

## Effect of Group Learning Strategy on Secondary School Students Achievement in Geometry

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### ABSTRACT

This study, investigated the effect of cooperative learning strategy on students achievement in geometry in senior secondary schools in Abakaliki education zone of Ebonyi State. Cooperative learning strategy is an instructional process where a class is divided into small groups in such a way that the group of students work together to achieve shared goals and task. In order words, it is a team based teaching and students are happy when they discover things by themselves. Three research questions and three null hypotheses guided the study. The population of the study comprised 5118, the breakdown has 1941 males, 3177 females in public secondary schools within the study area. The sample of the study comprised 300 students. Geometry Achievement Test of the multiple choice type which contained 30 items with a reliability coefficient of 0.74 was used for data collection. Data collected were analyzed using mean and standard deviation to answer the research questions and ANCOVA statistic to test the hypotheses at 0.05 level of significance. The analysis of the data revealed that cooperative learning instructional strategy enhanced the students' academic achievement in geometry better than the conventional (talk and chalk) method. Cooperative learning instructional strategy also enhanced the achievement of male students more than their female counterparts. There was a significant difference between the mean achievement scores of students taught geometry with cooperative learning strategy and those taught using the conventional (talk and chalk) method. There was also a significant difference between the mean achievement scores of male and female students taught mathematics using the cooperative learning strategy and the interaction between methods and gender of the students was not significant. Based on the findings of the study, it was recommended, among others that in-service training and workshops/seminars should be organized for teachers to train them on the use of cooperative learning strategy in classroom instruction because of its proven efficacy in enhancing students' academic achievement in mathematics. Such workshops and seminars should be made compulsory for every teaching staff so as to demystify the efficacy of cooperative learning strategy on students' academic achievement.

**Keywords:** Group Learning, Strategy, Secondary School Students, Achievement, Geometry

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### INTRODUCTION

Mathematics is an exact body of knowledge. It is concerned with the study of relative sizes, volume, weights and capacities. Mathematics is one of the skills everybody needs to survive in life. Mathematics is the basis of all sciences and technology and for all human progress. Mathematics is the mother of all sciences that deals with the logic of shape, quantity, measurement and arrangement [1]. Mathematics is all round us and in everything we do. Its knowledge is used and applied in virtually everything in our society. [2] described mathematics as a science that deals with the meaning of numbers and their relationships to space, measurements and quantities. [3] described mathematics knowledge as an indispensable tool in every society because it has application in all other human endeavours including basic science, technology, social sciences and in the arts. It is also known that mathematics encourages the habit of self-reliance and assists learner to think and solve their problems themselves [4] stated that, all mathematics topics, beyond computational skills, also have one good habit or trait they inculcate to the students. Topics in Geometry, for instance demand some amount of logical reasoning and analytical thinking from individuals so that they can establish a relationship between known and

