



Effect of Jigsaw II Cooperative Learning Strategy on Senior Secondary School Students' Academic Achievement in Algebra in Gombe State, Nigeria

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Abstract

This study examined the effect of jigsaw II cooperative learning strategy on senior secondary school students' academic achievement in algebra in Gombe State, Nigeria. The study adopted the pre-test, post-test, quasi-experimental and control group design. A sample of 146 students using multistage sampling procedure was drawn from four schools and was later divided into two groups; experimental group and the control group. The instrument used for the study is Algebraic Achievement Test (AAT). It was validated by experts in mathematics education and a reliability index of 0.78 was obtained using Kuder Richardson 20 (KR_{20}). The study revealed that students in the experimental group achieved significantly higher mean score than students in the control group in academic achievement in mathematics $F = 40.78(df, 1, 45), P = 0.00$. However, the finding on gender revealed that there is no statistical significant difference in the achievement scores of male and female students taught using jigsaw II learning strategy $F = 0.07(df, 1, 75), P = 0.94$. Based on the findings of the study, it was recommended that mathematics teachers should encourage jigsaw II learning strategy among students during mathematics lessons since it improved their academic achievement.

Keywords: Jigsaw II Cooperative Learning Strategy, Academic Achievement, Algebra, Gender

Introduction

Mathematics education which includes the practice of teaching and learning mathematics has consistently generated interest among scholars over the years. This is because of its importance which affects every facet of human activity such as: politics, economy, science and technology (Kadala, 2014). Most technological developments today in Nigeria owe their origin to scientific discoveries and the bedrock for scientific discoveries is mathematics (Iji, 2008). It is the importance of mathematics that compelled the Federal Government of Nigeria to make mathematics a compulsory subject at the primary and secondary levels of education and consequently a necessary requirement for admission into the Nigerian universities (Aburume, 2008; Matthew & Kenneth, 2013). Despite the importance of Mathematics as a tool for societal and national development, Nigerian secondary schools are bedevilled by incessant poor achievement among the students (Unodiaku, 2011). In fact, the problems of teaching and learning of mathematics in secondary schools have continued to be topical and worrisome issues to mathematics teachers, researchers, parents and examiners. It is common knowledge that many students do not assimilate the mathematical concepts taught in schools and so engage in examination malpractice to pass the subject. This has been attributed to the way the subject is taught. Oloruntegbe and Omoifo

(2008) asserted that the success of teaching depends on the method of teaching adopted by the teachers.

In line with the assertion of Oloruntegbe and Omoifo(2008) and the incessant poor performance of students in mathematics, this study tested the effect of jigsaw II cooperative teaching strategy on students' achievement in algebra. Algebra is one of the broad parts of mathematics that deals with the study of mathematical symbols or letters and the rules for manipulating these symbols. According to Adeniji and Ibrahim, (2015), algebra is a branch of mathematics that used letters in place of numbers. The poor performance of students in mathematics and particularly in algebra at the senior secondary school certificate examination in Nigeria has been a major concern to mathematics educators and other stakeholders in education.

There are several improved methods of teaching algebra and mathematics in general such as discovery method, inquiry method, problem solving, individualized teaching strategy, and Jigsaw cooperative teaching strategy. In this study, jigsaw cooperative teaching strategy is the focus. Jigsaw is a cooperative teaching technique which was developed by Elliot Aronson and his colleagues in 1978. The jigsaw technique was created with the goals of reducing conflict, enhancing positive educational outcomes and to help students realize they are essential components of a whole and encourages cooperation in a

learning environment. There are currently five types of Jigsaw cooperative teaching strategies available for teachers to use in the classroom as pointed out by (Jansoon, Somsook&Coll 2008) and Bolaji, Kajuru, Timayi (2015); They are: Jigsaw I, Jigsaw II, Jigsaw III, Jigsaw IV, Reversed Jigsaw, and Subject Jigsaw. Jigsaw II teaching strategy was used in this study. Jigsaw II cooperative teaching strategy was developed by Robert Slavin in 1987. It is an instructional strategy in which small equal groups, each with different ability levels, use variety of learning activities to improve their understanding of a lesson or concept. The process encourages students to listen and be engaged in a group setting. Just like a jigsaw puzzle, each member of the group plays an essential role in their groups. This strategy is effective because group member work together as a team to achieve a common goal which is to solve a problem. Members of the group are not able to succeed unless everyone works together as discovered by (Chan, 2004). In this strategy, each student is a member of two groups (jigsaw or home group and an expert group). In the jigsaw or home group, students are assigned separate portions of the material to be learnt. Each member in the home group is asked to focus on practising one portion of the material. Upon finishing, students who practice the same portion of the material come together to form an expert group to discuss their assigned portion. After the discussion, group members go back to their home group to teach what they have learnt in their expert group to other members.

