



## **Effects of Cooperative- Learning and Polya Problem-Solving Strategies on Attitude and Performance in Algebra among Senior Secondary School Students in Borno State, Nigeria.**

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### ***Abstract***

This study investigated the effects of Cooperative learning, Polya Problem-Solving instructional strategies on attitude and performance in algebra among Senior Secondary Students in Borno state. A quasi-experimental with pre-test-post-test control groups design was adopted for the study. The population of five thousand nine hundred students of SS2 sample consisted of 614 Government Senior Secondary 2 students, which was made of 278 males 216 female and 120 mixed students, and the sample was drawn by using simple random sampling by balloting in sixty eight (68) senior secondary schools in Borno state. The research instruments used were: Algebra Performance Test (APT) and Algebra Attitude Questionnaires (AAQ). The instruments were administered to students. The two research questions and hypotheses were analyzed and tested using means, standard deviation, t- test of independent means one way ANOVA. All hypotheses were tested at  $P < 0.005$  level of significance. The findings showed that: (i) there was a significant difference among the students when exposed to Cooperative learning and conventional method (ii) there was a significant difference in performance and attitude between cooperative learning and Polya Problem Solving strategies (iii) based on the findings the mean difference of cooperative learning was higher than Polya problem solving (iv), there was no significant difference between Polya Problem solving and Conventional. Therefore there is the need for teachers to adopt new strategies of teaching. Based on the findings, it is recommended that Cooperative, and Polya Problems solving instructional strategies should be adopted in teaching the Senior Secondary2 students.

**Key Words:** Cooperative Learning, Polya Problem Solving, Conventional, Attitude, Performance, Algebra

## Introduction

Instructional strategies vary in the teaching and learning processes. However, with the improvement in and application of technology nowadays, the teaching strategies had improved students learning process (Mstem,2011). Teaching strategies dealt with the way, skill, technique or procedure in which information is presented to learners. In other words it is the refinement process which the teacher uses or employs to make teaching more effective when using a behavioural method. The teaching strategies placed emphasis on the teachers and non teachers alike, in supporting the learner's development and providing support structures for a better performance. Strategies of teaching applies in the classroom by the teachers in collaboration with the use of chalkboard, teaching materials and reference materials and other variables such as textbooks, lesson plans, lesson notes, teaching aids, time, voice- management, self management, class- management and class participation. Classroom- communication is important to the teacher in selecting the strategy to use in teaching the subject as well as assessing students perception of the content of materials used during the learning process. There is no single strategy which can be regarded as the best for every teaching situation (Ada, 2005). Ada(2005) also reported that there were a number of criteria available that might guide the teacher in the choice of any given strategy of teaching .They include: the content to be taught, objectives to be achieved, time available, number of students, teachers preferences, needs and individual differences, the type of lesson, Mathematics is a leading logical science discipline upon which other sciences depend.

Mathematics can be defined as the communication system for the concepts of shapes, size, quantity and order used to describe diverse phenomena both in physical and economic situations. Mathematics is a tool used in science, technology and industries. The definition connotes that all sciences draw their inspirations from Mathematics which implies that Mathematics is a language of sciences. Ezeugo and Agwagah (2000), in their study looked at Mathematics as a scientific tool in realizing the nation's scientific and technological aspirations. Also Usman (2007) considered Mathematics as a subject that encroaches into all aspects of human endeavour. He further described Mathematics as the live wire in the studies of various disciplines. It is based on the importance of Mathematics that the Federal Government of Nigeria made Mathematics a core subject from the primary through to the senior secondary level of education. However, literature reviews consistently show low performance of students at all levels of education in the subject mathematics

According to Slavin (2011), Cooperative learning is an instrumental strategy in which teachers organize students into small groups to work together or help one another to learn academic content. Cooperative learning consists of five basic elements such as positive interdependence and promotes interaction, individual accountability, teaching of interpersonal and personal skills and quality of group learning. Yager (2000) stressed that positive interdependence meant that in cooperative learning situation students needed to work together as a cohesive group to achieve shared learning objectives. In the

process, students must be responsible for their learning and for the success of other group members learning. The teacher needs to structure lessons competitively, individually, or cooperatively. The decisions teachers make in structuring the lesson influence students interactions with knowledge, skills and attitudes (Carson1990). In a completely structured classroom, students engage in a win or lose structure in an effort to determine who the best student in the class is (Johnson, David and Smith 2002). In a competitive classroom, students perceive that they can obtain their goals only if the other students in the class fail to obtain their own goals (Johnson, Johnson and Holubec, 2001). In cooperative learning classroom, students work together to obtain group goals that may not be obtained by working alone or competitively. According to Smith (2002) and Uga (1996) cooperative learning methods use small groups so that students, worked together to maximize their own and each other's learning. In this classroom structure, students discuss subject matter, help each other to learn, and provide encouragement for members of the group (Johnson, Johnson and Holubec (2001). In a cooperative learning situation, interaction is characterized by positive goals and interdependence with individual accountability.

