

Effect of Jigsaw Instructional Method on Secondary School Students Academic Achievement and Retention in Biology in Calabar Education Zone, Nigeria

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Abstract

The study examined the Effect of Jigsaw Instructional method on Secondary School students' Academic Achievement and retention in biology in Calabar Education Zone. It adopted a quasi- experimental non randomized pre-test, post-test control group design with a sample size of 260 SSI students. Two research questions and hypotheses guided the study, the research instrument was a researcher made achievement test with a reliability index of 0.88 using split-half reliability estimate. The data was analyse using descriptive and ANCOVA statistics at 0.05 level of significance. The result indicated that there was a significant difference in the mean achievement and retention score of students taught using Jigsaw, and lecture strategy in favour of students taught using Jigsaw strategy. Students in the treatment group did better than the control group. It was recommended that teachers should use Jigsaw instructional strategy teaching scientific concept and other challenging and complex ideas in the subject.

Keywords: Academic achievement, Biology, Jigsaw strategy, Retention

Introduction

In order to address the problems that humanity is currently experiencing, a society that is influenced by experimentation and innovation must provide active support. Consequently, the goal of science education should be to develop a population with a systematic understanding of science and the capacity to apply that understanding to make well-informed decisions about the products of science and technology in their daily lives. Regretfully, recent reports on student performance in the National and West Africa Examination Councils continue to highlight a decline in students' achievement in these exams, particularly when it comes to science subjects like biology, which demands the serious attention of all stakeholders (Apata, 2020). Better remediation techniques that involve students actively participating in the creation of a collaborative learning environment have been recommended and should be investigated (Werder & Otis, 2023). These techniques have the potential to improve science education. Cooperative instructional approach is one of the strategy in which learners are anticipated to be actively engaged in the learning process, has gradually gained traction due to paradigm

shifts. Making students the leaders of their own learning is a defining characteristic of the cooperative learning approach. Elliot Aronson and associates created the Jigsaw puzzle in 1978 as one of the cooperative learning techniques.

The main goals of the learning technique were to increase student cooperation and decrease racial segregation. The class is broken into smaller groups to accomplish a particular goal, which fosters a sense of interdependence among the pupils. Jigsaw instructional strategy is a cooperative instructional method in which learners of various skill levels form a group known as the home group. Everyone in the group is in charge of studying various subjects before joining the expert group, which is a new group focused on the same subject. After collaborating well, the expert group will return to their original group, known as their home group, to apply the knowledge they have learned from expert group talks to synthesize the material for the home group, teachers will assess it, and scores will be assigned (Sari et al., 2021). In addition to academic performance and retention, results from active participation and engagement in the learning process

can motivate student towards higher academic attainment, having a positive attitude and social skills needed for in the society. It also promotes interaction and critical thinking among students.

Jigsaw instructional encourages among students' active interaction and interdependence on each other to succeed. It divides the class into groups and each group is given tasks to assemble and help complete the puzzle. It is also based on group dynamics and social interactions.(Gillies,et al., 2023). Theoretical underpinning is based on social learning theory, propounded by Albert Bandura, that highlighted the relevance of observational learning, imitation, and modeling in educational process. By working together in small, heterogeneous groups, students engage in cooperative learning experiences, observe each other's contributions, and collectively construct knowledge. This collaborative learning environment fosters active participation, enhances understanding of biology concepts, and promotes retention through peer teaching and reinforcement. Several experimental research have established the impact of jigsaw instructional method on academic achievement in science when compared to the conventional teaching strategy (Noor, et al.,2024, Hanapi, et al., 2024, Khan, et al.,2024, Cashata, et al.,2023, Adam, et al.,2023, Møgelvang, & Nyléhn, 2023, Daniel, et al., 2024, Nalls, & Wickerd, 2023).

However, findings from the reviewed literature revealed the existence few of such studies which are conducted in Nigeria or in disciplines other than Biology. The methodologies adopted, sample size and result vary in the review it was shown that learners who were instructed using jigsaw strategy outperformed learners who were instructed with lecture strategy, while other result revealed no statistical significant difference in academic achievement. This present study captured the concept of genetics in Biology and retention and was conducted in Ikom Education Zone, Nigeria which has not been done in other research studied. This study sought to address this gap and provide empirical evidence on the effectiveness of Jigsaw method of instruction on Secondary School student academic performance and retention in biology.

