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EFFECTS OF JIGSAW LEARNING STRATEGY ON SCIENCE STUDENTS' PERFORMANCE AND INTEREST IN BIOLOGY IN SELECTED SCHOOLS IN RIVERS STATE, NIGERIA.

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Abstract

The effective teaching and learning of Biology in schools have roles to play in the overall science education programme. Among science students whose future careers depend on good performance not only in Biology but in other science subjects, the quality of teaching and learning with the use of strategies that could help improve achievement and sustain their interests need to be tried out. The study determined the effects of Jigsaw learning strategy on senior secondary school students' performance and interest in Biology in Eleme Local Government Area of Rivers State, Nigeria. The study used the quasi-experimental, pretest, posttest, control group design. 92 students from intact Science classes in public coeducational senior secondary schools participated in the study. Instruments include: Biology Performance Test (r=0.88) and Biology Students Interest Scale (r=0.85) in addition to the stimulus instruments for the Jigsaw and conventional lecture. Treatment procedures for the experimental and control group lasted six weeks. Data obtained were analyzed using Analysis of Covariance. The findings indicated significant difference in the science students' performance and interest scores across the experimental and control groups (P<0.05).In both cases, students taught with the Jigsaw strategy achieved greater improvement in their mean scores than those taught with the conventional lecture method. The study recommended that teachers should adopt the Jigsaw learning strategy in classroom practice.

Keywords: Jigsaw-Puzzle, Learning Strategy, Students' performance, Science Students, Biology.

Introduction

The position of Biology among other school science subjects is basic, complimentary as well as utilitarian. As a basic subject, it provides necessary ingredients for the understanding of some chemistry and physics contents. It is complimentary as it provides certain processes and contents which presented side-by-side with constructs taught in other sciences, make learning more meaningful. The utilitarian place of Biology is such that it makes use certain chemical and physical subject matter in the explanation of biological processes and principles. These

are in tandem with the assertions of Bioexplorer (2018) that the preoccupations of Biology cover the study of and about life, provision of in-depth understanding of the several interactions between living and non-living organisms. The workings of the human body make use of chemical processes, for example, food digestion, respiration, sweating and the nervous system. Physics, considered as a science of how things move, is relevant to the biological study of retina behaviour and eye defects such as colour blindness (Socratic Q&A, 2018). These show that Biology shares a lot with Chemistry and Physics and student exposure to physics and chemistry have roles to play in the effective study of Biology.

As obtainable in other sciences, the processes involved in the learning of Biology concepts require application of scientific principles (Chukwu & Arakoyu, 2019). To enhance learner comprehension and ability to internalize fundamental concepts and appreciate biological principles as a science subject, appropriate instructional materials and diverse teaching strategies have been advocated, tried and recommended based on facts obtained over the years. The success or otherwise of such teaching activities and use of resources depends to a large extent on the teaching methods employed by the classroom teacher (Ogunleye, 2014).

In several classroom situation, the use of the conventional lecture method where the teacher employs the 'chalk and talk' approach, without significant participation of students. The students remain passive during the whole class process and rote learning becomes the order of the day. While this may be easier for the teacher to adopt and implement, it is detrimental to the academic development of students. Indeed, for the 2000-2009 period, students' performance in the Senior School Biology examinations in Nigeria was poorest among the school science subjects (Ogunleye, 2011). More recent reports of students' performance in the West Africa Examinations Council showed that 50.02% and 35.82% failed Biology in 2018 and 2019 respectively. While this trend calls for serious attention of all stakeholders, more effective strategies which can enhance the study of science where the students will be active participants have been advocated (Ogunleye & Bamidele, 2013) and need to be explored.

There have been gradual paradigm shifts towards the adoption of cooperative teaching and learning strategy, where the students are expected to be active participants in the teaching-learning process. The hallmark of the cooperative learning strategy is to make the students themselves the drivers of their learning process. The essence is for the students to work in small groups and be actively engaged in researching into the topics and concepts (Johnson, Johnson& Smith, 2014). The cooperative learning strategies enables the students to synthesize, analyze, and apply different concepts involved in their study.

