TEACHING JUNIOR SECONDARY SCHOOLS MATHEMATICS USING COOPERATIVE LEARNING SKILL

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Abstract
The essence of this study was to determine how the adoption of cooperative learning as an instructional skill for teaching Mathematics influences students' achievement and attitude towards learning of Mathematics. The study also determined how moderating variables like sex and ability affect students learning and performance in Mathematics when cooperative learning is used as an instructional skill. To guide this study, five (5) hypotheses were raised and tested at 0.05level of significance. Two instruments were developed and validated for data collection. They are Mathematics Achievement Test (MAT) and Attitude towards Mathematics Inventory (ATGI). The t-test for sample statistics was used to test for the hypotheses on performance and Mann Whitney U-test tool of least significant difference was used to test the attitude of the students taught with cooperative learning skill and traditional method. The major findings of the study included a significant higher achievement test scores of students in cooperative learning group than those in traditional classroom; a significant higher attitude scores of students in cooperative learning group than those in traditional classroom; a significant higher achievement test scores of all students of varying abilities in cooperative learning group than those in traditional classroom; a non-significant difference in achievement test scores between the male and female students in the cooperative learning group and non-significant interaction effect between sex and ability, sex and method and ability and method. By these results, the researchers recommend that cooperative learning strategy should be incorporated and adopted in teaching of Mathematics in junior secondary schools.

Introduction

Mathematics is still the subject that is considered difficult and boring to many students. According to Woodard (2004), weaker students feel anxiety toward Mathematics and this anxiety affects their performance in classroom. Students who lack mastery in Mathematics are less successful despite being in secondary schools for a long period of time. Furthermore, low proficiency students in Mathematics performed below average on the national examinations in Nigeria based on observations of high school Mathematics students. The information shows that students are not actively involved in developing knowledge. They receive information passively and are less motivated. This passivity has caused much concern among educators because knowledge of Mathematics plays a significant role in enhancing the country social economic development. The quality of education that teachers provide to students is dependent upon what teachers do in their classroom (Zakaria & Ikan, 2007). The teaching method used in the class is one of the factors that make students become passive and have less interaction with each other in doing tasks. Lazarowitz, Hertz Lazarowitz and Baird (1994) have criticized the lecture method use by teachers collectively. Cooperative learning encourages students to be active participants in the construction of their own knowledge (Webb Troper & Fall, 1995; Kolawole, 2008; Chianson, Kurumeh & Obidia, 2011). Cooperative learning also encourages students to interact and to communicate with peers in harmony. Cooperative learning promotes value such as honesty, cooperation, mutual respect, responsibilities, tolerance and willing to sacrifice a consensus. Execution duties in

cooperative learning can develop self-confidence in pupils. Cooperative learning has been well documented in the educational research as a successful pedagogy to improve students' academic achievement. It is a fundamental principle of cooperative learning that group members are linked together in such a way that they cannot succeed unless everyone succeed. They will actively assist each other to make sure that the assignment is done and the purpose of the group achieved. In cooperative learning environment, the goals of separate individuals become so linked that there is a positive correlation between them. Hence, this study aimed at identifying the effect of cooperative learning skill on teaching and learning of Mathematics in selected schools in Oyo West Local Government Area of Oyo state.

Hardly can any country survive the recent pressure of information, communication and technology without Mathematics (Azuka, 2000). It is also seen as a pivotal subject, both in its own right and also because of its important connections in diverse field such as the Natural sciences, Engineering, Medicine and the Social Sciences (Keith, 2000). Usman (2002) opined that Mathematics is a subject that encroaches into all aspects of human endeavours and has been described as life wire in the studies of various disciplines. Such disciplines are Physics, Chemistry, Biology, Economics, Sociology, Linguistics, Computer information theory, Cybermetrics among others. The significance of Mathematics in Nation building, Science and Technology has been well documented (Ale, 2005; Popoola and Olarewaju, 2010).