required facts. Such topics and others in algebra help people to reason logically and to realize that facts can be utterly established and so consequently develop the habit of desiring and demanding that in their affairs with others. Furthermore, mathematics is an exact and precise body of knowledge. The procedure by which the final answer is arrived at may be different, but the answer remains the same. A statement is either true or false and an answer is either correct or not correct and can be verified by working backwards or a reverse process. Accuracy and exactness are the pillars on which mathematics stands. Mathematics trains and disciplines the mind. A student that loves mathematics learns the value of accuracy and adopts it as a principle of life. Knowledge of mathematics, thus, promotes the habit of accuracy, logical, systematic and orderly arrangements of fact in the individual learner. Mathematics equally helps to develop proper moral attitude in individuals as there is no place for biased feelings, no place for dishonesty and it trains people to observe riches respect procedure and value time [5]. As [6] stipulates that mathematics enables students to acquire and broaden their knowledge, skills, and outlook in many fields because of its applicability to many areas of life. However, for students to possess the conceptual understanding in different ways, they should know how and when these different mathematical representations can be used for different purposes. Such presentation would enable the students experience, discover, discuss and reconstruct their views about the nature of mathematics. In spite of the indispensability and essentiality of mathematical knowledge to all works of life, mathematics education in Nigeria over the years has been grappling with numerous man-made problems despite all the efforts by the government through huge investments, different policies and programmes [7]. Nigerians especially parents are now forced and compelled to accept poor performance in the subject as normal. On the pages of Newspapers, and on the television and radio stations, we read and hear reports about this ugly trend of students' abysmal performance in mathematics. Before the civil war, mathematics was an exciting, interesting and lively subject [8]. This can be attributed to the fact that by then, the way the subject was taught to learners both at primary and secondary levels of education convinced them (learners) that it is a subject needed in every aspect of their life and they appreciated it [9]. But since after the Nigeria civil war, the teaching and learning of mathematics especially at the primary and secondary school levels, has been greeted by poor results [10]. No year passes, that parents do not hear about poor and below average achievement of their children and wards in this all important subject-mathematics. In fact, many students now live with the misconception and wrong belief that mathematics cannot be passed by oneself or through ones personal efforts, which is an erroneous impression. Most Nigerian children dread mathematics due to poor handling of the subject by teacher's right from primary school. As a result of the ugly development which has become a reoccurring decimal, [11] noted that Nigerian students do not immediately see the use or applicability of the subject to their lives and to the larger world and so wonder why they should be bordered or troubled with the study of the subject. Furthermore, it is particularly disappointing and disheartening to find that mathematics has remained one of the least successful subjects in Nigerian school system despite its role in our everyday life and its importance in society. Many students fear it and also have the obnoxious notion that Mathematics learning is an unattainable task, and that it is exclusively reserved for the gifted ones [12]. Indeed, most adults openly tell how much they hated Mathematics while in School and how they never did well in the subject. The kind of attitude towards mathematics displayed by the adult members of the society including some teachers is embarrassing. The fact that people, who should call the students to order and encourage them to study harder so as to excel in the subject are themselves bittered about the difficulty of understanding the subject raises a serious concern. Furthermore, the WAEC Chief Examiners' report in 2012 on students' performance showed that students' overall performance in the subject has not yet significantly improved. The report further showed that the percentage of students that passed the subject at credit level over the years still fell between 30 and 32 percent. Again in WAEC Chief Examiners' Report of May/June 2015 examination in mathematics showed that apart

from not giving answers to the required degree of accuracy, majority of the candidates could not apply the basic concepts and theorems correctly in some aspects of the syllabus especially in geometry. Such areas of the syllabus as reported include: mensuration in three dimensional shapes, circle theorems, and trigonometry and geometrical construction. Many candidates were able to solve the inequality problem but they were unable to get the greatest integral value of  $x$ . The Chief Examiners' report in the year 2016, pointed to similar problem. Many did not record all their readings to the same accuracy. They therefore, lost marks for inconsistency in expressing their answers in significant figures. Some candidates approximated too early in reading data table, such as in sines, cosines and reciprocals. Some candidates choose large scales for their readings and graphs but were unable to make their points correctly due to wrong interpretation of the intervals.

