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PROF. PATRICK C. IGBOJINWAEKWU

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EDITORIAL

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Prof. Patrick C. Igbojinwaekwu
Editor-in-Chief

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

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Abstract

The performance of secondary school students in Mathematics in West African Senior School Certificate has improved slightly but needs more efforts in some areas like Algebra to attain its full heights. This situation has remained a source of concern to the researcher, parents and the nation at large. Against this background, the study wants to determine the effect of Jigsaw cooperative learning strategy on the academic achievement of secondary school students in mathematics. Two research questions and two null hypotheses provided a guide to this study. Quasi experimental design; specifically, the pre-test post-test non-randomized control group design was adopted. The population of the study consisted of the entire senior secondary two (SS11) in Aboh Mbaise local Government area in Imo state. The sample for the study is made up of 105 SS11 students. Mathematics Achievement Test (MAT) was used for data collection and instructional tool was lesson plan. The instruments and the lesson plans were face and content validated by experts in Measurement and Evaluation, and secondary school mathematics teacher. Analysis of covariance (ANCOVA) was used to test the hypotheses at the 0.05 level of significance. From the findings presented and discussed, it is concluded that Jigsaw is more effective strategy that can be used to enhance academic achievement of students in mathematics. Based on the findings, it is also concluded that there is no influence of gender on mathematics achievement of senior secondary school students. Therefore, Jigsaw is gender friendly to teach mathematics to both male and female students. It is therefore recommended that Mathematics teachers should be encouraged to use jigsaw II co-operative learning strategy in their classrooms.

Keywords: Jigsaw cooperative learning strategy, mathematics achievement

Introduction

Mathematics education simply means all the skills, tools, approaches, tactics and methods that make the teaching and learning of mathematics easier and more successful. Mathematics education tries to make these theories and ideas easier to teach and learn in order to achieve the objectives of mathematics. 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 affects every facet of human activity such as: politics, economy, science and technology (Kadala, 2014).

Most technological developments today in Nigeria and the world at large owe their origin to scientific discoveries and the bedrock for scientific discoveries is mathematics (Iji, 2008). Mathematics as a field of study has its own theories, methods, concepts, ideas and rules. Okeke (2012) defined mathematics as the logical language for expressing ideas of shapes qualities sizes, order, change and dynamism in systems and for explaining the complexity of modern society in business, economics, academics, engineering, medical settings. It is considered the bedrock for development of science and technology of any nation. Mathematics as the central intellectual discipline of technological societies. It is therefore a major aspect of our educational system since its application cuts across all areas of human endeavors.

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 (Matthew & Kenneth, 2013). Despite the importance of Mathematics as a tool for societal and national development, Nigerian secondary schools are bedeviled 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. According to WAEC Chief Examiner's Report (2021), most students leave questions under algebra untouched, especially the ones that has to do with proves. 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 learning strategy.

In this study, jigsaw cooperative learning 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 six 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. For the sake of the present study, Jigsaw II teaching strategy was used 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 line with the views of and Bolaji, Kajuru, Timayi (2015), jigsaw 11 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 practicing 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 classes 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 centered strategies like lecture method accounts for the gradual poor performance of students in science and mathematics. This by implication can leads to poor academic achievement in mathematics in both internal and external examinations.

Academic achievement refers to the learning out comes 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).

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 Aboh Mbaise LGA of Imo state.

Statement of Problem

The growing rate of students' failures in mathematics in some aspects of WAEC examination has injected worry into the minds of all those who have concern for Nigerian youths. Students no longer have interest in the mathematics, it is perceived as a difficult subject and therefore it becomes difficult to understand the subject. This creates room for a slow achievement of the objectives of the subject. Considering the importance of the subject, it is essential that mathematics be taught in a way the maximum understanding is attained.