Despite the role of Mathematics to Nation building, the performance of learners has been poor at terminal and standardized examinations at all levels of education in Nigeria (Popoola & Olarewaju, 2010; Timayi, 2014). The Nigeria educational research and development council in 1997 reported that the performance of students in public examination over the years has been poor in the physical sciences (Physics and Chemistry). Many factors have identified to be responsible for this malady, these include learning difficulty, teacher factor, poor methodology, anxiety and fear for the subject among others. Junior secondary school certificate examination (JSCE) result is a predicator of a students' performance in Mathematics at the Senior Secondary School Certificate Examinations (SSCE) which indicates that poor achievement in Mathematics at the Junior Secondary Certificate Examination (JSCE) level may be reproduced at the SSCE level Co'kwu & Orun, 2013; Kola, Ala & Olatunji, 2014). Good knowledge in secondary Mathematics is a gateway for higher mathematics and mathematics related fields.

Many teaching methodology aimed at improving students' performances in Mathematics have been presented (Eshun Famiyeh, 2005; Willis, 2010; Timayi, 2014). A result oriented method for improving students' performances in mathematics is the cooperative learning skill which has been found to produce better result than the traditional methods among students in secondary schools world -wide (Mbacho & Githua, 2013)

According to David and Roger (2001), cooperative learning is a teaching strategy in which small teams, each with students of different levels of ability, use a variety of learning activities to improve their understanding of a subject matter. It is a learning environment that allows active participation of students in the learning process makes it possible for the students to have control over their learning and this leads to improvement in students' learning interest and relation (Johnson, Johnson & Stane, 2000). It is a learner centered approach that equips students with relevant cooperative skills which enable them to work and solve problems together with minimal efforts of the teacher (Aluko & Olorundare, 2011).

Johnson & Johnson (1990) point out after revising researchers about Mathematics learning under cooperative methods, the students who work systematically with these techniques show improvement in:

(i) the use of reasoning strategies;
(ii) the ability to generate new ideas;
(iii) the appropriate solution to problems; and
(iv) the ability to transfer what is learnt in the group to the individual solution of a problem.

In addition, the same authors underline the convenience of using techniques of cooperative learning in Mathematics due to, at least, the following reasons:

(i) Cooperation involves a greater performance than competitiveness and individualization.
(ii) Mathematical processes require an active learning process that emerges easily in students' discussions. The traditional way of teaching Mathematics has been based on the assumption that students are passive subjects that store what learn as the result of repeated practice and reinforcement (Keyser, 2000).
(iii) The solution of mathematical problems involve an interpersonal work and most students feel more comfortable clarifying their thought in small groups rather than in the discussions of the whole class. Discussing problems with classmates helps students to understand how to solve them in an adequate way.
(iv) The groups that are cooperatively structured involve a greater intellectual exchange that is essentially needed in the process of teaching and learning Mathematics.
(v) Within co-operative groups, students receive a supporting interaction that allows them to increase confidence in their own individual ability for Mathematics.

In cooperative learning situations, students like Mathematics more and they are more intrinsically motivated to continue to learn it.

There is little doubt that one of the most decisive aspects in cooperative work is the cooperative design of task. Thus, as Rue (1998) point out a teacher's imagination is important when developing working situations different from the habitual ones that are so typical of the interpersonal relationships among students.

From this perspective, the groups that are formed must have the following characteristics:

1. To be formed by three members that will alternate the work in a big group in a team and individual work during the teaching and learning process.
2. To be heterogeneous regarding the level of performance of members.
3. The team must have certain group cohesion that favours and promotes collaboration and cooperation when developing the task.
4. The Spatial distribution must be coherent with the co-operative and team work structure, and must remain stable at least during one term.

The teacher's role in cooperative learning skill is fundamental as it contributes to the class climate and allows people to develop themselves in a working environment of confidence participation, dialogue, co-operation and mutual respect. The teacher must be an active participant in the process of building knowledge on the student's side.

On the other hand the teacher must assume the role of observer, mediator adviser and/or tutor that guides, support, and solve problems at the same time promoting a series of basic norms that must continue during the group's interaction from these assumptions, the teachers functions are basically the following:

(i) To promote the students' interest in the new learning contents;
(ii) To value the level of previous knowledge of students;
(iii) To prepare the didactic units expounding their most relevant contents to the whole class;

(iv) To elaborate and/or select, from the explained topic, the material that students will work on in groups – he or she will only intervene if the difficulty cannot be overcome among the members of the group and as a task resort, by none of the group's members and his help therefore asked for.

