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Comparative Effects Of Jigsaw Cooperative Learning And Lecture Method On Biology Students' Achievement And Retention In Delta Central Senatorial District

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ABSTRACT

The study compared the impact of the lecture technique and jigsaw cooperative learning on biology students' retention and achievement in the Delta Central Senatorial District. To direct the investigation, twelve research questions and twelve hypotheses were put out, respectively. The study used a planned variation pretest-posttest method, which is a quasi-experimental design. 7,915 SSII Biology students from Public Senior Secondary Schools in the Delta Central Senatorial District made up the study's population. The study's sample consisted of 219 public SSII Biology students in four complete courses in the Delta Central Senatorial District. The BAT, or Biology Achievement Test, was utilised to gather data. The researcher created 50 multiple-choice test items for the BAT, which three experts verified. The Kuder-Richardson 21 was used to determine the BAT's dependability. A value of 0.75 for the reliability coefficient was found. The two treatment groups received instruction utilising the lecture method and the jigsaw cooperative learning approach, respectively. Prior to the treatment, pretests were given, and then a posttest. Four weeks following the initial posttest, a delayed posttest was given again to gauge students' retention. The t-test was used to analyse the results. The study's conclusions showed that there was a substantial difference, favouring the Jigsaw cooperative learning group of students, between the mean achievement and retention scores of students taught Biology using this cooperative learning style and those taught it through lectures. Compared to the lecture approach, jigsaw cooperative learning was found to improve students' achievement and long-term recall of biology subjects. As a result, the study suggested implementing jigsaw cooperative learning in biology classes since it encourages students to participate actively in the learning process and work together.

Keywords: Jigsaw, Cooperative Learning, Lecture Method, Achievement and Retention

INTRODUCTION

The physical characteristics, chemical reactions, molecular interactions, physiological systems, growth, and evolution of living things are all studied in the natural science field of biology. "Bios" (life) and "logos" (learning) are the roots of its name. Everything from cell components to ecosystems and climate change is covered by biology. Biology includes the study of breathing, eating, growing, excreting waste, and reproducing. In addition, it covers environmental microbes, health issues, human anatomy and physiology, and management. Biology plays a significant, useful, and complementary function in scientific classes. It serves as a basis for understanding some concepts in physics and chemistry. It is complementary to other sciences since it offers specialist procedures and expertise that improve learning.

Because biology is practical, it employs concepts from chemistry and physics to explain biological principles and processes. This lends credence to Bioexplorer's (2018) contention that biology is the study of life and the interactions between living and non-living objects. Sweating, respiration, digestion, and the nervous system are all governed by chemical processes. Physics, which investigates motion, has an impact on retinal behaviour and eye conditions such colour blindness (Socratic, 2018). These demonstrate how closely biology and

chemistry are related, and how important it is for students to be exposed to both in order for them to learn biology successfully. Like other science courses, biology topics should be learnt by scientific techniques (Chukwu & Arakoyu, 2019). A range of teaching techniques and pertinent educational materials have been approved, tested, and suggested over time to encourage student understanding, internalisation of foundational ideas, and enjoyment of biological principles as a scientific subject. These educational activities and resource utilisation are significantly impacted by the instructional practices of the classroom teacher.

Many educational environments employ the classic lecture style, in which the instructor primarily uses the "chalk and talk" approach with little to no student participation. The students remain silent the whole class hour, which leads to rote learning becoming the norm. This is detrimental to kids' academic progress even though it could be easier for the teacher to accept and implement. The Senior School Certificate Examination (SSCE) results of the students may have been influenced by the lecture method's use. In fact, students' performance on the Senior School Biology examination in Nigeria between 2000 and 2009 was the lowest of all the science courses taught in schools (Ogunleye, 2014). More recent data on academic performance from the West Africa Examinations Council shows that 35.82% of students failed Biology in 2019 and 50.02% of students failed it in 2018. Given that the students are passive during instruction, this subpar performance can continue if the lecture style is used consistently. As a result, substitute teaching methods have been suggested, such as cooperative learning, which encourages students to actively participate in class.

The emphasis of cooperative learning is on students taking ownership of their education. While researching themes and ideas, students must actively participate in small-group projects (Johnson, Johnson & Smith, 2014). Students can synthesise, analyse, and apply study concepts with the support of cooperative learning. In the teaching-learning process, cooperative learning has proven to be an effective approach. Students can cooperate through deliberate acts and small-group teamwork in cooperative learning. The objectives of cooperative learning practices are to improve social cohesiveness, accountability, teamwork, and group engagement (Ogunleye & Oladehin, 2012).