#### **Statement of the Problem**

Geometry teaching in Nigerian secondary schools today is still predominantly teacher-centered and transmission oriented. The teacher writes on the board and talks to the students while the students copy. The method has not yielded promising result as is evident on the achievement rate of candidates in WAEC and NECO examinations. For instance, the Chief Examiners Report of the West African Examination Council (WAEC) in 2016, showed that majority of the candidates performed below credit level. In particular, the report had it that in the years mentioned above, the percentage of students who recorded achievement up to credit level averaged between 30 to 32 percent. The Head, WAEC National Office, Yaba Lagos, Mr. Charles Eguridu while announcing the result said that a total of 529,425 candidates representing 31.28% obtained credits in five subjects and above, including english language and mathematics. This showed that the teaching of the mathematics is still a problem in Nigeria and Ebonyi state in particular. One therefore, notes with dismay the general poor achievement of students in this all-embracing and essential subject is still an issue. The report went further to state that mathematics teachers still have contributions to make in the teaching of the subject! From the above assertions, it could be argued that the method of teaching mathematics employed by mathematics teachers in secondary schools in Nigeria and Ebonyi State in particular, may have contributed seriously to the high rate of poor students' achievement in the subject especially in WAEC and NECO examinations. The conventional chalk and talk method has led to poor handling of some concepts by teachers and students' poor understanding of the concepts. As contained in the WAEC Chief examiners' report for the years 2015 and 2016 respectively, students find it difficult to attempt and answer correctly questions on geometry (mensuration) as in earth as a sphere (i.e. latitudes and longitudes), circle geometry, inequalities in  $x$  and  $y$  cartesian plane, statistics (especially in interpretation of graphs). A critical look at these problems and the topics above showed that, these have been the bane of students' poor achievement in mathematics especially at the senior secondary school level which in turn, contributed in no small measure to their poor performance in the subject. It is the opinion of the researcher therefore, that since learning is a change in behaviour, if learners work with their peers, learn cooperatively; this may be a panacea to students' problems in the teaching and learning of mathematics in Nigeria and can change students' poor achievement in the subject positively. Hence, the researcher's resolve to investigate the effect of cooperative learning strategy in enhancing the academic achievement of senior secondary two (SS II) students in mathematics.

#### **METHODOLOGY**

In this chapter, the following procedures were adopted; design of the study, area of the study, population of the study, sample and sampling techniques, instrument for data collection, validation of the instrument, reliability of the instrument, experimental procedure, control of the extraneous variables, method of data collection and method of data analysis.

#### **Design of the Study**

This study adopted the quasi experiment design using the pre-test post-test as contained in non-equivalent control group design. This means that intact classes of students were used.

The subjects were pretested before treatment was administered. After treatment, the test was repeated, which constitutes the post-test. This was to determine the efficacy of the independent variable (treatment) on the dependent variable (achievement). The justification for the choice of this design is because the group involves intact classes and no randomization as well as non- equivalent control group.

Symbolically, the design is represented thus;

O, X, O,

O, X, O,

O, represent Pre-test

O, represent Post-test

X, represents cooperative strategy.

X, represents conventional (chalk and talk) teaching method.

#### Area of the Study

This study was conducted in Abakaliki Education Zone of Ebonyi State. This zone comprised four (4) Local Government Areas, which are Abakaliki, Izzi, Ebonyi and Ohaukwu Local Government Areas. The choice of Abakaliki Education Zone was to enable the researcher enough time to supervise the experiment properly since he lives in Abakaliki and the area is more accessible to him. In addition, the public secondary schools to be used are of the same structure in terms of curriculum and learning objectives. Furthermore, the topic taught is in SS 2 curriculum.

#### Population of the Study

The population of the study is 5,118 and consists of one thousand nine hundred and forty-one (1941) males and three thousand one hundred and seventy-seven (3177) females SS II students in secondary schools in Abakaliki Education Zone in Ebonyi State, ^Source: Secondary Education Board, Ebonyi State 2017). (See appendix i).

#### Sample and Sampling Technique

All the SSII students in the sampled schools were used for this study. The researcher stratified the schools into three different strata (co-educational, boy's and girl's schools). Through simple random sampling by balloting, the researcher drew 2 co-educational. 2 boys and 2 girl's schools for the study. Through a simple, toss of the coin, the researcher assigned one co-educational, one boy and one girl schools respectively to the experimental and control groups. In each school that was drawn for the study, all the intact classes of SSII were used.