(v) To make sure that the relationship among equal is the adequate one;

(vi) To organize the student's self-evaluation and co-operation teams providing them with information about the mistakes that are produced in their work.

Statement of the Problem

The primary focus of this study is to examine the effects of cooperative learning skill on teaching and learning of Mathematics in Junior Secondary Schools in post COVID-19. This study determines if educators can help students learn Mathematics concepts better by using method of cooperative learning skill in the classroom.

Hypotheses

The following five hypotheses were raised and tested for this study.

Ho_1: There is no significant difference in achievement test scores between students instructed with cooperative learning skill and those taught using traditional classroom teaching method.

Ho_2: There is no significant difference in attitude scores between students instructed with cooperative learning skill and those taught using traditional classroom teaching method.

Ho_3: There is no significant difference in achievement of scores between male and female students instructed with cooperative learning skill.

Ho_4: There is no significant difference in achievement test scores between students of varying abilities instructed with cooperative learning skill and those taught with traditional classroom teaching method.

Ho_5: There is no significant interaction effect among method, sex and ability on achievement.

Research Design

The quasi experimental design was used for this study. The design consists of two selected groups (cooperative group and traditional classroom teaching group). Sex (male and female) ability (high and low) repeated testing (pre-test and post-test). The main independent variables were exposed to cooperative learning skill, sex and ability while the dependent variables were achievement and attitude.

Population of the Study

The test population consists of 2021 Junior Secondary Class Three (JSS III) students in mixed schools in Oyo East Local Government Area of Oyo State. The population is made up of 3,485 public Junior Secondary Schools Three (JSS III) Mathematics students in the ten (10) co-educational schools in Oyo East Local Government Area of Oyo State. The total number of JSS III male and female students in public schools are 3,485 of which 1,585 are females and 1900 are males.

Sample and Sampling Technique

The sample selected in this study consists of 120 students out of 3,485 junior secondary year three. JSS III mathematics students drawn from four (4) out of ten (10) co-educational government owned secondary schools. The two sexes were equally represented in the sample. The sampled subjects were randomly assigned to four classes of 30 students each. Two classes formed the cooperative learning group while the remaining two classes served as the traditional teaching method group.

Research Instruments

The following instruments were developed by the researchers and used for data collection.

(i) Mathematics Achievement Test (MAT) was used for pre-test, post-test and post-post-test.

(ii) Students Attitude Scale (SAS) was used to determine change in attitude in Mathematics.

Validity of the Instrument

The validation of Mathematics Achievement Test was done by four (4) expert mathematics teachers. These experts were intimated with the purpose of the study and content to be covered for six (6) weeks. The Students Attitude Scale (SAS) was constructed by the researcher by selecting and adopting some items in a section on disposition in an instrument higher order thinking and problem solving checklist constructed by Borich (2004). The SAS consists of 12 items on a 4-point likert scale testing for students' attitude towards Mathematics lessons and their fellow students and their groups. The instrument was validated by adopting the inter-rater reliability approach.

Reliability of the Instrument

The reliability index of the instrument was found to be 0.81 using the Kuder Richardson 21 formula. Recommendation by Borich (2004) indicated the reliability value of 0.70 or higher shows that the test is reliable, measuring the characteristics it was designed to measure. With this background information, all the test instruments were administered on the subjects.

Administration of the Instrument

The researchers sought the permission of the principals and the Mathematics Heads of Departments (HODs) of the participating schools and the Mathematics teachers of each of the school was used as research assistants.

The two instructional groups served as cooperative learning (Experimental) and traditional classroom teaching method served as control group. The effects of cooperative learning skill on the achievement and attitude of 120 Mathematics students in Junior Secondary School classes three (JSS III) was investigated in the controlled condition of classrooms. All the subjects were pre-tested before treatment. The material learned by the subjects from where the achievement test were drawn, where a six week instructional unit drawn from you and your home in Mathematics Teachers Association of Nigeria Mathematics Book III. During the treatment period, students in the cooperative learning classroom were instructed by teachers who followed the guidelines learned during the training by the researchers.

