Effects of Jigsaw Cooperative Learning Approach and Lecture Instructional Approach on Students' Retention in Mathematics in Schools in Delta State.

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DOI: https://doi.org/10.51244/IJRSI.2024.1106011

Received: 04 May 2024; Revised: 25 May 2024; Accepted: 29 May 2024; Published: 29 June 2024

ABSTRACT

The effects of the lecture method and the jigsaw cooperative learning approach on students' retention of mathematics was examined in this study. The thirty-nine thousand nine hundred and four (39,904) students enrolled at Delta State made up the study's population. Using simple random sampling, two hundred and forty students made up the sample. The researcher-created mathematics achievement test (MAT) served as the study's instrument. It consists of fifty multiple-choice questions that were utilized for the retention test, pretest, and posttest. A reliability coefficient of 0.84 was obtained using the Kuder Richardson Formula 21 (KR-21) after the validity of the instrument was assessed by three experts in science education. To direct the investigation, two research questions and hypotheses were presented and developed. The t-test and ANCOVA were used to test the hypothesis at the 0.05 level of significance, and the mean and standard deviation were used to answer the research questions. The study's conclusions showed that: Jigsaw cooperative learning and lecture methods had a significant effect on students' retention of mathematics. Additionally, there was a noteworthy variation in the mean retention. This study concluded that jigsaw cooperative learning strategy can improve students' retention of mathematics more than lecture group, and therefore recommends that the cooperative jigsaw learning approach should be adopted by mathematics teachers in teaching mathematics in senior secondary school.

Keywords: Jigsaw Cooperative Strategy, Retention, Revision group.

INTRODUCTION

Calculations and problem solving are all included in the scientific discipline of mathematics, which deals with the manipulation and analysis of numbers. Mathematics is a discipline that systematically looks for patterns, laws, principles, and theories to explain a variety of phenomena, according to Odogwu (2014). Since mathematics gives people the means to comprehend science, engineering, technology, and economics, it is essential to national development (Ijeh, 2014). As a result, Kravits (2013) noted that mathematics is a skill that everyone should be able to perform because it is fundamental to all facets of life and plays a significant role in public decision-making. Owing to mathematics' importance for human and national development, the Nigerian federal government made it a required subject for students in primary through secondary school and a prerequisite for admission to Nigerian universities through the National Policy on Education (FRN 2020). Therefore, improvements in the teaching and learning of science-related subjects, particularly mathematics and other sciences, have been pushed for by the national policy on education (FRN 2013). This is due to the fact that improving performance in mathematics in external exams and possessing a sufficient understanding of the subject matter cannot be overemphasized.

ISSN No. 2321-2705 | DOI: 10.51244/IJRSI |Volume XI Issue VI June 2024

Despite recent advances in teaching techniques, the traditional lecture method is still employed in nearly all Nigerian schools. As per Ajaja (2013), the teacher retains control over the instruction process, presents the material orally to the entire class, and endeavors to emphasize factual knowledge. Berger and Hanzen (2015) observed that a major obstacle to the learning process is that students are passive and it can be challenging to assess whether learning is taking place. The West African Senior Secondary Certificate Examination (WASSCE) reports from 2014 to 2023 revealed that less than 60% of the candidates obtained five credit with English language and mathematics, which falls short of stakeholders' expectations in terms of mathematics achievement. Enhancing students' performance and retention in mathematics is a common concern shared by all parties involved, which is why researchers have kept looking for new approaches for imparting the subject. Therefore, the lecture instructional approach and the jigsaw cooperative learning strategy are examined in this study.

In the Jigsaw Cooperative Learning Strategy, students are divide into groups of four, five, or six and assignments (subtopics) are broken down accordingly so that the group can put the puzzle together. Five fundamental components make up this cooperative learning approach: social skills, individual accountability, group processing quality, positive interdependence, promotive interaction (Sagsoz 2017). Each student in the class is placed into a small, diverse, inclusive group called a "home group," which consists of four, five, or six people. Each member of the "home group" is given a specific subtopic to study on their own before moving to a "expert group," where other students studying the same subtopic come together to learn the material before going back to their home group. Every student has the opportunity to make a significant contribution to peer tutoring and discussion, which is challenging to accomplish in a large lecture hall where the teacher is the only one in charge of instruction.