Groups	Number of Males	Number of Females	Total
<b>Treatment Group</b>			
(Group Taught with Cooperative Instructional Approach)	80	70	150
<b>Control Group</b>			
(Group Taught with Conventional Chalk - Talk Approach)	72	78	150
<b>TOTAL</b>	<b>152</b>	<b>148</b>	<b>300</b>

#### Instrument for Data Collection

The instrument the researcher used for data collection was Geometry Achievement Test (GAT). The mathematics achievement test was a 30-item multiple choice objective questions, with options a, b, c, d, developed by the researcher from the content area taught during the study. Details of item coverage with relation to content of the syllabus are shown in the test blue print, appendix (2).

#### Validation of the Instrument

The Geometry Achievement Test (GAT) was subjected to face and content validation. The thirty (30) item Geometry Achievement Test (GAT) was validated by 3 experts in Measurement and Evaluation and Mathematics Education from Ebonyi State University,

Abakaliki. The face validation scrutinized the items in terms of relevance, general test format, suitability and clarity. After the face validation, the items were assembled and subjected to content validation. The inputs and suggestions of the by experts of the measurement and evaluation and mathematics department which helped to raise the quality of the test items. The validators asserted that, in the lesson plan, the teacher reminds the students about parts of a circle which they did at their junior secondary school level. He told the students the day's topic. They also said, after drawing a circle, give the parts, separately. The expert advised the researcher to always explain the formulae. She also criticized the evaluation questions that should meet the objective of the lesson. That made the researcher to change some of the evaluation questions to suit the objectives of the lesson. She advised the researcher to develop lesson packages for cooperative lesson strategy and the conventional (talk and chalk) method. The researcher did as instruct.

#### **Reliability of the Instrument**

The mathematics achievement test was assessed for reliability using Kuder Richardson 20 formular. The K-R-20 was used to ensure that the instrument is internally consistent in measuring what it is purported to measure. The researcher administered the instrument to 30 non-participating SS11 students outside the area of the study after which the scores were used for the reliability test. The instrument yielded a coefficient of 0.74.

#### **Experimental Procedures**

The pre-test was administered to both the treatment and control groups. These were done in Abakaliki High School (Fresco (mixed school) Aziyokwu Girls High School, Abakaliki (Girls school only) and Boys secondary school, Iboko (Boys school only) in Abakaliki High school (Presco) (mixed school), Aziyokwu Girls High school, Abakaliki (Girls school only) and Boys Secondary school, Iboko (Boys school only). After the pretest, the experimental group was taught mathematics using the cooperative learning strategy. The control group was taught geometry using conventional teaching (chalk and talk) method. Topics taught to the two groups were the same. Research assistants who were the classroom/mathematics teachers of the schools administered the cooperative learning as treatment. The regular classroom mathematics teachers of the six sampled schools were used as research assistants. The researcher organized a conference for the research assistants. They were guided on the essential steps in using the cooperative learning strategy and the conventional teaching approach as may be applicable to teachers of each group. All the necessary instructional materials for the study were made available to the research assistants, the materials ranged from cardboard papers, eraser, razor blade, gum, cello-tape (these were used to cut out parts of circle like chord, sector, segment) cylinders, cones, circles were formed using the above materials to show their "NFTs", The nets helped to have a clear view of cylinder and cone. A model of cooperative lesson plan was developed as a guide to the research assistants (see appendix 6). A model of cooperative learning lesson plan package and conventional teaching package were prepared to guide the researcher assistants of the two groups (see appendices 6 and 7). At the end of the treatment, GAT was reshuffled and re-administered to the two groups as post-test. Treatments in the two groups were of equal duration. The study lasted for six weeks. The research assistants administered all the tests, marked the scripts and scored them. The researcher regularly visited the schools to monitor the instructional delivery but did not impose himself on the teachers to avoid the students realizing that they were being used for experimental study.

#### **Control of Extraneous Variables**

The researcher employed the following measures to ensure that extraneous variables, which may introduce bias or error into the study, were checked appropriately.

