Effects of Jigsaw-puzzle and Graphic Organizer Instructional Strategies on Biology Students' Performance in Abia State

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

Short Research Article

ABSTRACT

The study investigated the effects of jigsaw-puzzle and graphic organizer instructional strategies on Biology students' performance in Ukwa West Local Government Area, Abia State. Three groups pre-test post-test control group non-equivalent quasi-experimental design was employed in the study. Two objectives, two research questions and two hypotheses guided the study. One hundred and fifty-one (151) senior secondary school one (SSS1) students out of a total population of 450 Biology students formed the sample size of the study. Biology Performance Test on growth (BPTOG) was used for gathering data. The instrument was tested using test re-test method and was validated by two experts in the Department of Curriculum Studies and Educational Technology, University of Port Harcourt, Nigeria. A reliability index of 0.75 was obtained using Pearson's Product Moment Correlation. The data was analyzed using mean and standard deviation to answer the research questions while analysis of covariance (ANCOVA) was used to test the hypotheses at 0.05 level of significance. The result of the study showed that Jigsaw-Puzzle and Graphic Organizer are effective instructional strategies for enhancement of students' academic

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performance in growth as a concept in Biology. It was recommended that Biology teachers should adopt Jigsaw-Puzzle and Graphic Organizer Instructional Strategies to teach the concept of growth in the class.

1. INTRODUCTION

The knowledge of Biology is needed for economic development especially in the area of Medicine, Pharmacy, Physical and Health Education and Biochemistry among others. Biology as a subject is designed to empower students with basic understanding about living organisms, the inter-relationship between them and other living things. Living organisms display organized structures, being made up of a cell or cells, they require energy to survive or sustain their existence, since they possess ability to reproduce and to grow. Biological disciplines apply a significant responsibility for the protection and welfare of all living species. In the National Policy of Education (NPE, 2014), Biology comes first under the Field of Studies: Science and Mathematics, followed by Chemistry, Physics, Further Mathematics, Health Education, Agriculture, Physical Education and Computer Studies. This means that Biology is a subject which students must pass if their overall success in the examination is to have any value. A credit pass in Biology is a compulsory requirement for any student seeking admission into all the institutions of higher learning in Nigeria.

Researchers like Isidor [1], Kalu [2] and Nkemka [3] had employed different strategies such as demonstration method, discussion method, explorative and field trip approach in teaching Biology concepts. Yet, students' performance in Biology is still dwindling. Meanwhile, the Federal Republic of Nigeria [4] in her Biology curriculum document, stipulated that Biology should be taught in such a way that it will help the students acquire adequate laboratory and field skills, meaningful and relevant knowledge in Biology through field studies, guided-discovery, laboratory techniques and skills.

In line with the above, Biology teachers are expected to ensure effective and meaningful teaching of Biology concepts to the students. Nevertheless, the poor and inappropriate method adopted by Biology teachers during classroom instruction has led to the poor performance of students in external examinations. In an attempt to help students learn and better understand the concepts of growth, jigsaw-puzzle and graphic organizer instructional strategies have been employed in this study. A major concern in science education is the development of teachers' pedagogical knowledge for improving classroom practice and students learning. Instructional strategies for easy implementation of Biology curriculum which encompasses affective domain could be Jigsaw-Puzzle and Graphic Organizer. Jigsaw-puzzle is a cooperative learning strategy. It needs a minimum of 30 to 50 minutes. Kelly [5] explained that Jigsaw-Puzzle improves social interactions in learning and supports diversity. The Jigsaw-Puzzle is comparable to the work place where each individual is expected to play a role to achieve a common goal. It is a training that leaves students as experts and receivers of knowledge. In a Jigsaw-Puzzle, the teacher divides learning experience into stages or sections. The teacher distributes the sub-topics to individuals in a group while students from different groups who have the same topic meet to have an in between groups discussion on the sub-topic allocated for the individuals to research their assigned area. Jigsaw-Puzzle is one of the strategies that teach peaceful coexistence, human worth, active participation of individuals, development of critical thinking and hard work. The strategy could be effective in learning a concept such as growth in Biology. It helps the teacher to cover a large content area within a short time. One other strategy which could enable students to achieve a higher academic performance is the graphic organizer instructional strategy. Different teaching strategies produce different results. The identification of the adequate teaching strategy for a group of students must be carried out if the best result must be attained or accomplished [6].

