

**EFFECT OF COOPERATIVE LEARNING STRATEGY
ON STUDENTS LEARNING EXPERIENCE AND ACHIEVEMENTS IN
MATHEMATICS**

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ABSTRACT: *The study investigated the effects of traditional instruction, cooperative learning jigsaw II and cooperative learning Student Team Achievement Division (STAD) Models on students' learning experience and achievement in mathematics. The study analyzed differences in students' scores on learning experience and differences in mathematics Achievement under the three mentioned experimental conditions. One hundred and Twenty SS II students selected from ten Senior Secondary Schools in Etche and Omuma Local Government Areas of Rivers State using the proportionate stratified random sampling technique constituted the sample for the study. Repeated measures ANOVA design was used for the study. Thirty intervention lessons (ten in each condition) were delivered during the six months intensive class lessons. Learning experience measure and Achievement test in mathematics were administered at the end of each phase. The results of the repeated Measure Analysis of variance (ANOVA) showed significant differences between students scores on learning experience measure across three experimental conditions. Similarly the ANOVA results also reveal that there was a significant difference in achievement scores in favour of the cooperative learning conditions. Finally cooperative learning enabled learners to receive positive feedback from the process of thinking, enhances students' academic achievement better than the traditional instruction and promotes group interactive learning experience. It is therefore recommended among others that to encourage teachers who want to implement cooperative learning in their regular classroom lessons, workshops should be organized where the benefits of cooperative learning strategy will be showcased.*

KEYWORDS: cooperative learning, jigsaw II Model, STAD Model, Traditional instruction, learning experience measure, achievement.

INTRODUCTION

Teachers are discovering untapped resources for accelerating students' achievements by themselves. Due to the traditional teaching method in Nigeria which is examination oriented, the procedure for the teaching of mathematics is less flexible. The teaching in mathematics classrooms still emphasizes teacher centered, teacher-directed instructions, and teachers' still make use of the traditional teaching methods where there is little or no interaction between teachers and students. Subjects such as mathematics in which students think are abstract, ought to be taught with methods or strategies that will make students interact among themselves and teachers. The problems students encounter with topics in mathematics and failure that accompany them has been attributed to the teaching strategies used in teaching such topics. Slavin (1995) stated that traditional instructional approach causes competitive learning and individual performance in classroom teaching.

However, too much competition might bring negative interdependence and hence lower the teaching effects. Cooperative learning, a multifaceted strategy seems a preferred solution to the teaching problems of the traditional instruction. Acar & Tarhan (2007), Nichols, (2002) Johnson & Johnson (1991) and Slavin (1990) proved in their various studies that students in a cooperative learning class perform extremely better than those in a non cooperative learning class with respect to achievement.

Cooperative learning is the instructional use of small groups in such a way that student's work together to achieve shared goals. Johnson & Johnson (1999), defined cooperative learning as the instructional use of small groups so that students work together to maximize their own and each other's learning, Abrami Paulsen & Chambers (2004) defined cooperative learning (CL) as an instructional strategy in which students work actively and purposely together in small groups to enhance both their own and their teammates learning.

Johnson, Johnson & Stanne (2000) sees cooperative learning as one of the best studied pedagogical strategies in the history of educational research, with over 1,000 research studies and hence noted that cooperative learning have been demonstrated in countless studies and several meta-analyses. Cohen (1994) suggest that cooperative learning strategies contribute to the promotion of higher order thinking, socially acceptable behaviour, and interracial acceptance. Tanner & Marr (1997) have shown that cooperative learning model has significant effects on academic peer relationships and social development, importantly peer instruction significantly enhances mastery of the original material. Active learners help each other to comprehend and accomplish the task as well as put in more effort and criticize if necessary. However, group goals, rewards and equal chance are the main aims of cooperative learning model.