After mastering all the sub-topics taught by each expert, individual group members take a short quiz. Individual score is then compared with the base score to calculate the individual improvement score, based on which a group average improvement score is worked out. The group having the highest average group improvement score is given group recognition by getting a group reward. Each member then learns and helps his mates to learn since the success of a group member is the success of all members. Therefore, jigsaw cooperative learning strategy is a strategy which makes learning and working together a way of life among students. It is better than the conventional method. One of the conventional methods which this research is interested in comparing with jigsaw II cooperative learning is the lecture method. The lecture method is one of the oldest methods of teaching used in the secondary schools. Lecture method is a method of teaching in which the instructor gives an oral presentation of facts, steps, strategies or principles to learners and the class

usually respond by taking note with little or no interaction. This feature tends to inhibit development of students' intuition, imagination and creative abilities (Anyichie & Onyedike, 2012). The direction of communication is always from teacher to student, which presents the teacher as the focal point of discussion and dispenser of knowledge (Ali, Hukumdad & Khan 2010). Ifeakor (2005) and Okeke (2011); Saleh and Subramaniam (2017) noted that the use of inappropriate teacher centred strategies like lecture method accounts for the gradual poor performance of students in science and mathematics. This by implication can lead to poor academic achievement in mathematics in external examinations.

Academic achievement refers to the learning outcomes that show the level to which a student has completed specific goals that were the focus of activities in an instructional environment such as school. Along this view, Ali (2013) defined academic achievement as a measure of the degree of success in performing specific tasks in a subject or area of study by the students after a learning experience. Also Tenty and Awe (2011) defined academic achievement as the gain in knowledge of students as a result of taking part in a learning activity or program.

Low level of academic achievement in mathematics is caused by teachers' non-utilization of the appropriate teaching methods (Fasasi, 2015). Also Eniayeju and Azuka (2010) lamented that statistics from West African Examination Council (WAEC) indicated that from 2000 – 2009, showed that less than 40% of Nigerian students obtained credit pass in mathematics in each of the 10 years in SSCE. Apart from teaching method, another variable that can influence students' academic achievement is gender. Umoru (2016) corroborated this assertion by explaining that gender is the ascribed attributes that differentiate feminine from masculine. There is a general belief in Nigeria that males are superior to female in terms of physical fitness, cognition, logical reasoning and even academic achievement. Hence this study investigated whether this argument is true or not by using jigsaw II teaching strategy in senior secondary school in mathematics class. Also another question bothering the mind of stakeholders is "Could poor academic achievement of students in mathematics be as a result of instructional strategies used in teaching by their teachers? Hence, this study was embarked upon to see if Jigsaw II cooperative teaching strategy could improve students' academic achievement in mathematics particularly Algebra in Gombe state.

Purpose of the Study

The purpose of the study is to investigate the effect of jigsaw II cooperative teaching strategy on Senior Secondary School Students’ academic achievement in Algebra in Gombe State. The specific objectives of the study are listed below:

1. to determine the effect of jigsaw II co-operative learning strategy and lecture method on academic achievement in algebra among SS II students in Gombe state.
2. to compare the effect of jigsaw II co-operative learning strategy on academic achievement of male and female SS II students in algebra in Gombe state.

Research Questions

In order to achieve the objectives of the study, the following research questions were raised to guide the direction of the study:

1. What is the mean difference between achievement scores of Senior Secondary School Students (SS II) taught algebra using jigsaw II co-operative learning strategy and those taught with the lecture method?
2. What is the mean difference between achievement scores of male and female Senior Secondary School Students (SS II) when taught algebra using jigsaw II co-operative learning strategy?