Cooperative learning has become entrenched in the teaching-learning situation as an instructional strategy with great potential and impact (Ogunleye, 2013). Cooperative learning allows students to work together in small groups, with each participating in the learning process along structured activities. The essence of cooperative learning strategies is to ensure the active participation of each and every member of the learning group, engender team spirit, entrench accountability and foster social cohesion among the work groups (Ogunleye & Oladehin, 2012).

One of the cooperative learning strategies is the Jigsaw puzzle. It was developed by Elliot Aronson and colleagues in 1978. The essence of the learning strategy was to reduce interracial

segregation and foster cooperation among the students. In order to achieve this objective, the class is divided into small groups. The essence of doing this is to create an atmosphere of interdependence among the students. According to Slavin (2011), in Jigsaw practice, the students act interdependently to assist and learn the academic content from each other. This is based on the fact that Jigsaw learning strategy revolves around task specialization. Each student is assigned a specific task of the lesson module to work on, after which they are expected to teach the other members of the group. In this aspect, the students are expected to achieve significant level of mastery of the lesson tasks assigned to them. Jigsaw-based cooperative learning is a cooperative learning strategy in which lesson contents are subdivided into different parts of information and given to groups of students who would later explain to each other their parts and these results in the whole jigsaw puzzle to be completed.

The effectiveness of Jigsaw puzzle learning strategy as a cooperative learning strategy is based on the social learning theory by Slavin (2009). According to Slavin (2009), the efficacy of the cooperative learning technique is anchored on four theoretical perspectives viz; developmental, cognitive, motivational and social-cohesion. These theoretical perspectives include:

i. Interaction among the learners when undertaking tasks will inadvertently enhance their mastery of the critical concepts. This is because they can achieve a lot more when working in groups than when working alone. This agrees with Vygotsky's Zone of Proximal Development. Under this situation, the students model each other as a group than they will, working as individuals, hence, the possibility of higher level of achievement.
ii. From the social cohesion perspective, there is an argument that the drive for group success would bind the group members together where each member of the group strives to prod other members to success in order to achieve group success. While doing this, there is the development of social bonds among the members.
iii. The cognitive perspective holds that socio-cognitive conflict arises as a result of individuals working together and cognitive disequilibrium is created which stimulates perspective-taking ability and reasoning.
iv. The motivational perspective argues that group success drives individual members to exert themselves and also to encourage others to succeed in order to achieve group success.

Appropriate teaching strategies have profound influence on students' performance in diverse subjects. Existing literature has shown increased influence of teaching methods on students' performance. Cooperative learning strategies have been shown to significantly increase students' achievement in different subjects. There have been studies that correlate jigsaw puzzle learning strategy with enhanced academic performance (Juneto, 2015; Abdullahi & Salisu, 2017; Doymus, 2007). Another important reason for applying the appropriate teaching strategy is to engage the student in the activities. Students' interest is critical in the teaching-learning process. This is because interest derives curiosity, engagement, commitment and the determination to succeed. It is the students' interests that drives their zeal to learn. According to Krapp, Hidi and Renninger (2015), there had been a systematic interest in the relationship between student's interest and learning since the early 19th century.

There is a growing body of evidence that students' interests are enhanced when they actively participate in activities regarding lesson objectives and lesson outcomes (Mitchell, 1999; Wiseman & Hunt, 2013). This linkage underpins the paradigm of cooperative learning strategy where the students are the main drivers' of the process in their active engagement and participation. The development of interest often leads to more robust participation, focused attention and enhancement of cognitive abilities of the students (Wigfield & Cambria, 2010). This argument is based on the fact that interest motivates students to learn and this linkage affects their academic performance. It is in view of these that the study became necessary. The main aim of the study was the determination of the extent of improvement in senior secondary school students' performance and interest in Biology when the Jigsaw learning strategy was applied.

Hypotheses

The following hypotheses were formulated and tested at .05 significance level.

1.There is no significant difference in the Biology achievement scores of students taught with Jigsaw-Puzzle Strategy and Conventional Lecture Method.

2.There is no significant difference in the Biology interest scores of students taught with Jigsaw puzzle learning strategy and those taught with conventional lecture method.