This form of teaching and learning strategy have been in practice in so many country's educational system and have yielded positive results in academic achievements of students generally. In a study conducted by Jolliffe (2005), he explored the implementation of cooperative (Student Team Assessment Division Model) in some selected schools in England and found that teachers in those schools were convinced of the effectiveness of cooperative learning regarding

its positive effects on academic achievement and development of social skills. Similarly Gomleksiz (2007) through an experimental study implored the effects of Jigsaw II method of cooperative learning on English as a foreign language and came to the conclusion that cooperative learning enhances students learning of vocabulary and use of active and passive voice in English. It also revealed that cooperative learning develops student's positive attitude towards learning English. Furthermore, for the small groups to work together successfully, a teacher has to compose five essential elements in each lesson thus; positive interdependence, face-to-face interaction, individual accountability, social skills, and group processing. Teachers use these five elements as guidelines in their teaching situations to improve teaching and learning effects in cooperative learning models. In cooperative learning, the teaching style is affected by cognitive theory unlike the traditional teaching style which is affected by behaviourists. The teacher conceives self as flexible, permissive, interested in stimulating discussion and seeing others grow, plays the role of a supporter, facilitator, observer, change agent and adviser (Robbins 1995, McDonnell, 1992). According to Chen (1999) the teacher's role is to arrange the students in heterogeneous groups, to provide students with proper materials, and to design structural systematic teaching strategy. A few studies, however, explored cooperative learning from different dimensions as it concerns teachers. Venman, Benthum, Bootsma, Duren & Kemp (2002) examined the attitude of prospective teachers regarding cooperative learning and its potential effect on them and found that prospective teachers had an overall positive attitude towards cooperative learning and had a significant effect on their pupils which increased the likelihood of its use by them in future. Despite the great positive effects of cooperative learning strategy, Siegel (2005) have argued that more research was needed to incorporate cooperative learning strategies into daily classroom lessons. Therefore the difficulties encountered by students in classroom teaching of mathematics by traditional instruction as regards their understanding and achievements in the subject prompted the need to explore and test innovative instructional strategies such as cooperative learning. Hence there was the need to determine the effect of cooperative learning strategy on student's learning experience and achievements in mathematics.

The study therefore investigated the effect of cooperative learning strategy on student's learning experience and achievement in mathematics. Specifically, the study aimed at determining:

1. The difference in learning experience of students under three learning conditions i.e. traditional instruction, Jigsaw II and Students Teams Achievement Division (STAD) CL Models.
2. The difference between students achievement scores under the three learning conditions.

Research Questions

The following research questions were formulated for the study.

- i. What is the difference in learning experience of students under three different learning conditions i.e, traditional instruction, Jigsaw II and students Teams Achievement Division (STAD) model of cooperative learning?
- ii. What Is the difference in students achievements scores under these three conditions?

Hypotheses

Two null hypotheses were tested at 0.05 level of significance to guide the study.

- i. There is no significant mean difference between the scores of students learning experience across the three conditions.
- ii. There is no significant mean difference between students achievement scores across all three conditions.

METHODS

Repeated measures ANOVA Design was used for the study where the same set of subjects participated in every treatment. The design involved three phases and all the students passed through these phases and filled in the learning experience measure thrice (one after each phase) and also wrote three achievement tests (one after each phase) relevant to the content covered at each phase. The population of the study consisted of all the SS II Students from ten Senior Secondary Schools in Etche and Omuma Local Government Areas of Rivers State. The sample for the study was 120 students selected using the proportionate stratified random sampling technique. In order to collect data regarding students learning experience and achievements, the researchers developed learning experience measure questionnaire designed to explore the learning experience of students under three learning conditions. The instrument which contained 20 statements on a 5 point scale was named LEM I, LEM 2 and LEM 3 for each phase respectively. The instruments were validated by 5 seasoned measurement and Evaluation experts and the reliability of the instrument at each phase was 0.76, 0.85 and 0.81 using cronbach alpha method. Similarly 30 achievement tests (MAT) each based on content covered in each phase, having the same format and scoring distribution were developed by the researchers. The research questions were answered using the mean and standard deviation while the hypotheses was tested using the repeated measures Analysis of variance (ANOVA) for both learning experience measures and achievements in mathematics respectively.

