

**EFFECT OF COOPERATIVE LEARNING STRATEGY ON STUDENTS
ACHIEVEMENT IN MATHEMATICS IN SENIOR SECONDARY SCHOOLS
IN ABAKALIKI EDUCATION ZONE OF EBONYI STATE**

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Abstract

This paper focused on the effect of cooperative learning strategy on students achievement in mathematics in senior secondary schools in Abakaliki Education Zone of Ebonyi State. Two research questions and one null hypothesis guided the study. The population of the study comprised all SS11 students in all public secondary school within the study area. The sample of the study comprised 300 students who participated in the study. Mathematics 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 statistics 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 mathematics 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 statistically significant between the mean achievement scores of students taught mathematics with cooperative learning strategy and those taught using the conventional (talk and chalk) method. 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.

Key words: Cooperative Learning, Instructional Strategy, Achievement, Mathematics Achievement

Introduction

Mathematics is the mother of all sciences that deals with the logic of shape, quantity, measurement and arrangement (Bashir, Abubakar & Garba, 2016). Mathematics is all round us and in everything we do. Its knowledge is used and applied in virtually everything in our society. Ugwuanyi (2015) described mathematics as a science that deals with the meaning of numbers and their relationships to space, measurements and quantities. Gupta and Pasrija (2012) 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.

In an effort to describe and highlight areas of mathematics application in various disciplines and in our daily living, mathematics is the carpenter's hammer,

Journalist's pen, broadcaster's microphone, doctors' stethoscope and lawyers wig. Furthermore, they qualified mathematics as an essential ingredient in manufacturing industries and essential tool in economic activities; the mother of all sciences, chief bride's maid of social sciences, ladies in waiting for engineering, cosmetology of arts and unavoidable servant of management sciences. This is to say that the application of mathematics to problem areas depend on the discipline and understanding of the concepts and the principles of mathematics by the problem solver. It is not surprising that mathematics is recommended as a core subject in secondary schools across Nigeria and in indeed all over the world.

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 (Egbulefu, Amaele & Osaat, 2015). 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. This has been noticed especially since after the Nigeria civil war. Before the civil war, Mathematics was an exciting, interesting and lively subject (Adaramola, 2014). 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 (Eniayeju, 2010).

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 (Timayi, Bolaji & Kajuru, 2015). 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 teachers right from primary school. As a result of the ugly development which has become a reoccurring decimal, 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 (Ajai and Imoke, 2015). Right from the Primary School level, many school children believe that it is for the selected few. Unfortunately, even many adults still share the same view and feeling. It is common these days to hear that Nigerian adults openly declare their lack of competence in Mathematics publicly without any feeling of shame. 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, encourage them to study harder so as to excel in the subject are themselves complains about the difficulty of understanding the subject raises a serious concern. Furthermore, the report of the WAEC Chief Examiners report between 2012 to 2016 on students' performance showed that students' 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 aforementioned years still fell between 30 and 32 percent. In May/June 2015 in particular, WAEC Chief Examiner's reports 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. 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 same Chief Examiners in the year 2016 report, pointed to similar problem. It was reported that a large number of candidates did not record to the accuracy expected of their measuring instruments. Others 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.

Mobark (2014) described Cooperative learning technique as an approach to group work that minimizes the occurrence of those unpleasant situations and maximizes the learning and satisfaction that result from working on a higher performance. According to Ugwuanyi (2015), cooperative learning is a method of instruction characterized by students working together in small groups to reach a common goal. It is generally understood to be a learning method which takes place in environment where students work collaboratively in small groups by sharing ideas while working on a given task. It is a discovery method in which small groups of learners are used. Other researchers such Zakaria, Chin and Daud (2010), have confirmed the effectiveness of cooperative learning in higher education. They postulated that cooperatively taught students tend to exhibit higher academic achievement, greater persistence through graduation, better high-level reasoning and critical thinking skills, deeper understanding of learned

material, greater time on task and less disruptive behaviour in class. The learners also exhibit lower levels of anxiety and stress, greater intrinsic motivation to learn and achieve greater ability to view situations from others' perspectives, more positive and supportive relationship with peers, more positive attitudes towards subject, and higher self-esteem.