Methodology

The study employed the quasi-experimental version of the pretest, posttest, control group research design.92 science students from selected coeducational secondary schools in Eleme Local Government Area of Rivers State, Nigeria were purposively selected. Intact classes were used with classes randomly assigned to treatment groups. The experimental group was taught using the Jigsaw puzzle learning strategy while the control group was taught with the traditional lecture method. The researchers developed two response instruments for the study. The Biology Performance Test (BPT) and Biology Students Interest Scale (BSIS). The BPT was used to measure the level of achievement of the students before and after treatment and it comprises 20 multiple-choice objective test items, 10 fill-in the blank spaces type of items and two essay-type questions. The BPT test items were drawn from the Senior School Biology National curriculum based on the topic taught which 'the respiratory system' was. The researchers benefited from the assistance of experienced Biology teachers who participated in the study as research assistants. The teachers were trained on the use of Jigsaw puzzle learning strategy. The teachers administered the two teaching strategies to the experimental group (Jigsaw puzzle) and the control group (lecture method) respectively. The BSIS consists of eight items with a 5-point weighted response options of Very Much Like Me (5), Like Me (4), Indifferent (3), Unlike Me (2) and Very Much Unlike Me (1). The item statements cover the four domains of interest including emotion, value, knowledge, and engagement. The study was conducted over a period of six weeks. The pretest was administered to the students in the first week. The experimental group was sub-divided into groups of seven and each group assigned a subtopic on the lesson. They were asked to assign each member a part of the subtopic to work on after which the members taught others. This was carried out every week within the study period.

Steps involved in the Jigsaw Strategy

The jigsaw technique organized classroom activity with students' independence on each other for success. Classes were split into groups, assignments broken into pieces for the group

assemblage of the tasks towards completion of the (jigsaw) puzzle. The mixed groups worked on small problems that the group collated into a final outcome. Students were split into groups with one member assigned to each topic. Working individually, each student learnt about their topic and presented it to their group. Next, students gathered into groups divided by topic and each member presented to the topic group. In same-topic groups, students reconciled points of view and synthesized information gathered and a final report was presented. Finally, the original groups reconvened to listen to presentations from each member. The final presentations afforded all group members an understanding of their own material, as well as the added information from topic-specific group discussions.
STEP ONE: Division of students into 5- or 6-person jigsaw groups diverse in terms of gender, ethnicity, race, and ability.
STEP TWO: Appointment of a student from each group as the leader, possibly the most mature student in the group.
STEP THREE: Division of the day's lesson into 5-6 segments.
STEP FOUR: Assignment of each student to learn one segment.
STEP FIVE: Giving students time to read over their segments at least twice to become familiar with it without memorization.
STEP SIX: Formation of temporary "expert groups" with one student from each jigsaw group and joining other students assigned to the same segment. There was opportunity for discussion of the main points of their segment and rehearsal of the presentations.
STEP SEVEN: Bringing the students back into their jigsaw groups.
STEP EIGHT: Asking each student to present their segment to the group while encouraging others in the group to ask questions for clarification.
STEP NINE: Floating from group to group, observing the process.If any group has trouble, an appropriate intervention was provided.
STEP TEN: At the end of the session, students were given a quiz on the material.
These steps were followed by revision and posttest in the final week. Students' interest in Biology was also measured. The data obtained were analyzed at 0.05 level of significance with the Analysis of Covariance statistic and interpretations based on the works of Ogunleye (2008).

Results

Hypothesis One

There is no significant difference in the Biology achievement scores of students taught with Jigsaw-Puzzle strategy and Conventional Lecture Method.

Table 1: ANCOVA of Students' Achievement in Biology by Treatment

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	1840.57	2	920.28	84.14	.00	.65
Intercept	814.40	1	814.40	74.46	.00	.45
Pretest scores	982.62	1	982.62	89.84	.00	.50
STRATEGY	**177.99**	**1**	**177.99**	**16.27**	**.00***	**.15**
Error	973.34	89	10.93			
Total	100640.00	92				
Corrected Total	2813.91	91				

*Significant at P<0.05

Table 1 shows the summary of Analysis of Covariance on the difference in the achievement scores of students taught Biology using Jigsaw Puzzle and those in conventional Lecture Method group. The results showed that there is a significant difference in the achievement mean score of students taught Biology using Jigsaw Puzzle and conventional Lecture Method strategies ($F_{(1,91)} = 16.27$, $P<0.05$). Based on this, the hypothesis was rejected. There is, therefore, a significant difference in the mean achievement scores of students taught with Jigsaw Puzzle strategy and those taught with conventional lecture method. The estimated marginal means on Table 2 shows the magnitudes of achievement scores in the two groups.