Method of Data Analysis

Post achievement test was administered to both the experimental and control groups. Also, at the end of every week's instruction, attitude scores of the subjects in experimental and control groups were taken. At the end of the sixth week of instruction, the achievement test and attitude scores of the subjects in the experimental and control groups were averaged to arrive at the individual students post-test and attitude scores.

Testing of Hypotheses

The hypotheses were tested using t-test and Mann-Whitney U-Test.

Hypothesis 1:

There is no significant difference in achievement test scores between students instructed using cooperative learning skill and traditional method.

Table 1: Summary of Independent t-test of the Academic Performance between Cooperative Group and Traditional Group

Variable	Group	N	Mean	S.D	Df	t-Cal.	t-Crit	Sign.	Response
Academic performance	Cooperative Learning Group	60	83.34	17.74	118	14.68	1.96	0.00	Rejected
	Traditional Group	60	64.55	16.65					

Source: Field Work Result *Significant at p = 0.05*

T-calculated value is higher than the t-critical value of 1.96, at df 118. Their calculated mean academic performances were 83.34 and 64.55 by cooperative group and traditional group students respectively. Consequently the null hypothesis which states that there is no significant difference in achievement scores between cooperative learning skill and traditional method is hereby rejected. This means that there is significant difference between achievement scores of the cooperative learning and traditional groups. Thus, the hypothesis is rejected.

Hypothesis 2: There is no significant difference in attitude scores between students instructed with cooperative learning skill and traditional method.

Table 2: Mann-Whitney U-test on Attitude Scores of JSS III Students taught with Cooperative Learning Skill and Traditional Method

Variable	Group	N	Mean Rank	Sum Rank	Z-Cal	Sign.	Response
Attitude	Cooperative Learning Skill	60	140.07	4007.36	6.32	0.00	Rejected
	Traditional Method	60	100.05	380701			

Source: Field Work Result *Significant at p<0.05*

The result showed that significant differences exist between cooperative learning skill and traditional group students in their level of attitude towards Mathematics in Junior Secondary Schools in Oyo East Local Government Area of Oyo State. This is because the calculated significant value of 0.00 is lower than the 0.05 alpha value of significance. This shows that cooperative group of students had significantly higher mean level of attitude toward Mathematics than their counterparts in traditional group that were not exposed to the treatment.

Hypothesis 3: There is no significant difference in achievement for scores between male and female students instructed with cooperative learning skill.

Table 3: Summary of t-test on Achievement Scores between Male and Female Students instructed with Cooperative Learning Skill

Gender	Group	N	Mean	S.D	Df	t-Cal	t-Crit	Sign.	Response
Male	Cooperative Group	30	60.69	8.74	58	0.62	1.86	0.06	Accepted
Female		30	60.94	8.96					

Source: Field Work Result *Significant at p = 0.05*

From Table 3, the calculated t-value is 0.62, this is less than the critical value of 1.86 at degree of freedom (df) is 58. This means there is no significant difference between achievement scores of male and female in cooperative group. The null hypothesis is thus accepted.

Hypothesis 4: There is no significant difference in achievement scores between students varying abilities instructed with cooperative learning skill and those thought with traditional method.

Table 4: Summary of T-test on Achievement Scores between Students of Varying Ability instructed with Cooperative Learning Skill and those taught with Traditional Method

Variable	Group	N	Mean	S.D	Df	t-Cal	t-Crit	Sign.	Response
High	Cooperative Learning Group	30	58.50	7.54	58	1.89	1.67	0.00	Rejected
	Traditional Group	30	47.59	3.34					

Source: Field Work Result *Significant at p = 0.05*

Hypothesis 5: There is no significant interaction effect among method, sex and ability on achievement.

Table 5: Summary of T-test on interaction among method, sex and ability on Mathematics Achievement

Variable	Group	N	Mean	S.D	Df	t-Cal	t-Crit	Sign.	Response
Low	Cooperative Learning Group	30	43.4	6.3	58	1.98	1.86	0.00	Rejected
	Traditional Group	30	31.0	3.8					

Source: Field Work Result *Significant at p = 0.05*

Significant difference were found between mathematics students of varying abilities in the cooperative learning classroom and in the traditional teaching method classroom, as shown in the Table 4 and 5. In table 4, t-calculated value is 1.89 while the table critical is 1.67, since t-cal is greater than t-critical at the degree of freedom of 58 at 0.05 and in table 5, t-calculated value is 1.98 while the table critical is 1.86, since t-calculated is greater than t-critical at the degree of freedom of 58 at 0.05, the null hypothesis 4 is rejected.