**a. Teacher Variables:** To ensure that errors that may emanate, from teacher variables do not interfere with the findings of this study, the researcher organized a pre-experimental sensitization for all the mathematics teachers that participated in this study. During the conference, the mathematics teachers of the sampled schools who served as research assistants were tutored on the use of cooperative learning strategy as well as the

conventional method. Lesson plan on the topics were given to teachers in the groups respectively by the researcher. The experiment was also regularly monitored by the researcher to ensure that the teachers do not deviate from the agreed pattern of instructions.

**b. Instructional Situation Variables:** To ensure that instructional situation is the same for all the schools, the researcher issued out the lesson plan to the teachers in each group. The teaching was conducted in all stream's classes of SSII in the various schools that were used for this study.

**c. Initial Differences;** It is certain that the entry behaviours of the participating students were not the same. This is because; it is obvious that some of them may be taking private lessons. As, a result, the initial difference was statistically taken care of by the use of analysis of co-variance (ANCOVA) at an alpha level of 0.05. This is to ascertain the behaviours of participating students.

**d. Subject Interaction;** The research did not select the treatment and control group from the same school to ensure that the students in the treatment and control groups do not mix up at all. This reduced the error that could arise from interaction and exchange of ideas among research subjects from the two groups.

**e. Test Sensitization:** This effect was taken care of by rearranging the test item each time it was administered.

**f. Hawthorne Effect:** This is the effect of the subjects having the prior knowledge that they are participating in an experiment. To control this, their regular teachers were used and the entire classes in each school were used in a particular group.

#### Method of Data Collection

At the beginning of the experiment, the research assistants administered the pre-test to the students. Scores of the students on the pre-test were recorded and used after the experiment. At the end of the experiment, the achievement test was administered to the students as posttest For each of the groups, data for the pre-test and post-test were recorded separately. The pretest and posttest items were the same for both groups at each stage. However, the researcher instructed the research assistants to ensure that the test was reshuffled at post-test to avoid the subjects detecting easily that it was a test previously administered to them.

#### Method of Data Analysis

Research questions were answered using mean and standard deviation while the null hypotheses were tested using the analysis of co-variance (ANCOVA) at an alpha level of 0.05.

### RESULTS

#### Research Question 1

#### What is the effect of cooperative learning strategy on students' achievement in mathematics?

To answer this research question, reference is made to the information on table 1. The data was obtained using the Mathematics achievement test administered to both the experimental and control groups involved in this study. The pretest and posttest scores were adjusted simultaneously during the analysis. The summary of the result is shown on table 1.

**Table 1: Mean and standard deviation of achievement scores of students taught mathematics using the cooperative learning approach and those taught with the conventional method**

Group	Adjusted Mean	SD	N
Treatment	71.37	14.65	150
Control	48.07	9.23	150

The result on table one showed that students taught mathematics using cooperative learning strategy had an adjusted mean achievement score of 71.37 and standard deviation score of 14.65 while those taught using the conventional method had an adjusted mean

achievement score of 48,07, and standard deviation score of 9.23. The implication is that cooperative learning strategy enhanced achievement of students in mathematics better than the conventional teaching method.

**Research Question 2**

**What is the mean achievement scores of male and female students taught mathematics using cooperative learning strategy?**

Data collected from male and female students in the treatment group only were used to answer this research question. Summary of result is presented in Table 2.

**Table 2: Mean and standard deviation of achievement scores of male and female students taught mathematics using cooperative learning strategy**

Gender	Adjusted Mean	SD	N
Male	78.90	12.33	80
Female	62.76	12.19	70

Result as presented on table 2 showed that the male students had a mean achievement score of 78.90 and standard deviation score of 12.33 while the female students had a mean achievement score of 62.76 and standard deviation score of 12.19. This implies that cooperative learning strategy favoured the male students more than their female counterparts.

**Research Question 3**

**What is the interaction effect of method and gender on students mean achievement in mathematics?**

Data Collected for male and female students in both the treatment and control groups were used to answer this research questions. Summary is presented in Table 3.