Massialas (1991), Posit that Polya Problem solving strategy is the strategy that prepares for future or near future challenges by facing real life or real life problems in their learning environment, and finding appropriate solutions to them. Every society expects from its education system a preparation that enables the individuals to be effective. Problem solving method places emphasizes on how to learn independently as a student. The problem solving method is activity based learning that is applicable to all disciplines including mathematics. Many scholars have suggested different steps involved in the process of problem solving. According to their respective finding and views, Polya(1975) outlined four stages namely:- understanding of the problem, devising a plan ,carrying out the plan and looking back.

Conventional strategy is another teaching procedure in which there is one way channel of communication where the teacher makes on oral presentation of the subject matter and students react silently listening and taking notes (Akem ,2007). In this strategy the teacher delivers all the facts he wants the students to know and master, caring very little of whether or not the students are actively participating and contributing to the success of the lesson. This method is good for large classes since much work could be covered in a short time.

Attitude could be defined as a consistent tendency to react in a particular way-often positively or negatively-toward any matter. Attitude possesses both cognitive and emotional components. Algebra is one of the branches of mathematics taught at all levels of education in Nigeria (FME,2013). It is defined as a branch of mathematics where the English alphabet (such as x,y p q among others) are used to represent numbers in finding solution to a particular problem. The use of algebra to solve problem on equation or sentence is termed as algebraic process (Lucks,2010). Gambo(2005) Opines that algebra as a branch of mathematics that uses letters to represent numbers. in algebra the following topics: algebraic expansion liner and quadratic equation factorization among others as an aid for understanding discourse in the algebra classroom, and writing about algebraic thinking at the senior school level, students are expected to represent, analyze, and make generalizations about patterns. These patterns should be linear in nature, arising from a constant rate of change. In each pattern, the students should

be able to use multiplication and addition to find the relationship between the two sets of numbers. Students should look at patterns through the use of tables, graphs, and symbolic representation (NCTM, 2000). There has also been an increase of awareness by those concerned about mathematics education that the conventional method of teaching mathematics has not been successful. For effective teaching to occur the skillful mathematics teacher needs to adopt many different strategies of teaching. A well formulated teaching strategy would yield teaching and learning effectively.

### **Statement of the Problem**

Researchers have shown that some mathematics teachers use instructional strategies that are abstract and usually not related to the learner's physical environment as a result students are made passive participants in the lesson. Their role is just of listeners and it makes them unable to transfer knowledge. This is attributed to the conventional strategy much used by teachers. This has made delivery of instructions in various disciplines in secondary schools across the globe ineffective and performance to be low. Due to this fact, the falling standards and low performance at post primary level is therefore attributed to pedagogical approaches adopted by teachers in schools. It has been reported that learning and understanding of school subjects have been frustrated by the clumsy strategy and institutional materials used.. So for effective teaching of mathematics to occur, the teachers should get the learners involved as much as possible in activities that will enable them to develop the needed process skills and attitude relevant to scientific life (Etukudo,2006). To support this assertion Salua (2011) opined that the low performance of students in mathematics has become a concern in mathematics education. Consequently many students find it very difficult to solve mathematical problems. The reason for these difficulties may vary but this could sometimes be related to the teaching method being used to explain such topics.

### **Research Questions**

The following research questions were formulated to guide the study.

1. What is the effect of Cooperative Learning strategy on performance and attitude of secondary school students taught algebra with those taught by conventional method in Borno state?
2. What is the effect of Polya Problem Solving on performance and attitude of secondary school students taught algebra with those taught by conventional method in Borno state?

