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Comparative Consequence of Puzzle Cooperative Learning Tactic and Lecture Instructional Tactic on Learners' Mathematics Recall in Schools in Delta State Nigeria

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Abstract

The research examined the consequences of the standard lecture method and the puzzle cooperative learning technique on learners' academic performance and recollection of mathematical ideas in Delta State schools. With a quasi-experimental pretest, post-test, and delayed post-test control group design, three research questions and hypotheses were developed for the research. 39,904 secondary school learners made up the target population. With basic random selection, 197 individuals were picked at random from five randomly selected schools to represent the sample. With the Kuder Richardson (KR-21) formula, the research's 50 multiple-choice geometry attainment questions produced a reliability coefficient of 0.83. The research questions were answered with the mean and standard deviation, and the hypotheses were checked with a t-test with a significance threshold of 0.05. The findings showed that learners who learned geometry with the cooperative puzzle method did better than those who were taught through a lecture method, as evidenced by their higher mean accomplishment and memory scores. Additionally, pupils' recollection of geometry topics was substantially improved by the puzzle cooperative technique. To improve learners' mathematical attainment and recall, the research suggests instructors use the puzzle cooperative approach to learning in secondary school geometry classes by implementing diverse learning clusters.

Keywords

Puzzle Cooperative learning, Attainment, Recall

1. Introduction

The research of integers and their operations is the focus of the scientific field of mathematics. It is important for a variety of human endeavors and disciplines of research. Numbers, symbols, forms, sizes, patterns, generalizations, measures, models, values, relationships, and functions are all included in Aminu's (2005) definition of mathematics. As stated in the National Policy on Education (FRN, 2004), the Federal Government of Nigeria classifies mathematics as a core topic throughout the Nigerian educational system, from basic to secondary levels, in recognition of its critical role in human and national development. It is also a requirement for enrollment at universities in Nigeria. Mathematics is essential for a country's industrial advancement and serves as the basis for science and technology, making it essential to a nation's overall growth. Aguele (2004) and Ijeh (2014) correctly point out that the practical use of mathematics is essential in today's society, which is defined by global interconnection and supported by technological advances.

The National Policy on Education (FRN, 2004) accentuates the value of mathematics by outlining specific objectives for primary and secondary education in relation to mathematics instruction.

- Establishing a strong groundwork for the understanding of numeracy and scientific reasoning.
- Providing children with chances to enhance manipulative skills, enabling consequential functioning within the bounds of their capabilities in society.
- Instilling a concentration in mathematics and fostering a social foundation for everyday life.
- Cultivating competitive skills and the capacity to identify and solve problems with relevant mathematical knowledge.

Therefore, to attain both the aforementioned goals and to raise student triumph in the schoolroom, Impactful math instruction is required. Fewer than 50% of scholars earned a West African senior school certificate between 2010 and 2016, according to Zalmon and Wonu (2017). Since the low academic performance of pupils has drawn national attention, stakeholders in mathematics are searching for solutions to raise student accomplishment and recall in the schoolroom plus potential causes of the low performance. Researchers have linked inappropriate instructing strategies to low math triumph; chief examiner reports from 2015 also linked this to learners' poor performance on geometry problems. To ascertain which method will be most triumphful in instructing mathematics in senior secondary schools in Nigeria, this research will compare the lecture instructional technique with the puzzle cooperative learning strategy.

The most popular instructing method in the world is the lecture. A typical lecture lasts between forty and forty-five minutes and consists primarily of a teacher speaking to learners without interruption. Learners are expected to listen and take notes, with slight to no participation from them aside from class exercises and questions from the tutor. The majority of scholars view this kind of instruction as the instructor imparting information to the pupils, who are only acting as passive recipients of it. Among the many special benefits of lecturing are increased instructor control in the schoolroom and an engaging style that makes the topic easier to understand. It can be deployed in a large class, and the teacher can cover lots of material in a short amount of time. However, Ajaja (2011) and Bennett (2005) state that the main drawback is that there is slight to no active student participation, and Ruhl (2003) suggested that simply providing the rules or formula without sufficient understanding could upshot in rote learning. Thus, the purpose of this research is to investigate a student-centered learning strategy that incorporates student engagement.