Discussion of Results

The findings of this study have demonstrated the effectiveness of cooperative learning in the teaching and learning of Mathematics in Junior Secondary School. This study is also significant in that it demonstrated the effects of cooperative learning skill on students' achievement and attitude in one single study. Again, the study compared how sex and ability variation influence students' scores in cooperative classes. The combination of variables helped to determine the interaction between and among the variable influence students test scores in Mathematics.

One major finding of this study is that students taught using the cooperative learning method scored higher marks in mathematics achievement test than those taught using the traditional classroom teaching method. This may have been achieved by the high level of students' participation in

learning activities. All the students in the cooperative group performed specific role in solving problems which are presented in the classroom to the benefit of all members of group. When learners are confronted with problem which they must solve, they are forced to reason and think critically in order to solve the problems. This finding agrees with the findings of Stevens and Slavin (1995) and Borich (2004). It is believed that when properly and carefully used cooperative. Cooperative learning activities engage the students in the learning process and seek to improve the critical thinking, reasoning and problem solving skill of students (Bramleft, 1994; Megnin, 1995; Webb Troper & Fall, 1995).

Specifically, these research findings are hinged on certain principles which guided the studies. Bramleft (1994) hinges his study on the principle that cooperative learning enhances active engagement of students and critical thinking. Megnin (1995) based his study on the principle that cooperative learning enhances students' memory and creativity Webb et al (1995) anchored their study on the principle that constructive activity and collaborated learning are enhanced in cooperative learning classroom.

The students in the cooperative learning classroom were found to exhibit better attitude towards the learning of Mathematics as measured by their attitude scores using an attitude scale. This seems to agree with the general notion that individual can change their attitude and disposition through interaction with others in one way or the others.

Conclusion

Results show that cooperative learning skills have a positive effect on students' overall interaction with each other leading to improvement in students overall understanding and problem solving. After analysis of MAT data, the results showed that the percentage increase made by the students. The findings also show that students performed better overall on their MAT; built stronger relationships with their classmates and enjoyed working in cooperative groups which lead to a stronger positive impression about Mathematics.

Recommendations

- Based on the conclusion, the researcher recommends that the study should be done with a larger group of participants in order to ensure that the findings are accurate.
- Seminar should be conducted for mathematics teachers on the benefit of group work and how to prepare students to work in groups.
- Experimental design with a control group and randomized assignments to treatment group should be used along with regression analysis to control for students differences.
- The researcher suggests that the use of cooperative learning groups in Junior Secondary School Mathematics class be part of the daily routine to provide more in-depth learning to take place for not only struggling students but all students within the Mathematics classroom.

References

Aluko, I. A. & Olorundare, P. A. (2011). Improving the teaching and learning of Mathematics in second cycle institutions in Ghana. ***Pakistan Journal of Social Science***, 4 (3), 340 – 344.

Ale, S. O. (2005). Mathematics improvement project: A way to enhance students' performance in Mathematics. ***Nigerian Journal of Professional Teachers***, 1 (1), 7 – 21.

Azuka, E.L.F. (2000). The challenges of Mathematics in Nigeria economic goals of vision 2010. ***A paper presented at the 34th Annual Conference of Mathematics Association of Nigeria***. Held at the College of Education, Zuba, Abuja.

Borich, G. D. (2004). ***Effective Teaching Methods***. New Jersey: Pearson McMillan Prentice Hall.

Bramleft, R. (1994). Implementing Cooperative Learning. A field study evaluating issues of school based consultant. ***Journal of School Psychology***, 32 (1), 67 – 74.