Table 2: Estimated Marginal Mean for Students' Achievement in the Jigsaw Puzzle and Lecture Method

			Boundaries	
Strategy	**Mean**	**Std. Error**	**Lower**	**Upper**
LECURE	30.97	.53	29.91	32.02
JIGSAW	34.04	.49	33.06	35.03

Table 2 shows the marginal mean Estimates for the study. From the table, there is significant difference in the mean Achievement scores of students taught with Jigsaw-puzzle learning strategy and those taught with Conventional Lecture Method. The Jigsaw class had an estimated mean achievement score of 34.04 (standard error = 0.49) which was higher than the Conventional lecture class which had an estimated mean achievement score of 30.97 (standard error = 0.53). These two mean scores were compared on the line graph in Figure I.

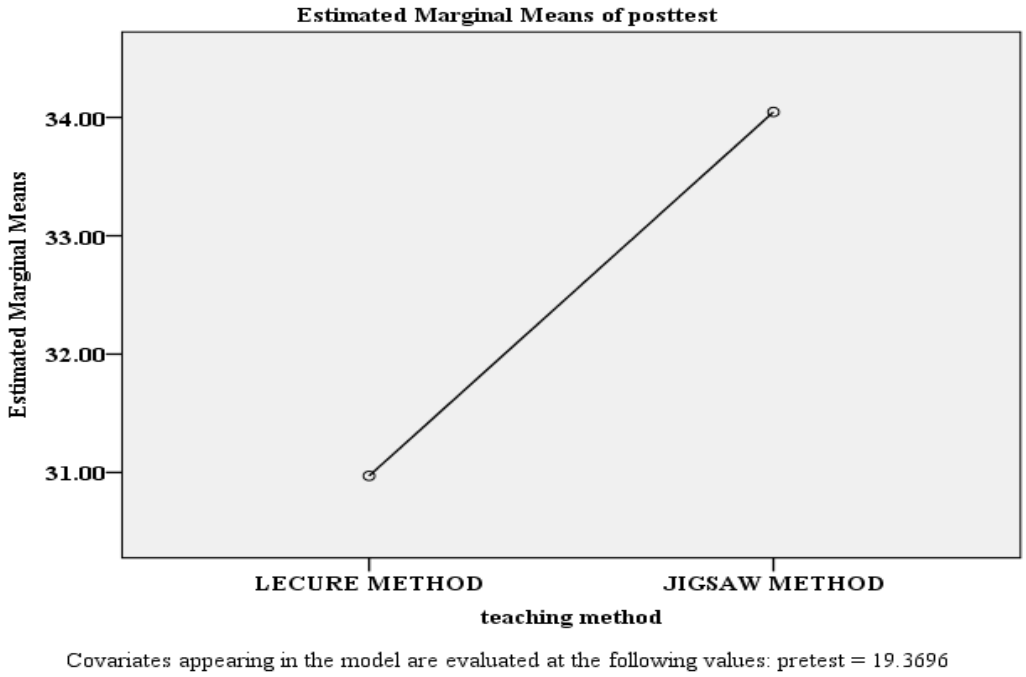

Fig. 1: Estimated Marginal Means of students achievement scores based on Jigsaw-puzzle and conventional lecture method

Hypothesis Two

There is no significant difference in the Biology interest scores of students taught with Jigsaw puzzle learning strategy and those taught with conventional lecture method.

Table 3: ANCOVA of Students' Interest in Biology by Treatment

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	1.17	1	1.17	94.57	.00	.51
Intercept	30.11	1	30.11	2416.22	.00	.96
Strategy	**1.17**	**1**	**1.17**	**94.57**	**.00***	**.51**
Error	1.12	90	.01			
Total	33.32	92				
Corrected Total	2.30	91				

*Significant at P<0.05

Table 3 showed that a significant difference was obtained between the students' interest scores in Biology across those taught using the Jigsaw Puzzle and the Conventional Lecture Method ($F_{(1, 91)}$ =94.57; P<0.05). The null hypothesis was rejected and it was concluded that there is significant difference in the Biology interest scores of students taught with the Jigsaw Puzzle Strategy and those taught with Conventional Lecture Method.

