



EFFECT OF JIGSAW STRATEGY OF COOPERATIVE LEARNING ON MATHEMATICS ACHIEVEMENT AMONG SECONDARY SCHOOL STUDENTS

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Abstract:

The aim of this paper was to investigate the effects of Jigsaw cooperative learning on students' academic achievement of first year senior secondary school (SS 1) students in Nigeria. The sample of this study consisted of 80 SS1 students. The study was carried out in two groups. One of the groups was randomly assigned to the Jigsaw strategy group, and the second group was assigned to the control group, in which the traditional teaching method (Lecture) was applied. The data collected were analyzed using descriptive statistics. The results of the findings indicated that the teaching of mathematics via the Jigsaw strategy was more effective than the traditional teaching method in increasing academic achievement. Additionally, it was further inferred that Jigsaw method increases positive attitudes toward learning the subject.

Keywords: jigsaw strategy, attitude toward learning mathematics, traditional teaching method, cooperative learning

1. Introduction

One of the major objectives of education is not only to transmit knowledge but to increase student ability of obtaining knowledge actively and help them to become independent learner. Therefore, learning how to learn independently is very important than spoon feed learning. The existing system of teaching mathematics in Nigeria is still followed the traditional method, where students learn mathematics concepts by heart just to pass examinations. These situations posed serious problems in the students' final

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year results at the end. Reys (2010) & Ariyana (2013) observed that unconventional teaching methods have among other factors been responsible for the low performance exhibited by the students in mathematics. This study aims to provide a practical way to assist students learn better. This predicament could be overcome using a cooperative learning strategy which has been identified as one of the ways teachers may apply to increase academic achievement and ensure active learning among students (Narzoles, 2015). Many studies have been conducted and conclusions have shown that cooperative learning strategy is a helpful instructional strategy which promotes students' learning achievement (Johnson & Johnson, 1989; Tran 2014; Slavin, & Farnish, 1991; Maden, 2011; Zakaria, 2013; Mevarech, 2016; & Van Dat, 2016).

Cooperative learning strategies involves grouping students into small mixed ability learning groups. It is premised on the fact that students work together cooperatively and interdependently in small groups (Abrami, Poulsen & Chambers, 2004; O'Leary and Griggs, 2010; Slavin, 2011; Farzad, 2015). There are several types of cooperative learning strategies. These include Students Teams – Achievement Division (STAD), Team-Games-Tournaments (TGT), Jigsaw Method, Team Accelerated Instruction (TAI), Group Investigation (GI), Team Assisted Individualization (TAI), Cooperative Learning and Teaching Scripts (CLTS), Cooperative Integrated Reading and Composition (CIRC), Cooperative Learning Structures, and Complex Instruction Maddinabeita (2006). Of all these, studies indicate that the use of Jigsaw strategy increases positive educational outcomes and reduces racial conflict (Mengduo & Xiaoling 2010; Sahin, 2010; Marhamah & Mulyadi 2013; Adams, 2013; Al-Salkhi, 2015; & Azmin, 2016). It is based on the relevance of the Jigsaw strategy that the present study is premised.

2. Research Findings Related to Cooperative Learning (Jigsaw) Strategy

Several studies investigated the effects of Jigsaw strategy of cooperative learning on students' achievement and found that Jigsaw method increase students' performance and learning retention. Sahin (2010) in his study which lasted for six weeks investigated the effects of Jigsaw Strategy. The study used a Pre-test and Post-test design. Results from the t-tests indicated that students in the Jigsaw Group outscored on the achievement test ($p < .001$) those in the traditional lecture-based learning group ($ES = 0.86$). The Jigsaw Group also had greater long-term achievement on the delay test ($p < .05$) than those in the Control Group ($ES = 0.69$). This confirms, to some extent the findings of Huang (2013) which conducted a study on Jigsaw Based Cooperative Learning approach to improve learning outcomes for mobile situated learning using experimental design Pre-test - Post-test. The results showed that the Jigsaw method of Cooperative Learning improved the students' learning attitudes and improved the efficiency of learning.

A similar study was undertaken by Temesgen & Enunuwe (2016). The research was also based on Jigsaw Cooperative Learning teaching style on students' achievement in organic chemistry. The study used 51 students in the intervention group and 54