Retention is another important factor affecting student academic achievement in biology. Rosanna et al, (2023) posited that learners support and responsibility in working with others, including learning is deficient, which leads to memorization to perform better. At the passage of time, knowledge and understanding of past lesson depreciates. Retention here simply refers to an act of retaining or recalling a

learned concept. Focusing on individual differences and encouraging learners to actively participate and collaborate with each other in the learning experience is one way of ensuring deep learning and retaining of learned concept, this improves cognitive achievement while promoting self-learning. In this situation the teacher plays the role of facilitator of knowledge. (Van Ryzin et al., 2020, Jacobs & Chau, 2021). After learning has occurred, a retention test is administered. The subject is typically revisited across a range of time periods to assess the extent to which the student has retained the material. The objective of the research conducted by Daiko et al. (2023), Ogbiku & Ajaja (2024), Pepple et al. (2024), Enyinnaya et al. (2024), and Nguyen et al. (2022) was to evaluate the efficacy of Jigsaw technique in enhancing biology retention in comparison to traditional teaching methods. The results indicate that the Jigsaw strategy's collaborative and interactive elements played a key role in its effectiveness in supporting students' long-term memory of biological ideas.

Students can collaborate with each other, with each student taking part in the planned activities, helping them synthesize, analyze, and apply the various concepts they have studied. Ensuring the active engagement of every member of the learning group, promoting teamwork, solidifying accountability, and fostering social cohesiveness within the work groups are the fundamental components of cooperative learning methodologies. Students cooperate with one another during Jigsaw practice in order to support and understand the academic material from one another. This is because task specialization is at the center of the Jigsaw learning technique. After working on a particular assignment from the lesson module, each student is expected to instruct the other group members. In this regard, it is required of the pupils to attain a noteworthy degree of proficiency with the instructional assignment that has been assigned. Jigsaw approach separates lesson content to discrete informational pieces assigned to learners in groups who work together to solve the problem. The objective of this research is to ascertain how Jigsaw method of instruction affected the academic performance and retention of biology concept in secondary school pupils.

Research Questions

1. How does the mean performance score of learners instructed with Jigsaw method of instruction differ from those taught with lecture strategy?

2. Does the mean retention score of learners taught biology with Jigsaw teaching technique differ significantly from those instructed with traditional strategy?

Hypotheses

- H₀₁ There is no significant difference between the mean performance scores of learners instructed with jigsaw technique and those taught with lecture method.
- H₀₂ There is no significant difference between the mean retention score of learners instructed with Jigsaw technique and learners instructed with lecture method.

Research Design

Quasi-experimental, pretest-posttest control group design was employed, since the nature of the research precludes randomizing students into treatment and control groups, intact classes were utilized, which is why the design is deemed adequate.

Sample and Method of Sampling

Every local government area in the Zone was regarded as a stratum, and a multistage sampling technique was used for the study. Three local government areas were chosen from the seven local government areas that are present in the research region method of purposive sampling. This was done to ascertain that all had equal opportunity of being chosen for the research, and the schools were spaced far apart to prevent interactions between the group's subjects. Four intact classes—that is, all members of the intact class were considered study subjects—were chosen from among the four schools—A, B, C, and D—from among the three local government areas using a simple random sampling technique. Two classes from each school were grouped as experimental and control groups, respectively. Two hundred (260) respondents

were selected at random from a population of 2,800 senior secondary II students in the zone to comprise the study's sample.

Instrumentation

A researcher-made biology achievement test (BAT) consisting of 25 objective test items with four response options—one correct answer and three distractors—was the instrument utilized in this investigation. The pupils in the two groups were compared using baseline data from the pretest. The achievement test's serial number and response options were rearranged for the post-test and retention test.

The instrument's validity

A thorough item analysis was used to determine the quality of the test items for the biology achievement test. This allowed for the identification of items that were unclear, too simple, or too challenging, which improved test security, validity, and reliability while lowering bias and increasing fairness. Additionally, the research tools' content and face validity were confirmed. The adoption of the SSII biology curriculum and test pattern guaranteed the content validity.

Reliability

Before using the instruments, adjustments were done. Dependability of the device Using the split half approach, trial tests were administered in two schools outside of the sampled schools to determine the reliability of the biology achievement test (BAT). A reliability estimate of 0.88 was found. For this reason, the device was regarded as trustworthy.

Methodology for Analyzing Data

Mean, Standard Deviation, and Analysis of Covariance (ANCOVA) were employed to examine the data obtained the tests. At the significance level of 0.05, the hypotheses were tested. The null hypothesis was upheld when the computed p-value was larger than 0.05 alpha and was rejected when the computed p-value was equal to or less than 0.05 alpha. Results

Table 1 shows the descriptive statistics of students' pretest and posttest results broken down into groups

Treatment Groups	N	Pre-test		Post-test	
		\bar{x}	SD	\bar{x}	SD
Jigsaw Strategy	130	8.89	1.93	38.67	5.96
Lecture Strategy	130	7.31	1.30	31.94	4.52

Table 1 revealed that Jigsaw group's pupils had a better mean score difference than the lecture groups, as

evidenced by their pretest and posttest mean scores of 8.89 and 38.67, and 7.31 and 31.94 for the lecture

group. The result of the hypothesis test is shown in Table 2.