### **Null Hypotheses**

The following null hypotheses were formulated for the study

H<sub>01</sub> There is no significant difference between the performance and attitude of students taught by cooperative strategy and conventional method

H<sub>02</sub> There is no significant difference between the performance and attitude of students taught by polya Problem Solving strategy and conventional method

## RESEARCH METHODOLOGY

### Research Design

The research design adopted in this study is quasi experimental /control group design, based on pre-test, post-test. Each strategy effects shall be compared with the conventional method. The study involves four groups in which eight classifications shall be designated. The first four classifications comprise male, female and mixed students out of which three are experimental groups 1, 2, and 3 while the fourth group is the control group 1, otherwise known as the conventional group. In the same manner the second four classifications comprise male, female and mixed students out of which three classifications were experimental groups 1, 2, and 3, while the fourth group is the control group2. Pre-test and Post-test are administered to both experimental and control groups.

### Population and Sample of the study

The population of the study comprises all the public senior secondary schools (SS2) in the four educational zones of Borno State Teachers Service Board (BSTSB). There are sixty eight senior secondary schools(SS2) with a population of five thousand nine hundred ((5900) students with three thousand and twenty (3020) males, One thousand nine hundred and twenty (1920) females, and from Mixed schools nine hundred and sixty(960). However, for the purpose of this study the target population used is senior secondary schools (SS2) students in Borno State. Sample schools are numbered as 1-12. The first eight were treatment groups, and the last four schools are the control groups. Male single 278, female single 216 and mixed 120 students are considered as sample size, and the selection was carried out by simple random sampling. Simple random sampling techniques is used to select the twelve schools out of the four zones .Maiduguri metropolitan (3) schools, Monguno (3), schools Gwoza (3) schools, and Biu (3) schools. A total of 12 government schools are used as a sample.

Two instruments were used in the study;- Algebra Performance Test (APT), Algebra Attitude Questionnaire (AAQ)

### Procedure for Data Analysis

The study involves comparison of effects and means of different groups; therefore mean and standard deviation are used to analyze the Research Questions and independent t- test sample and one- way analysis of variance (ANOVA) are used to test all the null hypotheses each at 0.05 significance level.

## DATA ANALYSIS AND DISCUSSION

A descriptive statistic of mean, and standard deviation was carried out to answer the Research Questions

**Table 1: Descriptive statistics of the pre-test and the post-test results of the cooperative strategy and conventional method of teaching Algebra in senior secondary schools**

Methods	Pre-Test			Post-Test		
	N	Mean	SD	N	Mean	SD
Cooperative	128	29.84	10.89	128	64.24	13.12
Conventional	377	31.37	11.15	377	33.38	11.56

Table 1 showed the mean scores of students taught using cooperative strategy and those taught with conventional strategy in pre-test and post test. From the table, it could be seen that students taught using cooperative strategy obtained mean score of 29.84 in the pre-test and 64.24 in the post-test. The students taught with conventional strategy obtained a mean score of 31.37 in pre-test and 33.38 in the post- test. A comparison of the pre-test and post- test of the two groups showed that the students taught using cooperative strategy, obtained a difference of 34.4 while those taught using conventional method, obtained a difference of 2.01

**Table 2 Descriptive statistics of the Pre-test and the Post-test results of the Polya Problem Solving strategy and Conventional method of teaching Algebra in senior secondary schools**

Strategies	Pre-Test			Post-Test		
	N	Mean	SD	N	Mean	SD
<b>Polya Problem solving</b>	<b>123</b>	<b>28.62</b>	<b>9.65</b>	<b>123</b>	<b>63.86</b>	<b>12.67</b>
<b>Conventional</b>	<b>377</b>	<b>31.37</b>	<b>11.15</b>	<b>377</b>	<b>33.38</b>	<b>11.56</b>

Table 2 showed the mean scores of students taught using polya problem solving strategy and those taught with conventional strategy in pre-test and post- test. From the table, it could be seen that students taught using polya problem solving strategy obtained mean score of 28.82 in the pre-test and 63.86 in the post- test. The students taught with conventional strategy obtained a mean score of 31.37 in pre- test and 33.38 in the post- test. A comparison of the pre-test and post- test of the two groups showed that the students taught using polya problem solving strategy, obtained a difference of 33.24 while those taught using conventional strategy, obtained a difference of 2.75

**Table 3 :Summary of Descriptive statistics of the Pre-test and Post-test results of the comparative effect of cooperative learning, polya problem solving on attitude and performance in algebra among secondary school students**