Procedures

The study was conducted on 120 SS II students in ten senior secondary schools. Cooperative learning strategy was introduced to the students. An intervention in the form of experimental conditions was spread over 30 class lessons over a period of six (6) months and delivered in three phases. The researchers who incidentally doubled as the teachers divided the course content into three parts to be covered in each phase.

Phase One: Traditional Instruction

In the first phase, 10 lessons were delivered, through traditional instruction. Here the teacher does the presentation and the students answers the questions during or after the session. During the lesson, the students remained passive in the class. In completion of the 10 lessons, the researchers (teachers) administered achievement test I. The learning experience measure I (LEM I) was also administered at the end of this phase. The students were asked to fill the questionnaire and rate their experience so as to recall their mind on their learning experience during the first ten lessons (traditional instruction).

Phase Two: Cooperative learning Jigsaw II. This phase saw the introduction of jigsaw II model of cooperative learning. All the five essential elements of cooperative learning were involved namely, positive interdependence, face-to-face interaction, individual accountability, social skills and group processing. These elements serves as important guidelines to improve teaching and learning effects. In this phase, the teacher assigned students to thirty heterogeneous groups on the basis of their performance in the first achievement test with each group having up to six members who were high, average or low achievers. Each member of the group is responsible for his or her section. After the teachers presentation, students from different groups meet in an expert group to discuss their section.

The experts later return to their original group and take turns teaching their team mates what they had learned. During the group work, the teacher worked as a facilitator and ensured that group members were incorporated in all the five elements of cooperative learning during the group work. At the end, students take examinations that cover all the topics, and the quiz scores become team scores.

The score that students contribute to their group are based on the individual improvement score. At the completion of this second phase, the students were administered achievement test II based on the content/topics covered in next 10 lessons (i.e. 11 to 20). The students were also administered learning experience measure 2 (LEM 2). This is to find out their feeling about the ten (10) lessons they attended during second phase.

Phase Three: Students Teams-Achievement Division (STAD) model of cooperative learning. In this phase, the teachers presentation which is in form of a lecture was followed by group work. Students master the material and discuss together to prepare for a quiz related to the lecture. After the group work, students take quizzes individually sitting in formal testing conditions. However in STAD, students were divided into 37 groups of 4 heterogeneous member teams. Each team's score will be the average score of the four team members. The score was therefore compared to members' previous scores. If a team's score meet or exceed certain criteria, members are given certificates or other rewards. Each certificate contained a team score and individual scores of team members. Thus, through reward structure, a sense of individual accountability and positive interdependence was developed. At the end of the third phase, students were administered achievement test based on the content of the last 10 lessons. The students were also administered learning experience measure 3 (LEM 3). This was to find how their experience were in the lesson received at the last phase.

RESULTS

Table I: The difference in learning experience of students under the traditional instruction, cooperative learning jigsaw II and cooperative learning STAD models.

Learning Conditions	N	$\bar{X}$	SD
Traditional Instruction	120	53.5	17.5
Cooperative Learning Jigsaw II model	120	60.3	21.8
Cooperative Learning STAD model	120	66.8	23.6

The table 1 revealed that student's mean and standard deviation on the traditional instruction are 53.5 and 17.5 while the cooperative learning models of jigsaw II and STAD are 60.3, 21.8 and 66.8, 23.6 respectively.

This shows that the students appreciated cooperative learning models than the traditional instruction in their learning experience measures.

Table 2:

Repeated Measures Anova showing the significant difference between the scores of students learning experience measures across the three conditions.