Cooperative learning help students to brainstorm in small group, share common interest, dramatize, debate, discuss and demonstrate, all these strategies make the learner to participate actively in the instructional process. At present, Mathematics teaching in Nigeria has been pre-dominated by chalk and talk method whereby the teacher is the chief actor and students are passive-listeners. This pedagogy assumes that learning can only take place when it is transferred from the teacher to the learner. The teacher is the expert and the students the passive-receivers. This leads to the memorization of facts which might help students prepare for examination/test in the immediate future, but this option leads to forgetting the reasoning behind the explanation. But a reformed vision of teaching and learning in Mathematics calls for a new mind-set in which the teacher assumes a new role. In cooperative learning strategy, the teacher is no longer the sole custodian and source of knowledge; he plays the role of a facilitator.

However the importance of cooperative learning on students understanding and achievement in mathematics, a pertinent question may arise as to whether cooperative learning as an instructional approach might have differential effect on male and female students' achievement in mathematics. This is sequel to the fact that some research results showed that gender inequalities exist in mathematics achievement of students in secondary schools. Ajai and Imoko (2015) established gender differences in students' achievement and retention in mathematics in favour of the males. On the other hand, Timayi et al (2015) found no significant gender differences in students' achievement in geometry. Could it be that the inconsistency existing between male and female students' achievement in mathematics be adequately addressed by cooperative learning instructional approach? This (effect of cooperative learning on male and female students' achievement in mathematics) has not been investigated in the area of this study and the researchers intends to establish empirically if the approach could be gender friendly and effective in enhancing the learning of both male and female students.

Statement of the Problem

Mathematics 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 by the West African Examination Council (WAEC) between 2012 – 2016, showed that majority of the candidates performed below credit level. In particular, the report had it that between the stipulated years, 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. One therefore, notes with dismay the general poor achievement of students in this all-embracing and essential subject. The report went further to state that Mathematics teachers still have contributions to make to the change teaching and learning 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 (ie, 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 researchers therefore, that since learning is a change in behaviour, if learners work with their peers, learns 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 researchers' resolve to investigate the effectiveness of cooperative learning strategy in enhancing the academic achievement of senior secondary two (SS II) students in mathematics.

Purpose of the Study

The main purpose of this study was to investigate the effect of cooperative learning as an instructional strategy on students academic achievement in Mathematics. Specifically, this study determined the following:

1. Mean achievement scores of students taught Mathematics using cooperative learning strategy and those taught using conventional (talk and chalk) method.
2. Effects of cooperative learning strategy on mean achievement scores of male and female students in Mathematics.

Significance of the Study

The outcome of this study would be of immense benefit to the following in education enterprise: Mathematics teachers, Curriculum planners, Textbook writers, Researchers, Education administrators, Education supervisors, Students, teachers, Lecturers in Colleges of Education and Universities and General public

To Mathematics teachers, the outcome would be beneficial to them because it will help them change from the current teaching-learning strategy whereby the teacher is the sole authority in the classroom and the students are just passive listeners. Under this new dispensation, the teacher becomes the facilitator of learning. Under the conventional (talk and chalk) method, contributions from the learners do not matter as they are in class merely and mainly to receive knowledge from the teacher. A situation where the teacher dominates the class has been discovered to be didactic and stifles learner's active participation in the class. But this new technique of cooperative learning method is a total deviation from the above. Here, the learners work in groups to achieve a common goal. There will be brain storming, interactions, discussion, games, projects, and assignments among others, the teacher only acts as a facilitator.