The puzzle cooperative learning strategy is a way to set up activities in the schoolroom that hearten learners to rely on one another. Learners are grouped into small clusters of four, five, or six so they might collaborate and make the most of their own and each other's learning (Trowbridge & Bybee, 2000). Aronson (2010) presented the puzzle cooperative schoolroom for the first time. With the puzzle method, pupils are separated into home clusters of four, five, or six, and the instructor presents a theme and its "sub" to them. Before moving on to a skilled group, each student in the group is given a unique subtopic to research on their own. In this group, learners with the same subtopic meet together to generate ideas for their allocated subject.

In puzzle, an atmosphere of increased collaboration is created because every member of the group is equally central and responsible for the success of the group; this reduces competitive attitude among learners. The teacher is a facilitator, he provides the course material besides learners' personal research and also gives time for presentation by individual learners to present their work, make corrections and revise the work with the learners.

Eachempti et al. (2017) studied the paraphernalia of puzzle cooperative learning strategy compared to the lecture method for designing cast partial dentures, the upshot revealed that no substantial Variation was found between the puzzle and the lecture methods at pre-tests, but there was a Variation in mean recall scores between learners in puzzle group and lecture group.

Retention or recall is the capacity to hold on to knowledge or a response after the requirement has been met, according to Ilogu (2009), and Joni (2009), recall is the mental ability that enables us to remember experiences and knowledge over extended epochs of time. Human memory is a very sophisticated brain process that each person is able to encode, retain, recall, and interpret independently, according to a 2010 Live Science research.

Geometry is a branch of mathematics that concentrates on the dimensions, angles, sizes, forms, and placements of things. Because geometry provides methods for interpreting and reflecting on our physical world, the National Council of Teachers of Mathematics (NCTM) has highlighted the significance of geometry in schoolroom mathematics. Coordinate geometry, according to Mukati (2016), has several uses, such as characterizing an object's position or the positioning of things on land and in the air. On student's achievement and recall geometry knowledge, Atebe (2008) study revealed that male students outperform their female counterparts in basic geometry.

This research focuses on geometry instruction in secondary school mathematics. Specifically, it compares the efficacy of lecture and puzzle cooperative learning strategies to determine which is most consequent for raising learners' mathematical attainment and recall in senior secondary school, regardless of gender.

2. Statement of problem

Researchers argue that a key constraint to the learning process is the traditional lecture technique, in which the instructor is the only one in custody of the education process. Learners participate very slight in this method since they mostly just listen to the speaker and take notes. Thus, an alternate approach to puzzle cooperative learning was investigated in this research. This approach involves learners actively participating in class, acquiring knowledge in clusters where each member adds to the group's activities, discovering information and imparting it to other group members, and learners interacting with one another.

3. Research Questions

1) What is the consequence of puzzle cooperative learning approach and lecture instructional approach on learners' attainment in mathematics?

2) What is the consequence in the mean recall scores of learners taught mathematics with puzzle cooperative learning approach and lecture instructional approach?

3) What is the variation in the mean recall scores between male and female learners taught mathematics with puzzle cooperative learning approach?

4. Hypotheses

1) There is no consequence of puzzle cooperative learning approach and lecture instructional approach on student's attainment in mathematics.

2) There is no substantial consequence in the mean recall scores of learners taught mathematics with puzzle cooperative learning approach and those thought with lecture instructional approach.

3) There is no substantial variation between the mean recall scores of male and female learners taught mathematics with puzzle cooperative learning approach.