Elliot Aronson and associates established cooperative learning in 1978. The goal of the teaching strategy was to improve student cooperation and lessen racial segregation. To do this, the class divides into smaller groups. Teaching students about interdependence is the goal. Students in Jigsaw collaborate and share academic knowledge with one another (Slavin, 2011). Jigsaw learning, which emphasises task specificity, is the foundation for this. Every student, upon finishing a course work, is required to instruct the group. Throughout the lecture, the students must grasp their assignments. Cooperative learning based on jigsaws splits the course material into manageable chunks and assigns them to student groups. After then, these groups break into their parts to finish the learning assignment.

Slavin (2011) claims that there are four theoretical vantage points from which cooperative learning can be viewed: social cohesiveness, motivation, cognitive, and developmental. According to these views, when students collaborate on projects, they will inadvertently pick up important knowledge. Together, they can accomplish more than they could on their own. This validates the Zone of Proximal Development idea proposed by Vygotsky. As a result, group effort may yield better results than solitary work. The social cohesiveness theory states that members of a group will encourage one another to succeed in order to attain success as a group. Participants' social ties are strengthened by this. The cognitive perspective holds that collaboration leads to socio-cognitive conflict, which enhances thinking and perspective-taking. From a motivational standpoint, group achievement encourages members to put in more effort and support one another.

With the ultimate goal of improving students' academic achievement, there is currently a rising emphasis on the implementation of teaching approaches that facilitate collaborative group work among students. Students' academic success in a range of topics is significantly impacted by effective teaching strategies. Academic achievement is defined as the knowledge and skills gained in a subject area as determined by test and exam scores or grades assigned by the subject teachers. It serves as an illustration of how well students comprehend, analyse, apply, synthesise, and assess knowledge after receiving instruction. The body of research indicates that instructional practices have a growing impact on students' academic progress. Research has shown that the implementation of cooperative learning strategies improves student performance in a number of academic domains. Research has connected the use of Jigsaw cooperative learning methodologies with higher academic

achievement (Juweto, 2015; Abdullahi & Salisu, 2017). Abdullahi and Salisu (2017) found that students engaged in a jigsaw cooperative learning activity developed their cognitive and affective skills in science through debate and explanations given to one another in both expert and home groups. As a result, jigsaw cooperative learning has the potential to improve students' academic performance and retention of biology information.

Selecting the best teaching technique also heavily depends on how long students stay in the class. Martinez, Frick, Kim, and Fried (2020) defined retention as the process of information encoding, preserving, and retrieval. Through encoding or registration, information from the external environment can reach our senses, stimulating them chemically and physically. It needs that incoming data be taken in, examined, and saved. Retention, put simply, is the ability of students to hold onto knowledge over time. Students will perform better academically if they can remember new topics. Martinez et al. (2020) claim that Nigerian academics are become increasingly aware of the need of deep retention and achievement in science. Student retention is influenced by a variety of factors, including students' aptitudes, information-storage capacities, processing speeds, ability to combine processing and storing, ability to filter out irrelevant information, quality of knowledge representation, and teacher-led instruction. Low student retention in the sciences appears to be caused by the implementation of a teacher-centered approach that leads to poor academic retention and the acquisition of necessary skills. For outstanding idea retention, a method that prioritises the demands of the students is therefore required. One of the modern student-centered teaching strategies, the jigsaw model, encourages students to work in groups of four to six to complete tasks, exchange ideas, and develop their own expertise. Studies have shown that jigsaw model lessons are effective for both cognitive and affective elements, including enhanced retention and meaningful learning (Gumel, 2015). In light of this, the goal of this study was to identify the best approach for teaching biology by comparing the effects of lecture and jigsaw cooperative learning on students' academic performance and biology retention in Delta Central Senatorial District.

Statement of the Problem

A primary goal of biology education in Nigerian secondary schools is to generate dynamic learners who will make valuable contributions to the nation's progress. The quality of scientific graduates from Nigeria's secondary schools appears to be declining, despite the government's efforts to improve education in the nation (Chukwu & Arakoyu, 2019). In the specific instance of biology, it is evident that while the subject is important for science, students are not performing well in it on external exams like the WASSCE.