Teaching Strategy	Pre-Test				Post-Test			
	N	Mean	SD	MD	N	Mean	SD	MD
<b>Cooperative learning</b>	<b>128</b>	<b>29.84</b>	<b>10.89</b>		<b>128</b>	<b>64.24</b>	<b>13.12</b>	
<b>Polya problem solving</b>	<b>123</b>	<b>28.62</b>	<b>9.65</b>	1.22	<b>123</b>	<b>63.86</b>	<b>12.67</b>	0.38
<b>Conventional</b>	<b>377</b>	<b>31.37</b>	<b>11.15</b>		<b>377</b>	<b>33.38</b>	<b>11.56</b>	

Table 3 showed the mean scores of students taught using cooperative, polya problem solving strategies and those taught with conventional method in pre-test and post- test. From the table, it could be seen that students taught using cooperative strategy obtained mean score of 29.8,28.62 in the pre-test while 64.24,63.86 in the post test. The students taught with conventional method obtained a mean score of 31.37 in pre- test and 33.38 in the post- test. A comparison of the pre-test and post- test of the three groups showed that the students taught using cooperative, polya problem solving , obtained a difference of 0.38 while those taught using conventional method, obtained a difference of 1.22 . Thus a mean difference of 1.22, 1.57 in the pre test between cooperative learning and polya problem solving, while a mean difference of 0.38, 2.21 in the post test between cooperative learning and polya problem solving , and conventional. Therefore students taught algebra using cooperative learning polya problem solving strategies performed and has positive attitude better than those taught conventional method with a difference of 0.38 , 2.21

### Test of Hypotheses

**Table 4: Summary of the independent sample t-test on the mean difference of the students taught cooperative learning strategy and conventional strategy**

Teaching Strategies	N	Mean	SD	Df	t	p-value
<b>Conventional teaching strategy</b>	129	32.95	10.99	255	-20.73	0.00
<b>Cooperative learning strategy</b>	128	64.24	13.12			

Results from Table 4 revealed that there was significant difference in academic performance between students taught using cooperative learning strategy and those taught by conventional strategy with p-value (0.00) less than the level of significance (0.05). The result further revealed that the mean score of the students taught using cooperative learning strategy (*mean = 64.24*) is higher than those taught using conventional strategy (*mean = 32.95*) . Therefore, cooperative learning strategy is more effective in teaching mathematics.

**Table 5: Summary of the independent sample t-test on the mean difference of the students taught problem solving strategy and conventional strategy**

Teaching Methods	N	Mean	SD	Df	T	p-value
<b>Conventional teaching strategy</b>	123	34.11	11.94	244	-18.95	0.00
<b>Problem solving strategy</b>	123	63.86	12.67			

Results from Table 1 to 5 revealed that there was significant difference in academic performance between students taught using problem solving strategy and those taught by conventional strategy with p-value (0.00) less than the level of significance (0.05). The result further revealed that the mean score of the students taught using problem solving strategy

(*mean* = 63.86) is higher than those taught using conventional strategy (*mean* = 34.11) . Therefore, problem solving strategy is more effective in teaching mathematics than conventional teaching strategy.

### **Discussion**

Tables 1 showed that there is significant difference between the group taught with cooperative, polya problem solving and guided discovery strategies and those taught with conventional method. Also the group exposed to guided discovery strategy has a higher mean than their counterpart taught with cooperative learning and problem solving because the mean difference of guided discovery is higher than cooperative, polya problem solving and conventional method. Findings were supported by Zaidi(2000), Keeler(2000), Nicolas(2001), Cohen(2003),Native(2004), Adeyemi(2008). Omwiriheren(2002), Ekhasemohe(2010) and Isah(2015). The lone contradiction to the finding was that of Augie(2015) who found there was that no significant difference between the performance of students exposed to cooperative ,problem solving and discovery. That students taught using problem solving performed better than cooperative and guided discovery.

### **Conclusion.**

Based on the findings of this study it can be concluded that;

1. Instructional strategies cooperative learning and, polya problem solving have effects on the student's performance and attitude in teaching and learning.
2. The use of cooperative learning and polya problem solving can facilitate learning of algebra in senior secondary schools.
3. The conventional method does not enhance performance and attitude among senior secondary school students
4. Algebra attitude performance test according to gender reveals that both sexes in the experimental groups show significant effects when exposed to treatment.

### **Recommendations**

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

1. There is a need for change from the conventional strategy used.
2. Teachers are expected to vary their teaching strategy and based on students groups and experiences to enable the learners easily learn what is being taught in both classroom and outside.
3. Teachers are expected to used teaching strategies Cooperative and Polya problem solving to enhance attitude and performance

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