5. Methodology

The pretest, posttest, delayed post-test, quasi-experimental research design was deployed in this research. The research's population comprises all Delta State Senior Secondary School two (SS2) pupils. The sample of the study consisted of One hundred and ninety-seven (197) senior secondary school class (SSII) student in five intact classes from five senior secondary schools in Delta South Senatorial District. There are 117 schools in Delta South Senatorial District, simple random sampling (balloting) was used to select five (5) schools for convenience an (SS2) science class was chosen in each of the schools, and hence 5 intact classes made up of 197 students formed the sample of the study. A simple random selection procedure was employed to choose a sample of 197 SS2 mathematics learners for the research. The research employed the Geometry Attainment Test (GAT) to gather data. The instrument was verified by two professionals in science education, and Kuder Richardson formula 21 was deployed to regulate the instrument's dependability (KR-21). The instrument was administered to 30 students who were not part of the main study but were in the same class (SS2) and age bracket. The test questions were selected from past senior secondary school examination questions (SSCE). The reliability was calculated with Kuder Richardson 21 approach which gave an estimate of the internal consistency of the instrument. This involved the analysis of the responses to items in the instrument to the number of items on the test, the arithmetic average (mean), and the variance of the scores (Standard deviation Squared), which were computed using the Kuder Richardson 21 formula and a reliability index of r = 0.83 obtained.

The pre-test and post-test of the GAT were given to math learners in the chosen schools after six weeks of instruction in the puzzle and lecture clusters. A Recall exam was also conducted at the conclusion of the four-week retro, and data were gathered.

To address the research issues, the obtained data were analyzed with the mean and standard deviation (Std), and the hypotheses were tested at the 0.05 level of significance with the t-test.

$$\text{Puzzle Group} \rightarrow O_1 \rightarrow X_1 \rightarrow O_2$$

$$\text{Puzzle Group} \rightarrow O_3 \rightarrow X_2 \rightarrow O_4$$

O_1 = Pre-test puzzle group.

X_1 = Treatment for puzzle group.

O_2 = Post-test for puzzle group.

O_3 = Pre-test for lecture group.

X_2 = Treatment for lecture group.

O_4 = Post-test for lecture group.

Intervention: Learners were alienated into lecture clusters and puzzle clusters as part of the therapy. Following that, learners in the two clusters took a pretest with the Geometry Attainment Test (GAT). The puzzle cooperative learning approach was deployed to teach mathematics to the learners in the cooperative learning group. In this method, individual learners are given subtopics to work on in clusters of four or five, called the home group, after which individual learning learners who are working on the same subtopic will come together to form an expert group.

Home clusters of a class of twenty-five (25) learners for example are made up of five (5) members each, the members are denoted by letters and sub numbers representing their expert clusters.

Home Cluster

A1A2A3 AEA5	B1B2B3 B4B5	C1C2C3 C4C5	D1D2D3 D4D5	E1E2E3 E4E5

Expert group

A1B1C1 D1E1	A2B2C2 D2E2	A3B3C3 D3E3	A4B4C4 D4E4	A5B5C5 D5E5

After the six weeks of instruction, the two clusters received a posttest. Four weeks later, the two clusters received a delayed posttest, the material of which was rearranged for the GAT. The t-test, mean, and St.d were deployed to examine the upshots from the pre- and delayed post-tests.

The intervention (treatment) consisted of a six-week instructional unit in mathematics. During the six week the students were exposed to five topics:

Polygon, angles in a triangle, Quadrilateral, Congruent triangles and circle geometry.

The instrument used for the study Geometry Attainment Test (GAT) consisted of 50 multiple choice test items selected from past Senior Secondary Certificate Examination (SSCE) drawn from the topics above.

Upshots

Conveniently 0.05 (5%) has been accepted as the threshold to discriminate significant from non-significant, reject or not to reject the hypotheses. At $P < 0.05$ shows that there is significant effect on students achievement based on scores of the pretest and posttest mean scores. The mean gain shows that there is a significant effect of the instructional approach on students' achievement and $P > 0.05$ means the hypothesis is accepted as there is no significant effect.

Research Question One: What is the consequence of puzzle cooperative learning strategy and lecture instructional approach on learners' attainment in mathematics?