**Table 3: Summary of result on effect of method and gender on students mean achievement in algebra**

Gender Groups	Adjusted Mean for Treatment Group	Adjusted Mean for Conventional Method
Males	78.90	50.22
Females	62.70	46.08

Summary of results presented in Table 3 revealed that male students had a mean achievement score of 78.90 and standard deviation of 50.22 while female students had a mean achievement of 62.70 and standard deviation of 46,08. Results presented in the table indicated that cooperative learning strategy is superior to the conventional approach at the two levels of gender (male and female).

**Hypotheses**

**Ho<sub>1</sub>:** There was no significant difference in the mean achievement scores of students taught mathematics using cooperative learning strategy and those taught using the conventional method.

**Ho<sub>2</sub>:** There was no interaction between methods and gender on students mean achievement in mathematics. Summary of results of the two hypotheses is as presented in table 4 below.

**Table 4: Analysis of Co Variance for Students overall mathematics achievement scores by teaching methods and interaction between methods and gender**

Source of Variation	Sum of Squares	Df	Mean Square	F	F. probability
Covariates	16454.675	1	16454.675	220.256	.000
Pretest	16454.675	1	16454.675	220.256	.000
Main Effects	45528.021	2	22764.010	304,710	.000
<b>Method</b>	<b>42458.400</b>	<b>1</b>	<b>42458.400</b>	<b>568.331</b>	<b>.000*</b>
Gender	1487	1	1487	19.906	.000
2-Way	1375.628	1	1375.628	18.414	.072
Interactions					
<b>Method Gender</b>	<b>1375.628</b>	<b>1</b>	<b>1375.628</b>	<b>18.414</b>	<b>.072*</b>
Explained	63358.320	4	15839.580	212.022	.000
Residual	2038.596	295	74.707		
Total	85396,917	299	285.608		

Result on table 4 showed that for hypothesis 1, the alpha level (0,05) is greater than the Sig. of F value (.000). The decision rule is to reject the null hypothesis when the alpha level is greater than the Sig. of F value. Based on the decision rule the researcher rejects the null hypothesis and concludes that there is a significant difference in the mean achievement scores of students taught mathematics using the cooperative learning strategy and those taught using the conventional method. For hypothesis 3, the alpha level (0.05) is less than the Sig of F value (0.072). Based on the decision rule the researcher upholds the null hypothesis and concludes that there is no significant interaction between methods and gender on the students mean achievement in mathematics.

**Ho,:** There is no significant difference between the mean achievement scores of male and female

students taught algebra using the experiential teaching method. Data collected with the Mathematics Achievement test (Pre and Post-tests) for the treatment group only was used to test this null hypothesis. Summary of result is presented in Table 5.

**Table 5: Analysis of Co Variance for the effects of Cooperative instructional approach on male and female Students achievement scores in mathematics for treatment group only**

Source of Variation	Sum of Squares	Df	Mean Square	F	F.probability
Covariates	10436.792	1	10436.792	84.804	.000
Pretest	10436.792	1	10436.792	84.804	.000
Main Effects	3454.771	1	3454.771	28.072	.000
<b>Gender</b>	<b>3454.771</b>	<b>1</b>	<b>3454.771</b>	<b>28.072</b>	<b>.000*</b>
Explained	13891.563	2	6945.782	56.438	.000
Residual	18091.270	147	123.070		
Total	31982	149	214.650		

Result on table 5 shows that the alpha level (0.05) is greater than the Sig of F value (0.00). Based on the decision rule, the researcher rejects the null hypothesis and concludes that there is a significant difference between the mean achievement scores of male and female students taught mathematics using cooperative strategy.

#### Summary of Findings

This study recorded the following findings:

1. The mean achievement scores of students taught mathematics using the cooperative learning strategy was higher than those taught using the conventional method. In addition, there was a significant difference in the mean achievement scores of students taught using cooperative learning and those taught using the conventional method;
2. The male students taught mathematics using the cooperative learning strategy had a higher mean achievement score than their female counterpart. In addition, the difference in their mean achievement scores is statistically significant.
3. There was no interaction between method and gender on the students mean achievement in mathematics.