The capacity to hold on to knowledge or an answer once the requirement has been met is known as retention. Additionally, Joni (2010)in Olusakin (2014) noted that retention is the capacity to remember details and events for an extended period of time. According to Chauhan (2009), self-recitation, mnemonic devices, overlearning, meaningful topic organization, and the development of clear concepts are all effective ways to increase retention. The goal of this study is to determine which method of teaching mathematics in schools regardless of a student's gender is most effective by comparing the jigsaw cooperative learning strategy and the lecture instructional approach.

Statement of problem

Concerns over the best method for teaching mathematics are becoming more and more prevalent. The poor performance of West African senior secondary certificate examination of students in mathematics from 2015 to 2023 and our recent improvements in teaching methodologies are the causes of this study. Thus, the study investigated the effects of the lecture instructional approach and the jigsaw cooperative learning strategy on students' retention and achievement in mathematics in schools.

The jigsaw cooperative learning strategy is a way for students to actively participate in class learning in groups. Each member of the group helps the group succeed as they learn new material and pass it on to others, which leads to the development of cognitive structure for learning. In contrast, the lecture approach involves little to no student activity because the teacher is solely in charge of the instruction process and students are usually only allowed to listen and take notes. Hence the jigsaw cooperative learning strategy and the lecture instructional approach is examined to see if there are any notable differences in students' retention and achievement in mathematics across sexes is the study's main challenge.

Purpose of the study

The main purpose of the study is to examine the effects of using jigsaw cooperative learning strategy and a lecture teaching approach on students' retention of mathematics in schools in Delta State. Specifically, the study examined;

ISSN No. 2321-2705 | DOI: 10.51244/IJRSI |Volume XI Issue VI June 2024

1. the effects of jigsaw cooperative learning strategy and lecture teaching approach students' mean retention scores in mathematics.

2. the mean retention scores of the students taught mathematics using the cooperative learning strategy, the lecture teaching approach, and the students in the revision group which is the control group.

Research Questions

1. What is the effect of jigsaw cooperative learning strategy and the lecture instructional style on students' retention of mathematics?

2. What are the difference in the mean retention scores of students taught mathematics using jigsaw cooperative learning, lecture approach, and the revision group?

Hypotheses

$H_{1.}$ There is no significant difference in the mean retention scores of students taught mathematics using the jigsaw cooperative learning approach and those who were taught using lecture instructional approach.

$H_{2.}$ There are no significant difference between the means retention scores of students taught mathematics through the jigsaw cooperative learning strategy, lecture instructional style and the revision group.

METHODOLOGY

Pre-test, post-test, control group, quasi-experimental design was chosen by the researcher for the investigation. Students in the jigsaw group received treatment; the revision group did not receive any treatment. All students in Delta State's senior secondary schools with thirty-nine thousand nine hundred and four (39,904) students made up the population for the study. Through the use of simple random sampling, 240 students made up the sample. The Mathematics Achievement Test (MAT) the tool utilized in the research. The MAT is a multiple choice test consisting of fifty (50) items that are created by the researcher. Kuder Richardson Formula -21 (KR-21) was used to obtain a reliability coefficient of 0.84 after the instrument was validated by three experts. Two days prior to the treatment, a pretest was administered to the students. Six weeks was used for the jigsaw group's and the lecture group's treatment the revision group did not received any treatment, Following that, each of the three groups were given a post-test, which was scored and documented. Four (4) weeks after posttest, the students took a delayed post-test. This was noted and scored as well. The t-test and ANCOVA were used to test the hypotheses at the 0.05 level of significance, while the mean and standard deviation were used to answer the research questions.

Treatment Procedure of Jigsaw Group

Home Group Plan

Group A	Group B	Group C	Group D	Group E
A_1, A_2, A_3, A_4 A_5	B_1, B_2, B_3, B_4, B_5,	C_1, C_2, C_3 C_4 C_5	D_1, D_2, D_3, D_4, D_5,	E_1, E_2, E_3 E_4, E_5,

A number code was assigned to each member of the home group. A1, A2, A3, A4, and A5. These code numbers specify the expert group, in which students are assigned to, with the same subtopic and assigned

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material.