Learners taught mathematics with the puzzle cooperative learning approach had a pretest mean attainment score of 14.08, with a St.d of 5.55, as shown in Table 1. Learners taught mathematics with the lecture approach had a pretest mean attainment score of 14.75, with a St.dof 5.69. In the posttest, learners in the lecture group scored 65.57 on average with a Standard Deviation of 13.62, whereas those in the puzzle cooperative learning group scored 71.85 on average with a St.dof 12.73.

The lecture clusters' mean gains are 50.82 and the puzzle cooperative learning clusters' mean gains are 57.77. The mean gains of learners taught mathematics with lecture and cooperative learning methods differ by 6.95, favoring the learners of Puzzle.

Hypothesis One: There is no substantial consequence of puzzle cooperative learning strategy and lecture instructional approach on student's attainment in mathematics.

Table 1. Mean ($\overline{x}$) and St.d of pretest and posttest attainment scores of learnerstaught mathematicswithpuzzle cooperative learning and lecture approaches.

Group	N	Pretest		Posttest		Mean Gain	Mean Gain Variation
		$\overline{x}$	SD	$\overline{x}$	SD		
Puzzle	108	14.08	5.55	71.85	12.73	57.77	6.95
Lecture	89	14.75	5.69	65.57	13.62	50.82	

Table 2. Summary of paried samples t-test comparison of pretest and posttest mean attainment scores of learners taught mathematics with puzzle cooperative learning and lecture approaches.

Group	N	pretest $\overline{x}$	SD	posttest $\overline{x}$	SD	Df	t-cal.	Sig. (2-tailed)	Remark
Puzzle	108	14.08	5.55	71.85	12.73	107	44.273	0.00	Ho_1 is rejected
Lecture	89	14.75	5.69	65.57	13.62	88	33.003	0.00	

$P < 0.05$.

Table 2 shows that there is a substantial consequence of puzzle cooperative learning strategy and lecture approach on student attainment in mathematics (t = 44.273 & 33.003, P (0.00 & 0.00 < 0.05). Hence, the null hypothesis is rejected. Therefore, there is a substantial consequence of puzzle cooperative learning strategy and lecture approach on student attainment in mathematics.

Research Question Two: What is the consequence of puzzle cooperative learning approach and lecture instructional approach on learners' Recall in mathematics?

According to Table 3, learners who were taught mathematics with the puzzle cooperative learning strategy had mean scores on the posttest and delayed posttest of 71.85 and 60.94, respectively, whereas learners who were taught mathematics through the lecture instructional approach had mean scores on the posttest and delayed posttest of 65.57 and 51.66, respectively. Table 3 displays a percentage loss of 15.18% and 21.21%, respectively, for learners who were taught with lecture and puzzle cooperative learning methods. Table 3 also shows that learners who received instruction through lecture and puzzle cooperative learning methods recalled 84.82% and 78.79% of geometry, respectively. This suggests that the impact of the two instructing strategies on pupils' recall of geometry varied.

Table 3. Mean posttest attainment and delayed posttest scores of learners taught mathematics with puzzle cooperative learning and lecture instructional approaches.

Method	N	Posttest		Delayed Posttest		MD	$\% L = (\frac{MD}{PM} x100)$	$\% R = (\frac{DPM}{PM} x100)$
		Mean	St.d	Mean	St.d			
Puzzle	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

St. d = Standard Deviation, %L = Percentage Lost, %R = Percentage Retained, MD = Mean Variation.

Hypothesis Two: There is no substantial consequence in the mean Recall scores of learners taught mathematics with Puzzle cooperative learning approach and those taught with lecture instructional approach.

Table 4 demonstrates that learners' recall of mathematics is substantially impacted by both lecture instructional techniques and puzzle cooperative learning (t = 110.77 & 117.76, P (0.00 & 0.00) < 0.05). The null hypothesis is thus disproved. Learners' Recall of mathematics is substantially impacted by lecture instructing styles and puzzle cooperative learning.