To curriculum planners, the outcome of this research will assist them to plan teaching contents for students in line with this approach to teaching-learning method. There will be a shift from the old method of teaching. To textbook authors, the outcome of this research will help them use teaching methods to reflect this new approach. For example, books on methodology of teaching will be written using ASEI approach. ASEI is an acronym meaning: A = Activity, S = Student-Centered, E = Experiment and I = Improvising/Improvisation. This method is aimed at making teaching and learning more student-oriented. It is a paradigm shift from talk-chalk approach to activity based students centered approach. ASEI as an intervention strategy takes into cognizance how students learn better.

Research Questions

The following research questions guided the study:

1. What is the mean achievement scores of students taught mathematics using cooperative learning method and those taught using chalk and talk method?
2. What is the effect of cooperative learning method on the mean achievement scores of male and female students in Mathematics?

Hypothesis

The following null hypothesis was formulated and tested at 0.05 alpha level.

HO₁: There is no significant difference in the mean achievement scores of students taught Mathematics using cooperative learning method and those taught using the conventional (talk and chalk) method.

Concept Mathematics

Mathematics is the science of numbers, quantity and space (Hornby, 2007). Mathematics has the following branches; Trigonometry, Geometry, Algebra, Arithmetic and Statistics. Mathematics deals with orders, shapes, quantities, space and lines. Mathematics is the language of the Sciences, the queen and servant of the Sciences, Mathematics is the central processing laboratory for the Sciences. But despite all these, its teaching and learning in Secondary Schools in Ebonyi State is still grappling with problems. A dedicated Mathematics teacher should be able to lift his/her students to the level they would begin to appreciate Mathematics, its beauty and its applications so that the students attitude towards the subject would begin to change and their performance in the subject consequently would also improve.

Mathematics being 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. Mathematics is one skill everyone needs to master in life. According to him, even if it is the only one, one will at least be able to live without being cheated, robbed or abused. The problem in the teaching Mathematics is that, people have the erroneous notion that anybody can be a teacher, well, anyone can teach but not everyone can teach well.

Co-operative Learning Strategy

Co-operative learning strategy can be best described as team-based learning. One of the greatest challenges education face these days, is how to determine the best and most effective teaching strategy. The achievement or otherwise of students to a large extent is hinged on the efforts by a teacher to facilitate learning which in turn will motivate students interest. Co-operative learning strategy is a form of active learning pedagogy which takes place through an individual's interaction with his or her environment and peers. Abdullahi (2014) observed that, co-operative learning became a commonly used form of learning and active pedagogy in the 1980s, and continues to be a valuable tool for learning in academic institutions even today , “students significantly work harder and learn more from the cooperative learning components than from the traditional lecture and text-based components.

In co-operative learning strategy students learn in groups, there is positive interdependence, individual accountability, shared leadership, shared responsibility, task and good maintenance are emphasized and the teacher only acts as a facilitator, observer and intervenes where there is problem in learning in small groups and cooperatively builds constructive relationships among students as well as overcomes prejudices and prevents behaviours like delinquency (Melihan & Sirri, 2011). In cooperative learning, success in that effective learning occurs through individuals' interaction with each other and with his or her environment.

Teachers' Role as Facilitator under Co-operative and Peer-group Learning Strategy

The current method of teaching Mathematics whereby the teacher dominates the class does not augur well for students' achievement in Mathematics. Under this dispensation, teachers' acquisition of the procedural fluency in Mathematical theories the conceptual understanding by students in the real problem-solving strategies are lacking. In this scenario, students come out of the classroom with hope to do well in standardized tests but cannot apply their knowledge of Mathematics to problems in the real life situation. Boaler, (2008) said, their test scores are low and they still have not obtained the skills necessary for higher-level problem-solving. Low achievement in Mathematics Education has been discussed in numerous policy reports. For years, administrators have appealed for Mathematics-Education reforms but little seems to change. Scores have not gone up, and it appears that the traditional method of teaching Mathematics through direct instruction is alienating students from the education system. In order to increase students' success, we must reverse and review the way Mathematics is taught presently. If Mathematics is about problem-solving, we do not just want students to memorize formulae. They must make connections between Mathematics ideas and the real world. Students therefore, must be Mathematics lovers by being active in the class. This include, exploring, justifying, representing, discussing, using, describing, investigating and predicting.