Expert Group and Sub-topics

A_1 B_1, C_1 D_1, E_1	Polygon
A_2, B_2 C_2 D_2 E_2	Angles in a triangle
A_3, B_3 C_3 D_3 E_3	Exterior angles of a triangle
A_4 B_4 C_4 D_4 E_4	Congruent triangles/Similar triangles
A_5 B_5 E_5 C_5 D_5	Quadrilaterals
Revision Post Test	

All students went back to their home groups in accordance with the Jigsaw Cooperative Learning Strategy Procedure after finishing their studies in the expert group (Aronson, 2010).

RESULTS AND DISCUSSION

Research Question One

What is the effect of the jigsaw cooperative learning strategy and lecture instructional approach and on students' retention in mathematics?

Table I: Mean Posttest Achievement and Delayed Posttest Scores of Students Taught Mathematics Using Jigsaw Cooperative Learning and Lecture Instructional Approaches

Method	N	Posttest		Delayed Posttest		MD	% L = (*MD/PM x 100)*	% R = (*DPM/PM x 100)*
		Mean	SD	Mean	SD			
Jigsaw	108	71.85	12.73	60.94	12.71	10.91	15.18	84.82
Lecture	89	65.57	13.62	51.66	13.61	13.91	21.21	78.79

SD = Standard Deviation, %L = Percentage Lost, %R = Percentage Retained, MD = Mean Difference

Table I shows that students who were taught mathematics through the jigsaw cooperative learning approach had mean scores on the posttest and delayed posttest of 71.85 and 60.94, respectively, while students who were taught mathematics through the lecture instructional approach had mean posttest and delayed posttest scores of 65.57 and 51.66, respectively. For students taught using jigsaw cooperative learning and lecture instructional approaches, respectively, Table I displays a percentage loss of 15.18 percent and 21.21 percent. Table I also shows that, for both lecture and jigsaw cooperative learning methods, students retained 84.81 and 78.79 percent of mathematics, respectively. This shows that both students' retention and lecture instructional strategy have varying effects on students' retention in mathematics.

Hypothesis One: There is no significant effect in mean retention scores of students taught mathematics using the jigsaw cooperative learning strategy and those who were taught through lecture instructional approach.

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Table 2: Summary of Paired Samples t-test Comparison of Posttest and Delayed Posttest Mean ($\bar{x}$) Achievement Scores of Students Taught Mathematics Using Jigsaw Cooperative Learning Approach and Lecture Instructional Approach

Group	N	Posttest		Delayed Posttest		df	t-cal	sig. (2-tailed)	Remark
		$\bar{x}$	SD	$\bar{x}$	SD				
Jigsaw	108	71.85	12.73	60.94	12.71	107	110.77	0.00	Ho_1 is rejected
Lecture	89	65.57	13.62	51.66	13.61	88	117.76	0.00	

P<0.05

Jigsaw cooperative learning and lecture instructional approaches have a significant impact on students' retention of geometry, as demonstrated by Table 2 (t = 110.77 and 117.76, P(0.00 & 0.00) < 0.05). Thus, it is decided to reject the null hypothesis. Thus, the way that students retain mathematics is greatly impacted by both lecture-based instructional methods and jigsaw cooperative learning.

Research Question Two:

What is the difference in the mean retention scores of students taught mathematics using jigsaw cooperative learning, lecture approaches, and the revision group?

Table 3: Mean Posttest and Delayed Posttest Scores of Students Taught Mathematics Using Jigsaw Cooperative Learning Approach, Lecture Approach and Revision Group

Method	N	Posttest		Delayed Posttest		% R = (*DPM/PM x 100)*
		Mean	SD	Mean	SD	
Jigsaw	108	71.85	12.73	60.94	12.71	84.82
Lecture	89	65.57	13.62	51.66	13.61	78.79
Revision	43	46.35	13.40	27.35	13.40	59.01

SD = Standard Deviation, %R = Percentage Retained, MD = Mean Difference, DPM = Delayed Posttest Mean, PM = Posttest Mean

Students who were taught mathematics using the jigsaw cooperative learning approach had a post-test and a delayed post-test mean score of 71.85 and 60.94; students who were taught mathematics using the lecture instructional approach had a post-test and a delayed post-test mean score of 65.57 and 51.66; and students in the revision group had a post-test and a delayed post-test mean score of 46.35 and 27.35, respectively. These results are displayed in Table 3. Table 3 demonstrates that, in the jigsaw cooperative learning, lecture, and revision groups, students retained 84.82%, 78.79%, and 59.01% of mathematics, in that order. The differences in the three groups' percentages of mathematics retained indicate that the retention rates of the students in each group differ.