students in the Control Group. The results indicated that there was statically significantly difference between intervention and control groups with the two sample t-test at $P < 0.05$ taken on the quiz and post-test achievement scores of students. The intervention group students performed better than those in the Control Groups. The results also showed that the responses to the questionnaires gathered from the intervention group in terms of Cooperative Learning was effective as they exhibited a deep understanding of chemistry concepts as they worked together in their groups. In a related study, Meng (2010) examined Jigsaw Cooperative Learning in English reading. The study comprised 146 freshmen students' majority in Arts in two different classes of Grade One. The results revealed that Cooperative Learning was more effective than Traditional Approaches in teaching reading. Similarly, Gambari, & Yusuf (2014) conducted a research on effectiveness of Computer-Supported Jigsaw 11 Cooperative Learning Strategy on the performance of senior secondary school student in Physics. The study reported that students taught physics using Computer-Supported Jigsaw 11 performed better than those who used Individualized Computer Instructions. Also, the results indicated that students who used Jigsaw 11 Cooperative Learning Strategy had positive attitudes to physics than those taught with Individualized Computer Instructions. However, students' gender had no influence on their performance. Van Dat (2016) studied the effects of Jigsaw Learning on students' knowledge retention in Vietnamese higher education. The result indicated that students in the Cooperative Jigsaw Group appreciated most working with others as they got help, discussed and shared information, taught others, and enjoyed the Jigsaw context. The findings of the study revealed that students in Jigsaw Group had greater long-term achievement than those who got theirs through lecture group. However, students in both groups had a similar percentage of knowledge retention on the delay test of achievement.

Chu (2014) conducted a research on application of the Jigsaw cooperative method in Economics course. The results of the study indicate that jigsaw cooperative learning method benefits students' academic achievement and knowledge retention in terms of the increase in mean scores and the decrease in standard deviation of scores.

3. Research Objectives

- The objective of the study is to investigate the effects of Jigsaw Strategy Cooperative Learning on Mathematics Classes in Nigerian Secondary Schools. Specifically,
- To determine the significant difference between the Pre-test and Post-test mathematics scores of the Treatment and Control Groups

3.1 Research Questions

- What are the significant differences between the Pre-test and Post-test mathematics scores of the Treatment and Control Groups?

3.2 Research Hypothesis

The study tests the following hypotheses;

HO₁: There are no significant differences between the pre-test and post-test mathematics scores of the Treatment and Control Groups.

3.3 Significance of the Study

The finding of this study will prepare students to learn to trust one another, listen with care, empathy, and disagree respectfully and us feedback of the opposing view to refine their ideas, and beliefs over certain propositions. Additionally, the study is very significant because it provides useful suggestions that enable parents, teachers and stakeholders for effective teaching and learning of mathematics in Nigerian secondary schools.

4. Research Design

The study employed the used of Quasi-experimental design. The design was selected since it was imperative that the students' class arrangement will not be interrupted.

4.1 Population/ Sample

The study used the population of 5,901, first year senior secondary one (SS 1) students in Gombe State – Nigeria. However, because of the huge size of the population, the researcher chooses sample comprises of 80 SS 1 students 33 males and 47 females and their average age of 15 years. A number of 40 students (23 males and 17 females) was identified as Treatment Group, while, 40 students (24 males and 16 females) were considered as a Control Group.

Group	Male	Female	Total
Treatment	23	17	40
Control	24	16	40
Total	47	33	80

4.2 Procedure for Conducting Treatment Group

In conducting the Treatment Group, the assigned teachers applied the Jigsaw Technique by implementing as shown below.

- Step 1: The objectives of the subject matter were clearly identified to the students.
- Step 2: The learning materials (Module, Worksheet & Score sheet) were distributed to each of the students.
- Step 3: The students were divided into ten heterogeneous groups (home groups) of four students each and eight Jigsaws expert groups of five students were formed from the ten home groups. Students (A1, A2, A3, and A4) composed one of the home groups, and students (A1, B1, C1, D1, and E1) comprised one of the Jigsaw expert groups.

- Step 4: The teacher explained how the entire unit is structured and organized. The Jigsaw Strategy Module content comprised four units, each unit was divided into different sub-units, and each sub-unit was assigned to each member of home group to study. Each student studied the task assigned so as to become acquainted with the procedure of the learning materials.
- Step 5: When the students in the home groups understood the learning structure, they were asked to move to new group called expert groups. The expert members brainstormed and learned the task by understanding the content materials. They rehearsed on how to convey the information learned to their home group members. While in the expert group, the assigned teacher asked the students to help one another to learn the task assigned to them. While the observer is monitoring the activities in the classroom.
- Step 6: After students in the expert groups learned assigned task, they were asked to return to their home groups to teach their members what they have learnt in the expert groups.
- Step 7: After the students understood the entire unit, they were asked to do the self-assessment questions independently. The whole process was repeated for each unit. The treatment group and control group used the same instructional material throughout the treatment period.
- Step 8: At the end of the three self-assessments (formative test), the students were asked to write post-test together with their counterparts in the Control Group.

