develop with the help from skillful peers within the Zone of their Proximal Development.

The Vygotsky's theory provides the basis for this study is based on the fact that children cognitive development comes from their social interaction with skillful peers. So, by grouping students in classroom heterogeneously in terms of gender and ability to work cooperatively on appropriate learning task will enable the group's members learn effectively. High ability group's members will help low ability ones through their interactions. According Felder and Brent (2007), every member of groups gains more when explaining or listening to their classmates' explanation of concepts or ideas. This is because when students are required to explain, elaborate, and defend their positions to others, they may be forced to think more deeply about their ideas before explanation; and students who are listening to explanations of others are exposed to and must think about other approaches to a given task. Therefore, cooperative learning activity among children of similar ages promotes their cognitive growth, because they may be operating within one another's proximal zones of development and modeling more advanced behaviors than those who perform individually.

Unamba *et al.*, (2015) conducted a study on the effects of cooperative learning technique on students' achievement in mathematics class using pre-test, post-test, experimental group and control group designed. The experimental group was subjected to cooperating learning while the control group to traditional teaching method. After t test, the result of the study showed a significant difference between the levels of achievement between the experimental group and the control group. Joseph and Barnard (2013) conducted a study on the effect of cooperative learning on learners' mathematics achievement in Kenya using Solomon four group designs under quasi-experimental research in the study. t-Test and ANCOVA tests were used to test the hypothesis at 0.05 level of significance. The results of the study indicated that there was no gender difference in students' mathematics achievement when taught using cooperative learning strategy.

Ieasa and Cerebima (2017) conducted a study on the effect of numbered heads together (NHT) cooperative learning model on elementary students' cognitive achievement in natural science in Indonesia. This study employed a quasi-experimental design with pretest-posttest non-equivalent control group with 2x2 factorial. There were two learning models compared NHT and the conventional, and two academic ability high and low. The results of ANCOVA test confirmed difference in the students' cognitive achievement based on learning models and general academic ability. However, the interaction between learning models and academic ability did not affect the students' cognitive achievement.

Nasrun (2016) conducted a study on the use of Cooperative Learning with Number Head Together Model to Improve the Students' Mathematics Subject. The instrument for study were questionnaire and learning outcomes test. The result of the study shows that the application of learning models Number Head Together has a role in improving student learning outcomes. Hasanah, and Surya (2017) conducted a study on cooperative method and found that it increased student achievement and improved student creative thinking in mathematics problem solving. Therefore, it is suitable method for mathematics instruction.

Casey, and Fernandez-Rio (2019) noted that in cooperative method, students learned to value both their own and others' views and solutions, become highly self-reliant on their own minds and ideas, adapt peer group work to suit their own and others' needs within the classroom, and think of academic success and achievement in terms of contribution than just performance in exams. They also noted an increase in positivity especially self-esteem and motivation in their work. Ehsan, Vida, and Mehdi (2019) conducted a study on cooperative learning and found that it increased student achievement in academics more than the traditional lecture-based system. The students had significantly improved their skills in the topics taught compared to their counterparts in the traditional lecture-based class. They also realized that student motivation

has significantly gone up high compared to their counterparts in the lecture based teaching. According them an intrinsic motivation came as a result of cooperative learning.

Ehsan *et al.*, (2019) conducted a study on cooperative learning and found that it increased the speaking skills of their students in class, motivation and positive attitudes in class. They recommended teachers to practice this method regularly and effectively by following through with its implementation procedure well.

Materials and Methods

Design of the Study

The design that was adopted for the study was a quasi-experimental, non-equivalent control group design. In the design, intact classes were randomly assigned to experimental and control groups. The experimental group was subjected to the treatment while the control group was taught with the traditional lecture method. Mathematics achievement test was given to both groups immediately after treatment to measure their academic performance.

Area of the Study

The area of the study was Biu Emirate, Borno State, Nigeria. It is located in the Southern part of Borno State and lies between latitudes 10° and 13° N, and longitudes 11.04° and 14.04° E. It consists of 4 Local Government areas namely Biu, Bayo, Hawul, and Kwaya kusar.

Population and sampling techniques

The target population for the study was all JSS3 Students in Public Junior Secondary Schools in Biu Emirate Zone, Borno State. The choice of JSS3 Students for the study was based on the fact that they are stable and more experienced. The sample for the study will be selected using intact classes in Junior Secondary Schools in Biu Emirate, Borno State. The researcher used purposive sampling to select two schools from the local government areas of the Emirate. In each of these Schools selected, two intact classes will be sampled from JSS3 classes and grouped into experimental and control groups. In a school where there are only two classes, the researcher selected both the classes. But in a school where there were more than two arms of JSS3 classes, simple random sampling will be used to select the two classes using hat-draw method. The intact classes were grouped into experimental and control groups by flip of coin.