Despite the efforts of Mathematics teachers, education administrators and professional bodies like Science Teachers Associations of Nigeria (STAN), Mathematics Association of Nigeria (MAN), Poor performance of mathematics students in external examinations such as WAEC, NECO and NABTEB has continued. Observations and reports from examination bodies revealed that a high percentage of secondary school students continue to perform poorly in mathematics due to poor teaching methods adopted by their teachers. Based on this situation, this study sets out to investigate the effect of Jigsaw 11 cooperative learning strategy on secondary school students' achievement in mathematics.

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 Aboh- Mbaise LGA of Imo State. The specific objectives of the study are;

1. To determine the mean difference between the students taught Algebra with jigsaw II cooperative learning strategy and lecture method.
2. To compare the mean achievement scores of male and female students taught Algebra with jigsaw II cooperative learning strategy.

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 cooperative learning strategy?

Hypotheses

The following null hypotheses were formulated and was tested at 0.05 alpha levels of significance;

$H0_1$: 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.

$H0_2$: 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 cooperative learning strategy.

Methodology

The design for this study is quasi-experiment. Quasi-experimental design is defined as an experiment that does not allow the random assignment of subjects to either experimental or control group. Hence, intact classes were used. The population of the study consists of all the SS2 Students in Aboh- Mbaise LGA of Imo State. The number of public secondary school students in Aboh- Mbaise LGA of Imo State is 26. Hence, the population is 2901 (Secondary Education Management Board, 2020). The sample of this study was made up of 105 Senior Secondary Two (SS11) students within Aboh-Mbaise LGA of Imo State. Sampling technique is specifying how elements are drawn from the population. The following sampling technique: simple random sampling, purposive and cluster were used in selecting sample from the population. The instrument, Mathematics Achievement Test (MAT) was used for collection of data in

this study. The instrument is described here under. Mathematics Achievement Test (MAT): this instrument was constructed by the researcher based on the topics chosen for the study. It is a 25-item multiple-choice question with four response options drawn from Algebra. A Table of specification guided the construction of MAT research instrument.

The MAT instrument was used as pre-test and after the treatment has been made, the same instrument was re-arranged and used as post-test. The Mathematics Achievement Test (MAT) was given to one expert in measurement and evaluation and a secondary school teacher for face and content. For the purpose of this research, the Kuder-Richardson formula 21 (K R - 21) was used for calculating the internal consistency of MAT. The K-R 21 is test reliability technique that estimates the degree of consistency with which the item of an instrument measures a given trait (Nworgu, 2015). The reliability co-efficient value obtained was 0.85, which indicates that the instrument is reliable. Data collected was analysed using mean and standard deviation to answer research questions and Analysis of Covariance was used to test the null hypotheses at 0.05 alpha levels of significance.

Results

Research Question 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.

Table 1: Mean and standard deviation on mean achievement scores of students taught mathematics using jigsaw II co-operative learning strategy and those taught with the lecture method

Group	N	Mean Pre-test	Mean Post-test	Mean Gain Score	SD Pre-test	SD Post-test
Jigsaw	52	33.2	62.9	29.6	9.43	11.3
Lecture Method	53	30.2	51.4	21.2	8.84	12.9

From Table 1, **Jigsaw** group has a mean gain score in achievement of 29.6 while lecture method has mean gain score of 21.2. This shows that **Jigsaw** is very effective on students' achievement in Mathematics. Also, from Table 1, **Jigsaw** group has a higher standard deviation score of 9.43 in pre-test than the lecture method group with standard deviation in pre-test of 8.84. Conversely in the post-test, **Jigsaw** group has a lower standard deviation of 11.3 while the lecture method (12.9). Thus, the table reveals that

the standard deviation score for each group is low in both pre-test and post-test. By implication, it shows that groups used in this study are homogeneous

Research Question 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 cooperative learning strategy

Table 2: Mean Achievement scores of Male and Female subjects taught with Jigsaw

Group	N	Mean Pre-test	Mean Post-test	Mean Gain Score	SD Pre-test	SD Post-test
Male	25	33.6	61.1	27.5	10.7	12.4
Female	27	30.6	54.5	23.9	7.98	13.6

In Table 2, the mean gain score in achievement of male (27.5) is higher than the mean gain score of their female (23.9) counterparts taught mathematics with Jigsaw. Table 2 further reveals that male students had higher standard deviation (SD) score before treatment (10.7) and lower SD after treatment (12.4) than their female counterparts whose standard deviation score is (7.98) before treatment and (13.6) after. In general, male students achieved higher than their female counterparts when taught with Jigsaw.