4.3 Analysis and Interpretation of Data

The mean Pre-test and Post-test scores of Treatment Group and Control Group were presented in the Table below;

Descriptive Variables = Pre-test, Post-test

Table 1: Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Pre-test	80	10.0	47.0	27.338	10.1057
Post-test	80	17.0	73.0	39.000	13.7085
Valid N (list wise)	80				

Means

Table 2: Case Processing Summary

	Cases					
	Included		Excluded		Total	
	N	Percent	N	Percent	N	Percent
Pre-test * Group	80	100.0%	0	0.0%	80	100.0%
Post-test * Group	80	100.0%	0	0.0%	80	100.0%

Group		Pre-test	Post test
1.0	Mean	27.825	40.075
	N	40	40
	Std. Deviation	9.9380	14.8002
2.0	Mean	26.850	37.925
	N	40	40
	Std. Deviation	10.3739	12.6195
Total	Mean	27.338	39.000
	N	80	80
	Std. Deviation	10.1057	13.7085

Jigsaw Strategy mean scores was ($X=27.825$, $SD = 9.94$) and (26.850 , $SD = 10.334$) went for Control Group had in the pre-test. It was observed that mean scores of the Jigsaw Strategy which was implemented in the Treatment Group was higher than the Control group. This indicated that the students in the Treatment Group one had achieved more than their counterparts in the other two groups. Also, when the post-test results were examined, it was observed that the Group, in which the Jigsaw strategy (JS) was implemented and the evidence had shown that the mean scores of ($X=40.075$, $SD = 14.80$) was apparent; the Control Group had ($X=37.925$, $SD = 12.62$). These analyses showed that the Jigsaw strategy of Cooperative Learning had higher mean scores than the Control Groups which indicated that JS had been more effective than its counterpart in the post-test.

4.4 Hypothesis

HO₁: There are no significant differences between the pre-test and post-test mathematics scores of the Treatment and Control Groups

Table 4: Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Pre-test	27.3375	80	10.10570	1.12985
	Post test	39.0000	80	13.70854	1.53266

Table 5: Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	Pre-test & Post test	80	.090	.429

Table 6: Paired Samples Test

Paired Differences		95% Confidence Interval of the Difference					T	Df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper			
Pair 1	Pre-test - Post-test	-11.66	16.285	1.820	-15.28	-8.038	-6.40	79	.000

Table 4 above shows the comparison analysis of two sample t-test that was performed between the two groups of students on pretest and posttest and the results indicate that there is statistical difference between the two groups of students in the pretest and posttest ($p < 0.05$). These results revealed that the Treatment Group scored better achievement than Control Group students.

5. Discussion

In this study, the students who learned under Jigsaw strategy of cooperative learning had greater mathematics achievement than did those taught by traditional method of teaching. The results also indicate that students in Jigsaw group had higher participation in the process of learning than students in the comparison group because of the principles of Jigsaw strategy where students in the treatment group are required to read and learn the learning materials, to move from home groups to expert groups to assist each other to learn their assigned task, and go back to the other teammates what they learned in the expert groups. Consequently, students' personal involvement in the learning process contributed to their gain mathematics achievement, by exchanging and sharing ideas also enhancing skills, since every student was responsible for a small part of the learning material and had to learn and teach it to the other members. By talking and discussing with others, the content materials is no longer an item to be memorized and too abstract, most students mentioned that the preparation and presentation were both challenging and relevant, leading to higher participation among the group members in the questions and answers sessions, apart from helping them to understand the topic better.

Another skill that was derived from this study was that students felt comfortable to get clarification from their peers on content that was blurred. This result agrees with the teachers' comment that students contributing in the discussion on the subtopics in Jigsaw strategy form. This means that the classroom ambience during the treatment is no longer threatening that students are able to contribute to their group members.

Furthermore, results indicate that there is difference in the mean scores and standard deviations of the treatment and control groups on the pretest and posttest. This finding validates the results of some earlier studies (Sahin, 2010; Chu, 2014; Temesgen & Enunuwe, 2016) that indicate that cooperative learning results in achievement greater than the traditional teaching method.

6. Conclusion

From the comparative analysis between the Treatment Groups and Control Group on the pre-test and post-test, it was observed that before the treatment, the pretest mean scores and the standard deviation of scores of the control and treatment groups are close to each other (Gap is not much). However, after the treatment is conducted students from the treatment groups showed better achievement than those who have learned with lecture method. Similarly, the qualitative analysis of data gathered from

students through students' inventory scale, checklist and interview indicated that the treatment groups helped the students to solve problems in mathematics together which improved their achievements as well as communication and social relations.

The results also revealed that cooperative learning (Jigsaw) strategy had increased mathematics achievements, fostered interest of students in mathematics learning, enhanced understanding and self-confidence. However, this study has some limitations. The treatment was conducted in a single school. Therefore, it is important to confirm the external validity of the findings of this study by conducting large-scale treatment. Secondly, this study evaluated the learning outcomes of the students using objective multiple-choice items. Therefore, the form of assessment such as essay items should be used to evaluate the learning outcomes of the students.

The learning outcomes of this study were evaluated immediately after the completion of the treatment. Therefore, it was impossible to find out whether the learning increased report in this study. To address this, there is the need to conduct a research on a comparison of the level of knowledge retention, between treatment groups and control group in feature. The results imply that incorporating cooperative learning in the mathematics in Nigerian secondary schools is vital.

To promote the implementation of Jigsaw strategy of cooperative learning effectively, Mathematics teachers should attend seminars, workshops and conferences that Jigsaw strategy of cooperative learning approach form part of their main themes, also teachers of mathematics should use Jigsaw learning method in teaching mathematics in order to enhance positive attitude to improve the academic achievement of the student in secondary schools.

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