Source	SS	Df	Ms	F. ratio	F. Crif.
Between Treatment	120675	2	60338	62.8	3.02
Within Treatment	378370	357			
Between subjects	149672	119			
Error	228698	238	961		
Total	877415	710			

$P < 0.05$

The result from the table 2 shows that there is a significant difference between the scores of students learning experience measures across the traditional instruction, cooperative learning jigsaw II model and cooperative learning STAD model. The calculated F. ratio 62.8 (2,238) is greater than the F. Critical 3.02 at 0.05 level of significance. As the mean difference on learning experience measures was significant at $P < 0.05$, Scheffe Post Hoc test was conducted to determine the comparative effect of the different conditions on the learning experience measures of students. The scheffe (Post Hoc Test) Comparison revealed that there was a significant difference between student's scores on LEM I and LEM II. The post hoc test 3.96 is greater than 3.02 at $P < 0.05$. Thus students valued their learning experience in cooperative learning jigsaw II more compared to traditional instruction. The test also showed that there is a significant difference between their scores on LEM I and LEM III. The post hoc test 5.01 is greater than 3.02, Favouring the third condition which again shows that students also appreciated the CL STAD model more than the traditional instruction. However the post hoc comparison between LEM II and LEM III showed that there is no significant difference between the students scores on LEM II and LEM III the test 1.19 is less than 3.02. This showed that students appreciated the structural learning under cooperative learning models of jigsaw II and STAD respectively.

Table 3: The difference in students Achievement scores under traditional instruction, CL Jigsaw II and CL STAD models

LEARNING CONDITION	N	$\bar{X}$	SD
Traditional Instruction	120	55.9	19.3
Cooperative Learning Jigsaw II model	120	73.9	24.6
Cooperative Learning STAD model	120	75.0	26.8

The table 3 shows the mean and the standard deviation of the students' achievement scores administered under three experimental conditions respectively. Traditional instruction has the mean and standard deviation of 55.9 and 19.3 while cooperative learning jigsaw II and STAD model has the mean and standard deviations of 73.9, 24.6 and 75.0 , 26.8 respectively. This again revealed that students had higher scores when taught with cooperative learning models than the traditional instruction.

Table 4: repeated measures Anova showing the significant difference in students achievement cores across all three conditions

Source	SS	df	Ms	F. ratio	F. Crit.
Between Treatment	153894	2	76947	75.1	3.02
Within Treatment	428736	357			
Between subjects	184872	119			
Error	243864	238	1025		
Total	1011366	716			

P < 0.05

The table 4 revealed that there is a significant difference between the achievement scores of the students across the three conditions, traditional instruction, CL Jigsaw II and CL STAD models. From the result, the calculated F. ratio 75.1 (2,238) is greater than the F-crit. 3.02. This shows that hypothesis 2 is rejected at 0.05 level of significance. Furthermore, because a significant difference exist on students achievement scores across the three conditions, a scheffe Post hoc test was again conducted. The post hoc test revealed that there is a significant difference between Achievement test I and Achievement test 2 since post hoc test 8.02 is greater than 3.02. Achievement test I and Achievement test III shows a significant difference between achievement test I and Achievement III since pos hoc test 9.04 is greater than 3.02. Finally the post hoc test between Achievement test II and Achievement test III showed that there is no significant mean difference between the two conditions since post hoc test 0.03 is less than 3.02. This is based on the fact that the students scored high marks in the achievement tests conducted under the two cooperative learning jigsaw II and STAD models.

DISCUSSION

The results of the study revealed the significance of cooperative learning in bringing a major change in the existing traditional method of instruction. Based on the findings of the study, cooperative learning is both an enjoyable and effective teaching strategy and result in significantly higher learning gains and positive learning experience compared to traditional instruction. It provided the students opportunity to interact with their classmates and such interaction develops in them feelings of cooperation and care for others.

The results of the present study are in line with the previous studies by Slavin (1996), Tanner and Marr, (1997) whose studies showed that cooperative learning models has a significant effect on academic achievement of students. The findings of the present study are also in agreement with the findings of the study by Chiason, Okwu & Kurumeh (2010) who found a high, level of achievement difference between students taught circle geometry using cooperative learning strategy and conventional learning strategy. The result of the present study is also in line with the previous studies of Akinbobola (2006) whose study revealed that students taught using the cooperative learning method performed better than those taught using the conventional method. Furthermore, cooperative learning model enables learners to receive positive feedback from the process of thinking, problem solving and group interaction, hence this results in better skills and comprehension of the educational concepts as well as in task sharing.