Instrument(s) of the study

Mathematics Achievement Test (MAT) was use as instruments for data collection in the study. It was given as Mathematics Achievement Test (MAT) to both the control group and experimental group after treatments. The MAT consists of forty (20) multiple choice test items. The items of the Mathematics Achievement Test was adopted from JSSCE General Mathematics past questions from 2019-2025. However, the MAT items were given to three mathematics experts to validate its content validity with respect to the selected topics.

Data collection and data analysis

The data for the study was collected using MAT through the help of three research assistants. The MAT was given to the students immediately after the treatment by the research assistants on the selected topics to measure the students' academic performance in the control and experimental. The research used one mathematics teacher in each of the two selected schools as research assistant to teach both the control and experimental groups in their schools. They were trained on how to teach both the control and experimental groups and was advice strictly to follow the teaching manual and lesson plans given to them. This was done in order to control teachers' variables in handling the Subjects. The experimental group was taught by cooperative learning strategy while the control group was exposed to traditional lecture method. Different lesson plans were used to teach the experimental and control groups. By the end of the treatment, MAT was administered to both groups to measure their performance.

The data collected was analyzed using descriptive statistics of mean and inferential statistics of Analysis of independent t-test using SPSS Statistics version 20.

Results and Discussion

Demographic Distribution of Subjects

The sample population for the study was 215 students, 105 and 110 students were used for cooperative learning and lecture method groups respectively as shown in Table 1. The cooperative learning group consist of 58 male and 47 female students was used for the study. The treatment group also used 50 students selected from rural schools and 55 students from town or urban schools.

Research Questions Answers

Research Question1: What is the mean score of students taught mathematics using cooperative learning and lecture teaching method?

Table 2 showed that the mean performance scores of students for cooperative learning group was 51.41, and SD=8.91, while the mean performance scores for lecture method group was 38.32 and SD=7.99). The mean difference in the performance scores of the two groups was 13.09 in favor of the cooperative learning group. This showed that there was

a difference between the mean performance scores of JSS students when exposed to the cooperative learning method and the lecture teaching method in the study area.

Research Question2: *What is the mean score of male and female students taught mathematics using cooperative strategy?*

Result indicated in Table 3 showed that the mean performance scores for males was 51.62, SD=9.11 was greater than the mean performance scores for female, 51.15, SD=8.74). The difference in the mean achievement scores of the males and females was 0.47 in favour of the males. This showed that there was small difference between the mean achievement scores of males and females JSS students when exposed to the cooperative learning method.

Research Question3: *What is the mean score of students taught mathematics using cooperative learning in rural and urban schools?*

Table 4 showed that the mean performance scores for urban students taught by cooperative learning was 49.02 and Standard deviation of 9.09 while that of rural students counterpart was 54.04. The mean difference of the performance scores of the Urban and rural was -5.02 in favor of the rural. This showed that there was a difference between the mean achievement scores of urban and rural JSS students when exposed to the cooperative learning.

Test of Hypotheses

H₀₁: *There is no significant difference between the mean scores of students taught mathematics using cooperative learning strategy and lecture teaching method.*

Table 5 showed that there was significant difference between the mean performance scores of JSS Students" taught mathematics concepts using cooperative learning strategy and those taught using lecture teaching method as supported by $t_{cal}=11.33$ at $df=213$, $p=0.000<0.05$. The result indicated that there was significant difference in the mean performance scores of mathematics Junior Secondary School Students"; hence the null hypothesis which says no difference was rejected.

H₀₂: *There is no significant difference between mean scores of male and female students taught mathematics using cooperative learning*

The Table 6 shows independent samples t test of mathematics performance scores of JSS Students by gender .The test indicated the p- value is 0.788 with degree of freedom of 103 and 0.5 for probability. From the means of male = 51.41 and female = 51.15 the result show that the mean difference is not significant $p > 0.05$. This mean that there is no difference in mean performance scores between male and female JSS students when subjected to cooperative learning.

H_{0 3}: *There is no significant difference between the mean score of students taught mathematics using cooperative learning in rural and urban schools?*

The Table 7 shows independent sample t- test of students taught by cooperative learning in urban and rural junior secondary school which indicated the p- value is 0.229 with degree of freedom of 103 at 0.5 for probability. The p-value 0.229 is greater than 0.05 level of significance which indicated that the mean difference is not significant. This mean that there is no significant difference in mean performance scores of students taught by cooperative learning in urban and rural in junior secondary schools.

Summary of Findings of the Study

1. There was a significant difference in mathematics mean scores of Junior secondary school students taught by cooperative learning and lecture teaching method groups
2. There was no significant gender difference in mathematics mean scores of Junior secondary school students when taught by cooperative learning teaching method.
3. There was no significant difference in mathematics mean scores of junior secondary school students when taught using cooperative learning in rural and urban areas.

Discussion of the Findings.