Methodology

This study adopted the pretest-posttest non-equivalent control group design as contained in quasi-experimental study. 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.

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 Area. The population of the study consists five thousand, one hundred and eighteen (1,665) SS II students in secondary schools in Abakaliki Education Zone in Ebonyi State. (Source: Secondary Education Board Ebonyi State 2017).

All the SSII students in the sampled schools were used for this study. The researchers stratified the schools into three different strata (co-educational, boys and girls schools). Through simple random sampling by balloting, the researchers drew 2 co-educational, 2 boys and 2 girls schools for the study. The instrument the researchers used for data collection was mathematics achievement test (MAT). The mathematics achievement test was a 30-item multiple choice objectives question, developed by the researchers from the content area taught during the study. The mathematics achievement test (MAT) was subjected to face and

content validation. The thirty (30) item mathematics achievement test (MAT) was face validated by 3 experts in Measurement and Evaluation and Mathematics Education from Ebonyi State University, Abakaliki. The mathematics achievement test was assessed for reliability using Kuder Richardson 20 formula. The K-R-20 was used to ensure that the instrument is internally consistent in measuring what it is purported to measure. The pre-test was administered to both the treatment and control groups. After the pretest, the experimental group was taught mathematics using the cooperative learning strategy. The control group taught using conventional teaching (chalk and talk) method. 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. Research questions were answered using mean and standard deviation while the null hypotheses were tested using the analysis of covariance (ANCOVA) at an alpha level of 0.05.

Results

This chapter presented the results of the study. The results were presented in tables in accordance with the research questions and hypotheses that guided the study.

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 implied that cooperative learning strategy favoured the male students more than their female counterparts.

Hypotheses

Ho₁:*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*

Table 3:*Analysis of Co Variance for Students overall mathematics achievement scores by teaching methods and interaction between methods and gender*

Source Variation	of Sum Square	of Df	Mean Square	F	F. probability
Covariates	16454.675	1	16454.675	220.256	.000
Pretest	16454.676	1	16454.675	220.256	.000
Main Effect	45528.021	2	22764.010	304.710	.000
Method	42458.400	1	42458.400	568.331	.000*
Gender	1487	1	1487	19.906	.000
2- Way Interactions	1375.628	1	1375.628	18.414	.072
Method Gender	1375.628	1	1375.628	18.414	.072*
Explained	63358.320	4	15839.580	212.022	.000
Residual	2038.596	295	74.707		
Total	85396.917	299	285.608		

Result on table 3 showed that for hypothesis 1, the alpha level (0,05) is greater than the Sig. of F value (.000). The decision rule is not to accept the null hypothesis when the alpha level is greater than the Sig. of F value. Based on the decision rule the researchers did not accept 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.

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.

Discussion

Result of analysis showed that students taught mathematics concepts using cooperative learning strategy achieved better than those taught with the conventional chalk-talk approach. In addition, result in table1 showed that the difference in the mean achievement scores of students taught mathematics 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 Timayi, Bolaji and Kajuru (2015) who recorded a significant difference in the mean achievement scores of students taught mathematics (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 Abdullahi (2014) 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 Effandi, Titi, Yusoff and Zulkarnain (2013) 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 Adeleye (2012) 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 Hussain and Ahmed (2012) 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.

Finding of the study showed that the male students had a greater mean achievement scores than their female counterpart. In addition, there was a significant difference in the mean achievement of male and female students taught mathematics using cooperative learning strategy in favour of the males.

The result is in tandem with that of Abdullahi (2014) who recorded a significant difference in the mean achievement scores of students taught mathematics using cooperative learning approach in favour of the male students. However, the result disagrees with that of Iji, Emiaku and Utubaku (2015) who recorded no significant difference in the mean achievement scores of male and female students taught trigonometry using Problem Based Learning approach.

Conclusions

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

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.

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