Chianson, M. M., Kurumeh, M. S. & Obida, J. A. (2011). Effect of cooperative learning strategy on students' retention in circle geometry in secondary schools in Benue State, Nigeria. ***American Journal of Scientific and Industrial Research.***2(1), 33-36

Co'kwu, E. I. & Orun, C. C. (2013). Junior secondary school certificate examination results as predictor of students' performance in Mathematics at the senior secondary school certificate examination in Benue State, Nigeria. ***Educational Research***, 4 (2), 130–133.

David G. & Roger J. (2001). An overview of cooperative learning. Retrieve from http://www.clerc.com/pages/overviewpaper.htm/

Eshun-Famiyeh, J. (2005). Early number competencies of children at the start of formal education. ***African Journal of Educational Studies in Mathematics and Sciences***, 3 (3), 21 – 31.

Johnson, D. W. & Johnson, R. T. (1990). Making cooperative learning work theory into practice, 38 (2), 67 – 73.

Johnson, D. W., Johnson, R. T. & Stane, C. (2000). Cooperative learning in middle schools interrelationship of relationships and achievement middle grades. ***Research Journal***, 5 (1), 1 – 18.

Keith, J. (2000). The student experience of mathematical proof at university level. ***International Journal of Mathematical Education in Science and Technology***, 31 (1), 53 – 60.

Keyser, M. W. (2000). Active learning and cooperative learning understanding the difference and using both styles effectively. Pg 34 – 44. Retrieve from: https//.www.sciencedirect.com>p.1

Kola, E. B., Ala, E.A.O. & Olatunji, O. A. (2014). Previous cognitive entry points as prediction of students' performance in SSCE Mathematics in some Nigeria secondary schools. ***Education Research***, 4 (1), 7 – 11.

Kolawole, E. B. (2008). Effects of competitive and cooperative learning strategies on academic performance of Nigerian students in mathematics. ***Educational Research and Review,*** 3(1), 33-37.

Lazarowitz, R., Hertz, L. & Baird, J. (1994). Learn science in a cooperative setting academic achievement and effect outcomes. ***Journal of Research in Science Teaching***, 31, 1121 – 1113.

Mbacho, N. W. & Githua, T. G. (2013). Effective of Jigsaw cooperative learning strategy on students. https//www.liste.orgs.article

Mergnin, J. (1995). Combining memory and creativity in teaching Mathematics. ***Teaching Prek***, 25 (6), 48 – 49.

Popoola, F. R. & Olarewaju, R. R. (2010). Factors responsible for the poor performance of students in Mathematics in Nigerian secondary schools. ***Journal of Research in Education and Society***, 1 (2 & 3).

Rue, R. (1998). Cooperative learning: Developments in research. ***International Journal of Educational Psychology***, 3 (2), 125 – 140. Retrieve from http://dx.do:org/10.17583/ijep.2014.1087.

Slavin, R. E. (1996). Research on cooperative learning and achievement on what we know, what we need to know. ***Contemporary Educational Psychology***, 21, 43 – 69.

Stevens, R. J. & Slavin, R. C. (1995). The cooperative elementary school effects on students achievement, attitude and social relations. ***American Educational Research Journal***, 32, 321 – 351.

Timayi, J. M. (2014). Repositioning education through the analysis of Mathematics anxiety among universal basic education teachers for access, quality and peaceful co-existence. ***A paper presented at the Annual Multi-cultural African Conference of the Faculty of Education, Ahmadu Bello University, Zaria***.

Usman, K. O. (2002). The need to retrain in service Mathematics teachers for attainment of the objectives of Universal Basic Education (UBE). ***A Journal of Mathematical Association of Nigeria (ABACUS)***, 27 (1), 37 – 44.

Webb, N., Trooper, J. & Fall, R. (1995). Constructive activity of learning in collaborative small groups. ***Journal of Educational Psychology***, 87 (34), 406 – 423.

Willis, J. (2010). Learning to love Mathematics: Teaching strategies that change students' attitudes and get results, USA, ASCD.

Woodard, T. (2004). The effect of Mathematics anxiety on post-secondary developmental students as related on achievement gender and inquiry. Retrieve from www.sc.e.pub.com

Zakaria, E. & Ikan, D. (2007). The effect of cooperative learning on students' Mathematics Achievement. Retrieve from http://thesc.pub.com