Table 2: An overview of the students' post-test results from the Analysis of Covariance (ANCOVA) classified by groups

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	178.623 ^a	2	89.311	33.480	.000
Pretest	16.988	1	16.988	6.368	.012
Treatment	72.294	1	72.294	27.101	.000
Error	685.573	257	64.9594		
Total	17939.000	260			
Corrected Total	864.196	259			

a. R Squared = .207 (Adjusted R Squared = .201)

b. Computed using alpha = .05

Source: Field Data (2024)

The effect of instructional techniques at df 1,257 in table 2 has a calculated F-ratio of 27.101 and a corresponding determined level of significance of 0.000 alpha. The decision-making threshold, which is less than .05, indicates a significant difference in the performance of students taught using lecture and

Jigsaw methods. This discovery led to the rejection of null hypothesis 1. The post-test mean scores demonstrate the significance is in favour of students in the Jigsaw group who had a higher mean score was 38.67 as opposed to 31.94 for those in the lecture group.

Table 3: Students' post-test and retention mean and standard deviation scores categorized according to groups

Treatment Groups	N	Post-test		Retention	
		\bar{x}	SD	\bar{x}	SD
Jigsaw Strategy	130			36.40	4.07
Lecture Strategy	130	38.67	5.96	33.39	3.57
		31.94	4.52		

Table 3 shows that students in the Jigsaw group have retention mean score difference of 36.40 when compared to the conventional group with 33.39,

indicating that the Jigsaw group had a higher retention mean score than in the Lecture group. The results for testing hypothesis two are presented in Table 4.

Table 4: An overview of students' retention scores categorized by treatment groups using the Analysis of Covariance (ANCOVA)

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	1121.688 ^a	2	560.844	44.234	.000
Posttest	533.685	1	533.685	42.092	.000
Treatment	64.352	1	64.352	5.076	.025
Error	3258.508	257	12.679	-	-
Total	32093.000	260	-	-	-
Corrected Total	13573.139	124	-	-	-

a. R Squared = .256 (Adjusted R Squared = .250)

b. Computed using alpha = .05

Source: Field Data(2024)

In Table 4, the calculated F-ratio at df 1,257 is 5.076 and its corresponding level of significance is .025 alpha, indicating a significant difference in the mean retention scores of learners given instruction with both strategies, leading to the rejection of the null hypothesis. Learners in the Jigsaw group had a slightly higher mean retention score when compared to the conventional group, as indicated in table 3.

Discussions

The results of the research on the effectiveness of Jigsaw and Lecture techniques on students' academic achievement showed a significant difference in the academic achievement of learners, with students taught with Jigsaw approach achieving higher than those in the conventional group. This could be accounted for by the fact that the jigsaw strategy is student-centered, involving students in activities that stimulate their cognitive capacities and encourage in-depth learning. This involves students as active contributors to the creation of knowledge, with the teacher acting as an instructional facilitator. The Jigsaw strategy has a better enhancing effect on students' achievement when compared to lectures, according to research by Noor et al. (2024), Hope, et al., (2024). Hanapi et al. (2024), Cashata et al. (2023), Adam et al. (2023), Daniel et al. (2024), Nalls & Wickerd (2023), Safkolam et al. (2024), Ojekwu & ogunleye (2020). It is suggested that a higher mean score could be attributed to the strategy's capacity to help students focus their energy on a task and its inter and intrapersonal attributes, which enable learners to analyze information, and interact with each other to gain an in depth view on the intended learning outcome.

The Jigsaw and lecture strategies were found to have a significant impact on students' retention of the material. Students in the Jigsaw group had a slightly higher mean retention score of 36.40 compared to those in the lecture group, which was 33.39. This finding may be explained by the fact that the strategy focused on the needs of the individual students, which increased their dedication to completing the work at hand. The results are consistent with those of Ogbiku & Ajaja (2024), Daiko et al. (2023), Anari, Nja & Neji .(2023) Pepple et al. (2024), Enyinnaya et al. (2024), and Ojekwu & ogunleye (2020), which implied that students' retention in biology is positively impacted by the Jigsaw approach. This implies that the Jigsaw technique's interactive and collaborative elements enhance

academic achievement and retention as well as help students develop positive opinion of the subject. These results highlight the potential advantages of using Jigsaw and other cooperative learning tools in educational settings to support students' positive attitudes toward difficult subjects and improve their academic success.

Conclusion

According to the study's findings, jigsaw instructional strategy appears to enhance students' academic achievement and retention of learned concepts when compared to conventional methods. Having ascertained the effectiveness of jigsaw instructional strategy in enhancing academic performance and retention of subject matter, it is recommended that science teachers should take advantage of its engaging capabilities in a science classroom as a means of not just increasing the performance of student but also to increase students' engagement and participation in the learning process.

Recommendations

1. Teachers should use jigsaw strategy when teaching science and other difficult and complex concepts in the subject;
2. Curriculum planners should make sure jigsaw strategy is incorporated into the teaching and learning of biology concept.

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