Hypothesis Two:

There is no significant difference in the mean retention scores of students taught in mathematics with jigsaw cooperative learning strategy, lecture instructional approach and revision group.

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Table 4: Summary of ANCOVA Comparison of Retention Scores of Students Taught Mathematics Using Jigsaw Cooperative Learning Approach, Lecture Approach and Revision Group

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	75596.898a	3	25198.966	26909.622	.000
Intercept	2157.606	1	2157.606	2304.077	.000
Posttest	40899.204	1	40899.204	43675.686	.000
Methods	1418.609	2	709.305	757.456	.000
Error	220.997	236	.936		
Total	711843.000	240			
Corrected Total	75817.896	239			

P<0.05

The mean retention scores of students taught mathematics through the jigsaw cooperative learning approach, lecture instructional approach, and revision group differ significantly, as indicated by Table 4 ($F(2,236) = 757$, $P(0.000) < 0.05$). The null hypothesis is thus rejected. The mean retention scores of students who were taught mathematics using the jigsaw cooperative learning approach, the lecture instructional approach, and the revision group differ significantly. To determine the direction of difference, the post-hoc test employed.

Table 5: Scheffe's Post-Hoc Test on Retention of Mathematics

(I) Teaching Strategy	(J) Teaching Strategy	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence Interval for Difference[b]	
					Lower Bound	Upper Bound
Jigsaw	Lecture	3.016*	.142	.000	2.737	3.295
	Revision	8.175*	.213	.000	7.756	8.594
Lecture	Jigsaw	-3.016*	.142	.000	-3.295	-2.737
	Revision	5.159*	.202	.000	4.762	5.557
Revision	Jigsaw	-8.175*	.213	.000	-8.594	-7.756
	Lecture	-5.159*	.202	.000	-5.557	-4.762

Table 5 shows that there is a significant difference in the mean retention scores of students who were taught mathematics using the jigsaw cooperative learning and lecture approaches, favoring the jigsaw cooperative learning approach ($P(0.000) < 0.05$). In addition, there is a significant difference in the mean retention scores of students in the jigsaw cooperative learning group and revision group, favoring the jigsaw cooperative learning group ($P(0.000) < 0.05$) and between the mean retention scores of students in the lecture group and the revision group, favoring the lecture group ($P(0.000) < 0.05$). This demonstrates how the direction of shifts from the jigsaw cooperative learning approach to the lecture instructional approach and revision group, in that order.

FINDINGS

1. Students who were taught mathematics through the jigsaw cooperative learning approach, the lecture method, and the revision group all had mean achievement scores that differed significantly from one another.

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2. There was a significant effect of Jigsaw cooperative learning and lecture instructional approach on students retention of mathematics in favour of the jigsaw cooperative learning.
3. There was a significant difference in the mean retention scores between students taught mathematics and those taught with the lecture instructional approach in favour of students in the jigsaw cooperative learning approach.

CONCLUSION

Based on the study's findings, it was concluded that while both lecture and jigsaw cooperative learning approaches can help students retain and improve their academic performance in mathematics, the jigsaw cooperative learning approach has a greater ability to enhance students' achievement and retention of mathematics knowledge more than the lecture instructional approach

RECOMMENDATIONS

Based on the findings and conclusion of the study, the following recommendations were made:

1. Mathematics teachers should adopt the use the Jigsaw cooperative learning approach when teaching students in mathematics at the senior secondary school level of education.
2. When using the jigsaw cooperative learning approach, mathematics teachers should en sure that the students 'learning groups are heterogenous in terms of gender, ability level, and aptitude.
3. When the use of jigsaw cooperative learning is not practical due to the time allotted for lectures, the lecture instructional approach may be used as an alternative. Additionally, when employing a lecture-based teaching style, math teachers should illustrate topics with real-world examples.

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