#### DISCUSSION OF FINDINGS

The results are presented in themes in line with the objectives of the study as follows:

- (a). Effect of cooperative learning strategy on students' mean achievement scores in mathematics;
- (b). Effect of cooperative learning strategy on mean achievement scores of male and female students' in mathematics;
- (c). Interaction effect of methods and gender on the mean achievement scores of students in mathematics;

#### Effect of Cooperative Learning Strategy on Students' Mean Achievement Scores in Mathematics

Result of analysis showed that students taught geometry concepts using cooperative learning strategy achieved better than those taught with the conventional chalk-talk approach. In addition, result in table 5 showed that the difference in the mean achievement scores of students taught geometry using cooperative learning strategy and those taught using the conventional chalk-talk approach was significant in favour of the students taught

using cooperative learning strategy. The result is in consonance with that of [13] who recorded a significant difference in the mean achievement scores of students taught geometry using Jigsaw IV cooperative learning strategy (J4CLS) and those taught using the conventional chalk and talk method. Furthermore, the finding is in agreement with that of [14] who recorded a significant difference between the mean achievement scores of students taught mathematics using cooperative learning approach and those taught using the conventional chalk and talk method. More so, the finding is in tandem with that of [15] who recorded a significant difference between the mean achievement scores of students taught mathematics using Jigsaw cooperative learning approach and those taught using the conventional chalk and talk method. The result is also in agreement with that of [16] who recorded a significant difference in the mean achievement of students taught mathematics using cooperative learning as against those taught mathematics using individualistic approach of learning. The is equally in tandem with that of [17] who recorded a significant difference in the mean achievement scores of students taught mathematics using cooperative learning strategy as against those taught using the conventional teaching method.

#### **Effect of Cooperative Learning Strategy on Mean Achievement Scores of Male and Female Students' in Geometry**

Finding of the study showed that the male students had a greater mean achievement score than their female counterpart. In addition, there was a significant difference in the mean achievement of male and female students taught geometry using cooperative learning strategy in favour of the males. The result is in tandem with that of [18] who recorded a significant difference in the mean achievement scores of students taught geometry using cooperative learning approach in favour of the male students. However, the result disagrees with that of [19] who recorded no significant difference in the mean achievement scores of male and female students taught trigonometry using Problem Based Learning approach.

#### **Interaction Effect of Methods and Gender on Students Mean Achievement Scores in Mathematics**

Result of the study revealed that there was no interaction effect between methods and gender on the students mean achievement scores in mathematics. The results tables 2 and 3 showed that cooperative learning strategy was superior to the conventional chalk-talk approach at the two levels of gender (male and female). The result is in consonance with that of [20] who recorded no significant difference in the mean achievement scores of students taught geometry using Jigsaw IV cooperative learning strategy (J4CLS) and those taught using the conventional chalk and talk method. However, the result is in disagreement with that of [21] who recorded a signification interaction between method of teaching and students gender on the students mean achievement scores in trigonometry using problem based learning approach.

#### **CONCLUSION AND RECOMMENDATIONS**

In this chapter the researcher presents the summary, conclusions, recommendations, educational implications, limitations and suggestions for further studies which were derivable from the findings of this study.

##### **Summary of the Study**

The study investigated effect of Cooperative Learning Strategy on Senior Secondary Two (SSII) students' achievement in geometry. In order to accomplish the purpose of the study, three specific objectives, three corresponding research questions and hypotheses were formulated to guide the study. Literature pertinent to the study was reviewed under three subheadings: conceptual framework, theoretical framework and review of empirical studies. The study adopted quasi-experimental design of the pretest posttest non-equivalent control group design. The population of the study comprised all the SSII students in all the public secondary schools located across Abakaliki Education Zone of Ebonyi State totaling 5118 made-up of males 1941 and females 3177. The instrument used for data collection was Geometry Achievement Test (GAT). Three specialists in Mathematics