$H0_1$: 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.

Table 3: ANCOVA Comparison Difference between the Achievement of Jigsaw group and Lecture method group

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	5168.045[a]	4	1292.011	9.518	.000	.276
Intercept	18747.776	1	18747.776	138.107	.000	.580
Pre-Test	476.628	1	476.628	3.511	.064	.034
Method	**2167.686**	**1**	**2167.686**	**15.968**	**.000**	**.138**
Error	13574.812	100	135.748			
Total	361600.000	105				
Corrected Total	18742.857	104				

Data in Table 3 reveals that significant difference exists between the achievement scores of students taught mathematics with Jigsaw and those taught with conventional lecture method in favour of Jigsaw group. This shows that the Jigsaw is very effective ($p < 0.05$).

$H0_2$: 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 cooperative learning strategy.

Table 4: ANCOVA Comparison Difference between the Achievement of Male and Female students in Jigsaw

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	5168.045[a]	4	1292.011	9.518	.000	.276
Intercept	18747.776	1	18747.776	138.107	.000	.580
Gender	**618.819**	**1**	**618.819**	**4.559**	**.085**	**.044**
Error	13574.812	100	135.748			
Total	361600.000	105				
Corrected Total	18742.857	104				

From the result of the ANCOVA test as shown in Table 4, the statement of hypothesis 2 is not rejected; implying that difference in the mean achievement scores of male and female students taught mathematics using Jigsaw is not significant ($p > 0.05$).

Results

From Table 1, **Jigsaw** group has a mean gain score in achievement of 29.6 while lecture method has mean gain score of 21.2. This shows that **Jigsaw** is very effective on students' achievement in Mathematics. Also, from Table 1, **Jigsaw** group has a higher standard deviation score of 9.43 in pre-test than the lecture method group with standard deviation in pre-test of 8.84. Conversely in the post-test, **Jigsaw** group has a lower standard deviation of 11.3while the lecture method (12.9). Thus, the table reveals that the standard deviation score for each group is low in both pre-test and post-test. By implication, it shows that groups used in this study are homogeneous. Table 3 reveals

that significant difference exists between the achievement scores of students taught mathematics with Jigsaw and those taught with conventional lecture method in favour of Jigsaw group. This shows that the Jigsaw is very effective ($p < 0.05$).

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 cooperative 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. Fasasi & Istifanus (2022) recommended that mathematics teachers should encourage jigsaw II learning strategy among students during mathematics lessons since it improved their academic achievement. However, the finding of Fasasi & Istifanus (2022) on gender revealed that there is no statistically significant difference in the achievement scores of male and female students taught using jigsaw II learning strategy.

This result is in line with those of Chianson, and Kurumeh (2010) as well as Gambari, Shittu and Taiwo (2013) detected that gender had no effect on academic performance of students in co-operative learning. The finding, however, debunked the results of Khairulanuar, 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

From the findings presented and discussed, it is concluded that Jigsaw is more effective strategy that can be used to enhance academic achievement of students in mathematics. Based on the findings, it is also concluded that there is no influence of gender on mathematics achievement of senior secondary school students. Therefore, Jigsaw is gender friendly to teach mathematics to both male and female students.

Recommendations

Based on the findings and implications of this study, the following recommendations were proffered:

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 cooperative learning strategy as evident from the research outcome.

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