The low academic performance of students has led to an ongoing reduction in the quality of education in Delta State, Nigeria, and throughout Nigeria. The subpar academic performance of the students may be ascribed to inadequate application of the Biology curriculum through the use of unsuitable teaching techniques. For the teaching of biology, a variety of instructional techniques have been suggested, including problem-solving, cooperative learning, 5E learning cycle, guided inquiry, and guided discovery. Nonetheless, based on the researcher's personal observations, the majority of secondary school teachers in Nigeria employ the lecture style of instruction. Since most students remain passive during instruction, the usage of the lecture technique may be related to students' low performance in biology. Because they are not engaged during instruction, students end up memorising the material they have learnt. Furthermore, lecturing does not encourage student interaction during teaching. Through student interaction, students who struggle with learning might benefit from the knowledge of other students who have a strong grasp of the subjects they have acquired. Compared to the lecture technique, an instructional style like jigsaw cooperative learning that encourages students' active participation and engagement during instruction may improve students' academic progress and recall of biology. Thus, the goal of this study was to determine whether or not using jigsaw cooperative learning improves students' academic performance and recall of biology in comparison to the lecture method.

Purpose of the Study

This study compared the effect of the jigsaw cooperative learning and lecture method on the academic performance and retention of biology students. The study specifically aimed to ascertain:

i. whether there was a difference in the mean achievement scores of students taught biology using the jigsaw cooperative learning strategy compared to those taught with the lecture method, and

ii. whether there was a difference in the mean retention scores of those students taught biology using the jigsaw cooperative learning strategy compared to those taught with the lecture method.

Hypotheses

The investigation was further directed by the following hypothesis.

1. The mean achievement scores of students taught Biology using the Jigsaw cooperative learning strategy and those taught using the lecture method do not differ significantly.
2. The mean retention scores of biology students taught using the jigsaw cooperative learning strategy and those taught using the lecture method do not differ significantly.

METHODS

The design of the investigation was quasi-experimental. It was expressly decided to use the pre-test, post-test planned variation design. The study's decision was based on the fact that intact classes were utilised since school administrators forbade the students from being randomly assigned to treatment groups. 7,915 SSII Biology students from the 187 Public Senior Secondary Schools in the Delta Central Senatorial District made up the study's population. In particular, the study's sample consisted of 219 public SSII Biology students in four complete courses in the Delta Central Senatorial District. Using a straightforward random selection technique, the researcher chose four schools at random from the total population. The BAT, or Biology Achievement Test, was utilised to gather data. BAT was selected from six-week biology education packages covering the following topics: (1) plant reproduction; (2) vertebrate reproduction; and (3) pollination. The 50 multiple-choice test items on the BAT were created by the researcher and validated by three experts: an expert in measurement and evaluation at Delta State University in Abraka; an experienced biology teacher from a school in the Ethiope East Local Government Area of Delta State; and a lecturer in science education with a focus on biology. The Kuder-Richardson 21 was used to determine the BAT's reliability. This approach is employed because it is suitable for objective test items with dichotomous scoring. Thirty students from a school outside the research region in Warri North Local Government, Delta State, were given the instrument, and the results were assessed for reliability using Kuder-Richardson formula 21. A value of 0.75 for the reliability coefficient was achieved.

Using jigsaw cooperative learning and lecture methods, respectively, the students in the two treatment groups were taught the following biology concepts: (1) reproduction in vertebrates, (2) reproduction in plants, and (3) pollination. Prior to the treatment, pretests were given, and then a posttest. Four weeks following the initial posttest, a delayed posttest was given again to gauge students' retention. The results were examined using the t-test.

RESULTS

HO_1: The mean achievement scores of students taught Biology using the Jigsaw cooperative learning strategy and those taught using the lecture method do not differ significantly.

Table 1: Independent Samples t-test Statistics Showing Comparison of Pretest Mean Scores of Students Taught Biology Using Jigsaw Cooperative Learning and Lecture Method

Method	N	$\bar{x}$	SD	df	t-cal.	Sig. (2-tailed)	Decision
Jigsaw cooperative	98	27.82	5.94	217	1.819	0.070	Not Significant
Lecture	121	29.31	6.09				

Table 1's group t-test comparison revealed a non-significant difference (t-cal = 1.819, P(0.070) > 0.05). This suggests that there is no discernible difference between the two groups' pretest results. Thus, hypothesis 1 was tested using the t-test.

Table 2: Independent Samples t-test Statistics Showing Comparison of Posttest Mean Scores of Students Taught Biology Using Jigsaw Cooperative Learning and Lecture Method

Method	N	$\bar{x}$	SD	df	t-cal.	Sig. (2-tailed)	Decision
Jigsaw cooperative	98	67.33	9.58	217	7.449	0.000	Reject hypothesis
Lecture	121	58.20	8.53				

Table 2 indicates a significant difference (t-cal = 7.449, P(0.000) < 0.05) between the posttest mean achievement scores of students taught Biology utilising the Jigsaw cooperative learning approach and the lecture technique. Consequently, the null hypothesis is disproved. Consequently, a noteworthy distinction exists between the average achievement levels of Biology students instructed through the Jigsaw cooperative learning approach and those instructed through lecture-style instruction, with the advantage going to the students in the Jigsaw cooperative learning group.