Table 4: Estimated Marginal Means for Interest in Biology in Jigsaw Puzzle and Lecture Method

			Bounds	
Strategy	**Mean**	**Std. Error**	**Lower**	**Upper**
LECURE	46.20	.06	42.00	49.50
JIGSAW	68.52	.07	65.00	71.00

Table 4 shows that the Jigsaw group had an estimated mean interest score of 68.52 with standard error of 0.06 while the Conventional lecture group obtained an estimated interest mean score of 46.20 with a standard error of 0.07. The Jigsaw learning strategy, therefore was more effective than the conventional lecture method.

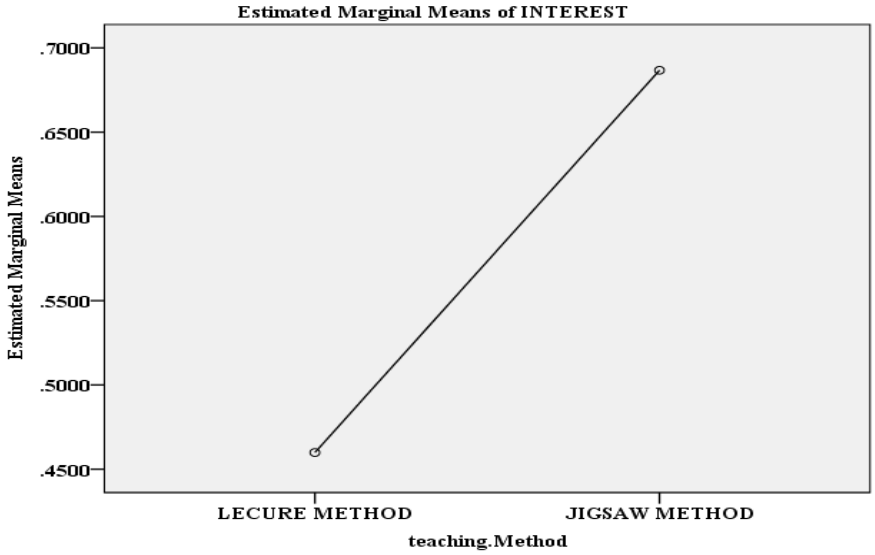

Fig. II: Graph of Estimated Marginal Means of Students' Interest in the Jigsaw-Puzzle and Conventional Lecture Method

Discussion

The findings of the study revealed that jigsaw puzzle as a cooperative learning strategy is an effective teaching method. The effectiveness of the strategy in improving students' achievement in Biology is in agreement with the findings of Bello (2016) and Chukwu and Arakoyo (2019) who reported similar findings in different contexts. The findings further revealed that the jigsaw puzzle learning strategy was more effective than the conventional lecture method in enhancing students' achievement (Juneto, 2015). This could have resulted based on the combination of individual, small group and whole group activities involved in the learning processes of Jigsaw.

The findings of the study also revealed that the jigsaw puzzle learning strategy improved the Biology interest of the students. There was significant difference between the interest scores of students taught with the jigsaw puzzle than those taught with conventional lecture method. This might be argued to be as a result of their active participation in the learning process and the interestingness of the Jigsaw group activities. This particular finding is in agreement with the findings of Darlington (2015) whose work demonstrated the importance of hands-on approach in teaching and the effectiveness of such strategies at improving students' interests.

Conclusion and Recommendations

Based on the findings of this study, it was concluded that jigsaw puzzle strategy proved very effective at improving students' achievement in Biology and interest in the subject. Based on these, the following recommendations were made:

i. That teachers of Biology should deploy cooperative learning strategies, especially the jigsaw puzzle strategy more often in the classroom to ensure more engagement and active participation of the students, thereby helping in the improvement of students' achievement and interests in Biology.
ii. That Biology teachers should be retrained through conferences, workshops and other capacity building activities to equip them with the necessary competence for handling cooperative learning strategies.

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