Recommendations

1. An encouragement in the form of workshops should be organized on cooperative learning strategy for teachers who want to implement CL in their regular classroom lessons.
2. More research studies should be conducted to test the usability and effectiveness of other CL models.
3. The traditional instruction should not get rid of radically, rather wise use and suitable time should be taken to gradually replace it by cooperative learning.
4. Teachers who are willing to implement this strategy should be prepared, patient, skillful, perseverant, and flexible so as to practice to reach teaching goals in current society.

REFERENCES

- Abrami, P.C. & Chambers, B. (2004). Teacher Motivation to implement an educational innovation: Factors differentiating users and non-users of cooperative learning *Educational psychology*, 24, 201-216.
- Acar, B. & Tarhan, L. (2007). Effects of cooperative learning on students' understanding of metallic Bonding. *Journal of Research in Education*.

- Akinbobola, A.O. (2006). Effects of cooperative and Competitive learning strategies on Academic Performance of students in physics. *Journal Research in Education*, 3(1), 1-5.
- Chen, H.C. (1999). A Comparison between Cooperative Learning and Traditional Whole Class Methods – Teaching English in a Junior College. *Academic Journal of Kang-Ning*. 3, 60-90
- Chiasom, M.M, Okwu, I.E. & Kunemeh, M.S. (2010). Effect of Cooperative Learning Strategy on Student Achievement in Geometry in Secondary Schools in Benue State. *Journal of Mathematical Sciences Education*, (G), 115-122.
- Cohen, E.G. (1994). Restructuring the classroom Conditions for Productive small groups. *Review of Educational Research*, 64 (1) , 01-35.
- Gomleksiz, M.N. (2007). Effectiveness of cooperative Learning (Jigsaw II) Method in teaching English as a foreign language to engineering students (case of Firat University, Turkey). *European Journal of Engineering Education*, 32(5), 613-625.
- Johnson, D.W, & Johnson R.T. (1999). Learning together and alone: Cooperative competitive, and individualistic learning (5th ed.). Englewood Cliffs, NJ: Prentice – hall.
- Johnson, D.W; & Johnson, R.T. (1991). Learning together and alone: Cooperative Competitive and Individualistic. Third Edition. Englewood Cliffs, NJ: Prentice Hall
- Johnson, D.E, Johnson, R.T., & Stanne, M.E. (2000). Cooperative learning methods: Meta-analysis, Minneapolis, MN: Univer of Minnesota Press.
- Jolliffe, W. (2005). The Implementation of cooperative learning in the classroom. Paper Presented at the British Educational Research Association Annual Conference, University of Gloamorgan, 14-17 September 2005. Retrieved <http://www.leeds.ac.uk/educol/documents/143432.htm> on 22-03-2014.
- McAonell, W. (1992). The Role of the teacher in the cooperative learning classroom. In C. Kessler (Ed., Cooperative language learning: A Teachers Resource Book (163-174). Englewood Cliffs, NJ: Prentice Hall.
- Robbinson, R.D. (1995). Helping adults learn and change. Wisconsin: Omnibook Co.
- Siegel, C. (2005). An Ethnographic enquiry of cooperative learning implementation. *Journal of School Psychology* 43, 219-239.
- Slavin, R.E. (1996). Research on cooperative learning and achievement: What we know, what we need to know *Contemporary Educational Psychology*, 21, 43-69.
- Slavin, R.E. (1995). Cooperative learning: Theory research and practice. 2nd edition Boston: Allyn and Bacon.
- Tanner, K. & Marr, M.B. (1997). Cooperative learning: Brief Review. *Reading and Writing Quarterly: Overcoming Learning Difficulties* 13: 7-20.
- Slavin, R.E. (1990). Cooperative learning: Theory research and practice. Boston: Allyn & Bacon
- Veenman, S, Benthum, N.V, Bootsma, D. Dieren, J.V. & Kemp, N.V.D (2002). Cooperative learning and teacher education. *Teaching and Teacher Education*, 18 87-103.