Education, and Measurement and Evaluation face validated the instrument. Kuder-Richardson formula 20 was used to establish the reliability of PAT and it yielded a coefficient of 0.74. Three hundred students comprising (152 males and 148 females) students were used as sample for the study. Data collected were analyzed using mean and standard deviations for the research questions and ANCOVA was used to test the hypotheses at 0.05 alpha level. Based on the analysis of the data, the following findings were obtained among others:

- ❖ Students taught mathematics with cooperative learning strategy achieved better than those taught with the conventional chalk-talk method;
- ❖ Male students taught mathematics using cooperative learning strategy had a higher mean achievement score than their female counterparts.
- ❖ Interaction effect of methods and gender on students mean achievement in mathematics was not significant.

#### **Conclusions of the Study**

In line with the findings of the study, the following conclusions were drawn: Cooperative learning strategy as a teaching method is significantly better than the conventional chalk-talk teaching approach in enhancing students' achievement in mathematics. With cooperative learning strategy, male students showed higher achievement than female students. The difference in the mean achievement of male and female students taught mathematics using" cooperative learning strategy was statistically significant. There was no significant interaction between methods and gender on students' achievement in mathematics. For both male and female students, cooperative learning strategy was superior to the conventional package in enhancing achievement in mathematics.

#### **Recommendations of the Study**

The following recommendations were made based on the findings of the study:

1. Mathematics teachers in secondary schools should be encouraged to embrace the use of cooperative learning strategy during teaching learning process to enhance students achievement in mathematics;
2. Textbook authors should be encouraged to recommend in their texts cooperative learning as a strategy for effective teaching and learning of mathematical concepts;
3. Curriculum planners should endeavour to include cooperative learning strategy as an instructional approach because of its efficacy in enhancing both male and female students' achievement in mathematics.

#### **Educational Implications of the Study**

The result of this study has provided empirical evidence on the efficacy of Cooperative learning strategy approach in teaching mathematics in mathematics. This suggests the need for mathematics teachers to employ cooperative learning strategy in teaching mathematical concepts in senior secondary classes. It would help students to be able to use their own mental process to solve problems in mathematics. By involving students in cooperative learning strategy, the teacher would be providing an environment in which equilibration can occur in the minds of the students. The findings of this study have implication for the government in the provision of in-service training and works for mathematics teachers. This will equip them with the knowledge of integrating instructional practices that are likely to have positive impact on students' achievement in mathematics. The fact that cooperative learning strategy lead to high level of understanding of geometric concepts points unmistakably to curricular implications. It implies that the mathematics curriculum developers should begin to integrate cooperative learning strategy in the curriculum especially at the senior secondary school classes. The absence of interaction between gender and teaching approach with respect to achievement indicates that the approach is not gender biased and therefore should be employed to develop creative thinking and problem-solving skills in boys and girls.

### Limitations of the Study

The generalizations made with respect to this study are however, subject to the following limitations:

- 1) The students' socio-economic background prior to treatment was not controlled in this study. This may constitute a limitation to this study. The students background, that is, some may be privilege to have attended private schools in their early stages in life, some may have the opportunity to have attended private lessons which may have enhanced their academic standard right from home.
- 2) Since different teachers were used for the two schools, it may be assumed that they may not be of equal attributes in terms of cognitive and affective functioning. This may introduce a little error into the study.
- 3) There was no randomization of the subjects because of some environmental constraints. That is, intact classes were used. Although ANCOVA was employed in data analysis, it does not completely eliminate the issue of initial differences especially in such situations where sampling errors are unavoidable.

### Suggestion of Further Studies

Based on the findings and limitations of this research, the following topics are suggested for further research.

- 1) Effects of cooperative learning strategy on junior secondary schools students' achievement in geometry.
- 2) Effect of cooperative learning strategy on senior secondary school students' achievement, interest and retention in mathematics.
- 3) Effect of cooperative learning strategy on senior secondary school students' achievement in trigonometry.

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