Hypotheses

The following null hypotheses were formulated and tested at 0.05 level of significance:

- H0₁:** There is no significant difference between the mean achievement scores of Senior Secondary School Students (SS II) taught algebra using jigsaw II co-operative learning strategy and those taught using the lecture method.
- H0₂:** There is no significant difference between the mean achievement scores of male and female Senior Secondary School Students (SS II) taught Algebra using jigsaw II co-operative learning strategy.

Methodology

This study employed a pretest-posttest, nonrandomized quasi-experimental design which involved a treatment and a control group. This design was used because there was no randomization of subject, instead intact classes were used. A multi-stage sampling procedure was used to draw 146 out of 17,939 students for the study from four schools. In the four schools selected for the study, two SS II intact classes in two of the schools were selected and exposed to jigsaw II teaching strategy which was referred to as the experimental group. The jigsaw II strategy was strictly followed during lesson presentations in which the students were guided on the use of cooperative learning procedure, and how to form the home and expert groups. The other two SS II intact classes were exposed to lecture method and are referred to as the control group. The instrument used for data collection is the Algebra Achievement Test (AAT). It was validated by three experts, two from Faculty of Education and another staff from Faculty of Science, Mathematics Department all validators are from Modibbo Adama University, Yola. The AAT consisted of 50 multiple choice items with options A-D developed from WAEC past questions (2010 to 2019). The internal consistency of Algebraic Achievement Test (AAT) was determined to be 0.78 using Kuder-Richardson’s formula-20 (KR₂₀).

Furthermore, the researcher prepared two different sets of lesson plans that were used in teaching during the study. One set of lesson plans is based on Jigsaw II cooperative learning strategy which was used for experimental group and the other set is based on lecture method which was used for the control group. The sets of the lesson plan prepared were used by the four research assistants who participated in the four schools selected for the study.

Data collected were analysed using mean and standard deviation to answer research questions and Analysis of Covariance was used to test the null hypotheses at 0.05 level of significance.

Results

Table 1: Mean and Standard Deviation of Pretest and Post Test Scores of Students Taught using Jigsaw II Cooperative Learning Strategy and those Taught using the Lecture Method in Algebra.

Teaching Strategy	n	Pre-test Mean		Post-test Mean		Mean Gain
		Score	SD	score	SD	
Jigsaw II	76	27.00	6.54	62.21	14.12	35.21
Lecture	70	29.74	6.21	46.69	13.93	16.95



Mean Difference	2.74	15.52	18.26
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Table 1 revealed that, jigsaw II co-operative learning strategy group with 76 students has a pre-test mean score of 27.00 and standard deviation of 6.54. While in the posttest jigsaw II co-operative learning strategy has the highest mean score of 62.21 with a standard deviation of 14.12. Lecture method group has 70 students with a mean score of

29.74 and standard deviation of 6.21 at pre-test level and mean score of 46.69 with standard deviation of 13.93 at post-test level. In summary, the mean gain between pre-test and post-test is higher in (jigsaw II co-operative learning strategy more than lecture method).

Table 2: Descriptive Statistics of Pretest and Posttest Scores of Male and Female Students when Taught Algebra using Jigsaw II Co-operative Learning Strategy.

Gender	N	Pre-test Mean		Post-test Mean		Mean Gain
		Score	SD	Score	SD	
Male	33	27.03	7.62	62.06	13.92	35.03
Female	43	27.00	6.52	62.33	14.43	35.33
Mean Difference		0.03		0.27		0.30

The descriptive statistics in Table 2 shows that, jigsaw II co-operative learning strategy group based on gender with 33 male and 43 female students, the male have pre-test mean score of 27.03 and standard deviation of 7.62. In the post-test male have the mean score of 62.06 with a standard

deviation of 13.92. Female group has 43 students with a mean score of 27.00 and standard deviation of 6.54 at pre-test level and mean score of 62.33 with standard deviation of 14.43 at post-test level. In summary, the mean gain of male and female students after post-test is almost the same.

Table 4: ANCOVA of Mean Achievement Scores of Students' Taught Algebra Using Jigsaw II Co-operative Learning Strategy and Those Taught using the Lecture Method

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	8855.532 ^a	2	4427.766	22.394	.000
Intercept	23073.325	1	23073.325	116.695	.000
PRETEST	73.168	1	73.168	.370	.544
TEACHMETHOD	8063.254	1	8063.254	40.780	.000
Error	28274.550	143	197.724		
Total	475048.000	146			
Corrected Total	37130.082	145			

a. R Squared = .239 (Adjusted R Squared = .228)

The results of the analysis in Table 4 shows that, there is significant difference of teaching strategies on students' academic achievement after post-test $F = 40.78$ (df 1, 145), $P = 0.00$. Since the computed p-value (0.00) is less than 0.05 level of significant,

therefore, the null hypothesis of no significant effect is rejected, which means there is significant effect of teaching strategies on students' academic achievement in algebra in favour of jigsaw II cooperative strategy.