HO_2: The mean achievement scores of students taught Biology using the Jigsaw cooperative learning strategy and those taught using the lecture method do not differ significantly.

Table 3: Independent Samples t-test Statistics Showing Comparison of Mean Retention Scores of Students Taught Biology Using Jigsaw Cooperative Learning and Lecture Method

Method	N	$\bar{x}$	SD	df	t-cal.	Sig. (2-tailed)	Decision
Jigsaw cooperative	98	61.33	9.58	217	12.332	0.000	Reject hypothesis
Lecture	121	46.20	8.55				

Table 3 demonstrates the substantial difference in mean retention scores between students taught Biology using the Jigsaw cooperative learning approach and the lecture technique (t-cal = 12.332, P(0.000) < 0.05). Consequently, the null hypothesis is disproved. The mean retention ratings of students taught Biology using the Jigsaw cooperative learning strategy and those taught using the lecture method differ significantly, favouring the students in the Jigsaw cooperative learning group.

DISCUSSION

The results of the study demonstrated a statistically significant difference, favouring the Jigsaw cooperative learning group of students, between the mean achievement scores of students taught Biology using this cooperative learning strategy and those taught using the lecture method. This suggests that when biology is taught using Jigsaw cooperative learning, students perform better academically than when biology is taught through lectures. Peer learning and active involvement may be the reason for the improved achievement ratings of biology students who were taught utilising jigsaw cooperative learning. Students actively participate in discussions, work together with their classmates, and instruct each other on the prescribed Biology topics when using the Jigsaw cooperative learning technique. Comparing this active engagement to the lecture method's passive listening could improve student achievement results. Additionally, students teach each other portions of the topic in the jigsaw technique. Peer-to-peer instruction has the potential to increase comprehension of the subject being learnt, foster critical thinking, and deepen understanding. This study supports the findings of Johnson et al. (2020), who discovered that, in comparison to the standard lecture method, jigsaw cooperative learning in biology courses resulted in considerable advances in students' knowledge of complicated biological concepts. According to the study, students who engaged in jigsaw activities demonstrated greater levels of achievement and knowledge retention over time. Similarly, this result supports the findings of Freeman (2014), who examined the differences between active learning and standard lecture methods in a major undergraduate biology course. When compared to students in the standard lecture group, the researchers discovered that students in the active learning group demonstrated noticeably larger achievement gains.

The study also revealed a statistically significant difference, favouring the Jigsaw cooperative learning group of students, between the mean retention scores of students taught Biology using this cooperative learning style and those taught using the lecture method. This shows that students who learnt biology through jigsaw cooperative learning outperformed their peers who learnt the subject through lectures in terms of recall ratings. Put another way, students who taught biology using jigsaw cooperative learning remembered the material better than those who taught it through lectures. This might also be based on how well kids participate actively, work together, and strengthen their problem-solving abilities thanks to jigsaw cooperative learning. Using the jigsaw cooperative learning technique, students actively participate in discussions, work together with their classmates, and instruct each other on the assigned topics. In comparison to students that only listen to their instructor instruction in a lecture style group, this active participation may have translated into higher recall results. The jigsaw method's collaborative learning also fosters in children a sense of community, teamwork,

and communication skills. This cooperative setting might improve information retention and learning results. Once more, the jigsaw technique necessitates group problem-solving and discussion among students. Long-term retention of the information and critical thinking abilities can both be enhanced by this proactive approach to problem-solving. This result supports the findings of Prince (2024) and Eddy and Hogan (2014) as well. The effect of active learning techniques on student retention in undergraduate biology courses was studied by Eddy and Hogan (2014). According to the findings, students who engaged in active learning exercises including problem-solving exercises and group discussions performed better than their counterparts in conventional lecture-based groups. Prince (2024), in contrast, examined a number of research regarding the efficacy of various science teaching strategies. When compared to traditional lecture-based training, the analysis showed that interactive and student-centered approaches—like cooperative learning—led to higher student achievement and information retention.

CONCLUSION

In comparison to the lecture approach, it was found that jigsaw cooperative learning improves students' comprehension and long-term recall of biology knowledge more.

RECOMMENDATIONS

The study's conclusions lead to the following suggestions being made:

1. Jigsaw cooperative learning is a teaching strategy that biology teachers should implement since it encourages students to actively participate in the teaching-learning process.
3. Whenever a teaching strategy is chosen for biology training, biology instructors ought to make an effort to include more cooperative learning activities.
4. The government should always provide teachers and students with specialised training on the successful use of jigsaw cooperative learning to help them become proficient in utilising this teaching approach in the teaching and learning processes.

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