The significant mathematics mean scores difference between the groups taught with the cooperative learning strategy and the one taught with the lecture method of teaching, means that cooperative learning method is better than the lecture method of teaching. This result was consistent with the study of ; Oloyede *et al.*, (2012); Gambari, James and Olumorin (2013), Nasrun (2016) who found out that cooperative learning increased students' achievement in Mathematics. This is because of the fact that cooperative learning activities develop students' high-order thinking skills, enhances student's motivation and improve interpersonal relations among students. According Gambari, James and Olumorin (2013) the higher achievement of students in mathematics in cooperative learning was due to the five elements for implementation of cooperative learning- positive interdependence, individual and group accountability, promotive interaction, groups' social skills and group processing. Students who make explanations of material to others in cooperative setting can understand the material more clearly because they may think more deeply about their ideas before explanation. Also, students who are listening to explanations of others are exposed to and must think about other approaches to a given task.

The mean score of male and female in cooperative learning strategy was not significant. This result was in line with the studies Ajaja and Ochuku (2010); Oloyede *et al.*, (2012); Joseph and Barnard (2013) Usman (2016); . They found

out that there was no significant difference between genders in cooperative learning classrooms strategies. This means that cooperative learning gains are not limited to a particular sex but to all who engage in it. This result was also contrary to the study of Bot and Eze (2016) found out that male students perform better than female in cooperative learning classes. Gender difference in mathematics performance of students would be as a result of factors such as classroom interactions, students' attitudes, interest and self-esteem, teachers' gendered attitude, curricular materials, beliefs, social and cultural norms (Ajai and Imoko, 2015)

The result of hypothesis three shows that there was no significant difference between the mean scores of Urban and Rural Students who were taught mathematics with Cooperative Learning Strategy. The result is consistent with the study of Usman (2016) who found out that no significant of mean scores of Social studies when students were taught by cooperative learning rural and urban areas.

The lecture approaches are considered ineffective due to the facts that, it creates little impact on learners' academic achievement, because the lesson is dominated by a teacher, talking to the learners where the learners remain passively listeners and recipient of knowledge. There were little or no use of materials by the learners, the learners level of abilities were not taking into cognizance by the teacher. It is believed that use of cooperative learning strategy make teaching and learning more interesting, make the classroom environment lively, arouse learners interest and sustained their interest and attention throughout the teaching and learning process as a result of involving all learners in the lesson through group work, learners of all abilities get opportunity to think, the teacher focuses on understanding not just memorization and recall of fact.

Conclusion and Recommendations

Based on the finding of the study the following conclusion was made:

1. Cooperative learning strategy improves students' academic performance in Mathematics.
2. Cooperative learning strategy minimizes gender differences in students' academic performance in learning Mathematics.
3. Cooperative learning improves student' academics performance in both rural and urban secondary schools

The following recommendations have been made based on the findings of the study:

1. Cooperative learning strategy is an effective method teaching, therefore, mathematics teacher should use it to encourage students maximized their learning in mathematics, particularly, at the junior secondary school level in rural or urban areas.
2. Cooperative learning should be used by mathematics teachers to make male and female students equally in learning mathematics.

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Tables

Table1: Distribution of students by group, gender and school location

Variable		Number of student	Gender		School location	
			MI	F	Rural	Urban
Teaching method	Cooperative learning	105 (49 %)	58	47	50	55
	Lecture	110 (51)%	67	43	44	66
Total		215(100%)	125	90	94	111

Table 2: Means and Standard Deviations for Mathematics performance scores of cooperative learning and lecture methods groups

Groups	N	mean	SD	Mean Diff.
Cooperative learning	105	51.41	8.91	13.09
Lecture method	110	38.32	7.99	

Table 3: Means and Standard Deviations for Mathematics performance scores of male and female Cooperative learning group

Groups	N	Mean	SD	Mean Diff.
Male	58	51.62	9.11	0.47
Female	47	51.15	8.74	

Table 4: Means and Standard Deviations for Mathematics performance scores cooperative learning students taught in urban and rural schools.

Groups	N	Mean	SD	Mean Diff.
Urban	55	49.02	9.09	-5.02
Rural	50	54.04	8.00	

Table 5: Independent samples t-test for Mathematics performance scores for Experimental and Control groups

Groups	N	Mean	MD	DF	T	P-value	Remark
Cooperative learning	105	51.41	13.09	213	11.33	0.000	significant
Lecture Method	110	38.32					

Table 6: Independent samples t-test of mathematics performance scores for male and female students in cooperative learning group

Groups	N	Mean	MD	DF	T	P-value	Remark
Male	58	51.41	0.47	103	0.270	0.788	not significant
Female	47	51.15					

Table 7: Independent t- Test of JSS students' mathematics performance taught by cooperative learning in rural and urban schools.

Groups	N	Mean	MD	DF	T	P-value	Remark
Urban	55	49.02	-5.02	103	-2.993	0.229	not significant
Rural	50	54.04					