Table 5: ANCOVA Summary of Students Mean Achievement when Taught Algebra using Jigsaw II Co-operative Learning Strategy Based on Gender

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	27.182 ^a	2	13.591	.066	.936
Intercept	14859.375	1	14859.375	72.657	.000
PRETESTS	25.871	1	25.871	.127	.723
GENDER	1.359	1	1.359	.007	.935
Error	14929.450	73	204.513		
Total	309088.000	76			
Corrected Total	14956.632	75			

a. R Squared = .002 (Adjusted R Squared = -.026)

The results of the analysis in Table 5 show that, there is no significant difference between the mean academic achievement scores of male and female students taught algebra at post-test level $F = 0.07$ (df 1, 75), $P = 0.94$. Since the computed p-value (0.94) is greater than 0.05 level of significant, therefore, the null hypothesis of no statistical significant difference is not rejected, which means there is no statistical significant difference between the mean academic achievement scores of male and female Senior Secondary School Students (SS II) taught Algebra using Jigsaw II co-operative learning strategy.

Discussions

The study indicated the existence of significant difference between the academic achievement of students taught using jigsaw II co-operative learning strategy and those taught using lecture methods in favour of those exposed to jigsaw II co-operative learning strategy. This implies that jigsaw II co-operative learning strategy was more effective than the lecture method in the teaching and learning of Algebra in mathematics. The result further suggests that jigsaw II co-operative learning strategy could help to enhance students' understanding of algebraic concepts in mathematics more than the lecture method. This finding agrees with the results of Gubbad (2010), Chianson, Okwu and Kurumeh (2010), Gambari, Shittu and Taiwo (2013) as well as Zakaria, Solfitri, Daud and Abidin (2013) who discovered that jigsaw II co-operative learning improved students' performance in mathematics.

The superiority of jigsaw II co-operative learning over the lecture method could be due to the fact that it is a strategy that emphasizes specialization on one aspect of a topic by each member of a group. Every group member must specialize on a portion of the topic while in the expert group, teach his portion to his group members, learn the whole lesson in the home group and individually solve some tasks. Thus, each student learns and helps his group members to learn by providing opportunity for dialogue and free discussion on a task, which is not obtainable in the lecture method. Also, the difference could be attributed to the group reward feature in-built in the jigsaw II strategy which serves as motivation to perform better in subsequent lessons by earning higher improvement scores.

The results of this study also revealed that there was no significant difference in the academic achievement of male and female students exposed to jigsaw II co-operative learning strategy. This result is in line with those of Chianson, and Kurumeh (2010),

Keramati, Tahmasbi, Rafat and Khashab (2011) as well as Gambari, Shittu and Taiwo (2013) who detected that gender had no effect on academic performance of students in co-operative learning. The finding, however, debunked the results of Khairulnauar, Nazre, Sairabanu and Norasikin (2010) who found gender difference in favour of male when exposed to co-operative learning. The result of this study indicates that jigsaw II cooperative learning strategy favoured both male and female in algebraic aspect of mathematics and the strategy is more effective in enhancing both male and female students' performance in mathematics.

Conclusion

Based on the findings of this study, the use of jigsaw II learning strategy enhances students' academic achievement in algebra in senior secondary school mathematics. Gender has no influence on students' academic achievement in algebraic concepts. Hence, it is hopeful that when mathematics teachers and teachers in other subjects use jigsaw II cooperative learning strategy as their teaching method, the students' academic achievement will improve.

Recommendations

Based on the findings of this study, the following recommendations are made:

1. Mathematics teachers should be encouraged to use jigsaw II co-operative learning strategy in their classrooms since it improved students' academic achievement in mathematics.
2. Mathematics Teachers should also actively involve male and female students in learning activities to avoid gender stereotyping. Both male and female students benefited from jigsaw II co-operative learning strategy as evident from the research outcome.

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