Research Question Three: What is the Variation in the mean Recall scores between male and female learners taught mathematics with puzzle cooperative learning approach?

Table 5 shows the male students in the puzzle cooperative learning group had a post-test mean recollection score of 62.40 with St.d of 12.15 while their female counterparts had a post mean recollection score of 59.42 with St.d 13.21. The mean difference between the two sex groups is 0.98, in favour of the male students.

Hypothesis Three: There is no substantial Variation between the mean Recall scores of male and female learners taught mathematics with Puzzle cooperative learning approach.

Table 6 demonstrates that there is no statistically substantial Variation (t-cal = 1.223, P (0.224) > 0.05) between the mean Recall scores of male and female learners taught mathematics with the puzzle cooperative learning approach. Therefore, the third null hypothesis is not disproved. As there is no discernible Variation in the mean Recall scores of male and female learners who were taught mathematics with the puzzle cooperative learning method.

Table 4. Summary of paired samples t-test comparison of posttest and delayed posttest mean ($\bar{x}$) attainment scores of learners taught geometry with puzzle 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				
Puzzle	108	71.85	12.73	60.94	12.71	107	110.77	0.00	Ho_2 is rejected
Lecture	89	65.57	13.62	51.66	13.61	88	117.76	0.00	

$P < 0.05$.

Table 5. Mean ($\bar{x}$) and st.drecall scores of male and female learners taught mathematics with puzzle cooperative learning approach.

Method	Sex	N	Posttest		Mean Variation
			$\bar{x}$	SD	
Puzzle	Male	55	62.40	12.15	2.98
	Female	53	59.42	13.21	

Table 6. Independent samples t-test comparison of mean recall scores of male and female learners taught geometry with puzzle cooperative learning approach.

Methods	Sex	N	$\overline{x}$	SD	df	t-cal.	Sig. (2-tailed)	Decision
Puzzle	Male	55	62.40	12.15	106	1.223	0.224	Ho_3 is not rejected
	Female	53	59.42	13.21				

$P < 0.05$.

6. Findings

The research revealed the following findings:

1) The mean attainment scores of learners taught mathematics with the Puzzle cooperative learning strategy and those taught with the lecture method differed substantially, favoring the learners in the Puzzle cooperative learning group.

2) The mean Recall scores of learners taught mathematics with the puzzle cooperative learning strategy and those taught with the lecture instructional style did not differ substantially.

3) The mean recall scores of male and female learners taught mathematics with the Puzzle cooperative learning approach did not differ substantially.

7. Discussion

The study shows that student taught geometry using puzzle cooperative learning approach obtained a higher achievement and retention scores than their counter parts taught using lecture instructional approach. This observation may be due to students active participation in the learning process. These findings agree with Timayi, Bolaji and Kajuru (2015) who reported a significant difference in performance between students taught geometry using jigsaw IV cooperative learning strategy and conventional lecture method, in favour of students exposed to Jigsaw IV Cooperative learning strategy, and the findings of this study also agree with that of Usman and Okeke (2017) who reported that jigsaw instructional strategy improved students' achievement in quadratic equation more than the lecture approach.

8. Conclusion

In relation to the research's findings, both lecture and puzzle cooperative learning methods can increase learners' academic attainment and recall of mathematics; however, puzzle cooperative learning methods can do so better than lecture methods in terms of improving learners' academic attainment and recall of geometry. Additionally, it was determined that learners of both sexes gain equally from the application of lecture instructional methodologies and puzzle cooperative learning. The research comes to the same conclusion once more: that the effects of puzzle cooperative learning and lecture approach on school attainment and recall of mathematics are not dependent on student sex.

Recommendations

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

1) Math instructors should use the Puzzle cooperative learning technique while instructing geometry at the senior high school level of education.

2) When with the puzzle cooperative learning strategy, math teachers should make sure that the learning clusters are diverse in terms of gender and skill level, among other factors.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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