Graphic organizer has to do with the use of charts, concept mapping, pictures, diagrams or a table of relationship formulated by the teacher to teach students in the class. It is used to help students reflect on what they have learnt, easy recollection of facts or points and to clarify gaps in knowledge. It is an effective tool in acquiring and retaining knowledge. Graphic organizer guides students' thinking as they fill-in and build

upon a visual map or diagram. Graphic organizer is an effective visual learning strategy for students and is applied across the curriculum to enhance learning and understanding of subject matter content. It can be used in a variety of formats dependent upon the task. Also graphic organizer facilitates students' learning by helping students identify areas of focus within a broad topic such as growth in Biology. Furthermore, it helps the students make connections and think constructively. Students often turn to graphic organizer for writing projects.

In addition to helping students organize their thinking and writing process, graphic organizer act as instructional tool. Teachers can use graphic organizer to illustrate students' knowledge about a topic or section of text showing areas for improvement. The instructional strategies can be used by both male and female students. The concept of growth is a difficult concept for students at senior secondary stage of education. It therefore requires the application of innovative teaching and learning strategies in order to achieve the desired objectives. It is based on the above that the study investigated Jigsaw-Puzzle and Graphic organizer instructional strategies on Biology students' performance in Ukwa West Local Government Area, Abia State, Nigeria.

1.1 Statement of the Problem

The reports of chief examiners of the West African Senior School Certificate Examination Council (WASSCEC) on Biology results at the national level for the years 2016 and 2017 [7] showed that though enrolment at the West African Senior Secondary Certificate Examination (WASSCE) by candidates may be high, the percentage failure has also remained consistently high. The report clearly pointed out that the performance of Biology students in 2017 was slightly poorer with a raw mean score of 31 and standard deviation of 11.92 when compared with the raw mean score of 31 and the standard

deviation of 10.91 of WASSCE 2016. The West African Examination Council (WAEC) Chief Examiner's Report 2013, 2014, 2015, 2016, 2017 and 2018 noted that students' performance in Biology as seen on Table 1 is very poor.

This has raised doubts among educators about the effectiveness of the teaching methods adopted over the years by Biology teachers. Students' academic performance in Biology actually depends on many factors and stands out to show how well the subject is being taught. Based on this, the question now is can Jigsaw-Puzzle and graphic organizer instructional strategies improve students' performance in Biology?

1.2 Aim and Objectives of the Study

The aim of the study was to determine the effects of Jigsaw-Puzzle and graphic organizer instructional strategies on Biology students' performance on growth in Ukwa West Local Government Area, Abia State. Specifically, the objectives of the study were to:

1. Assess the effects of jigsaw-puzzle instructional strategy and lecture method on students' performance in the concept of growth in Biology.
2. Measure the effect of graphic organizer instructional strategy and lecture method on SS1 students' performance in the concept growth in Biology.

1.3 Research Questions

1. What is the effect of jigsaw-puzzle instructional strategy and lecture method on SS1 students' performance in the concept growth in Biology?
2. What is the effect of graphic organizer instructional strategy and lecture method on SS1 students' performance in the concept of growth in Biology?

Table 1. Performance of students in biology at SSCE level from 2013 to 2018

Year	No of students present	No of students pass	No of students fail	% pass	% fail
2013	182659	39125	143534	21	79
2014	228953	80355	148598	35	65
2015	250099	86150	163949	34	66
2016	289520	84520	205000	29	71
2017	326541	98215	228326	30	70
2018	367562	120560	247002	33	67

Source: WAEC Office (2018)

1.4 Hypotheses

Ho₁: There is no significant difference between the mean performance of SS1 students taught the concept of growth in Biology using Jigsaw-Puzzle instructional strategy and lecture method.

Ho₂: There is no significant difference between the mean performance of SS1 students taught the concept of growth in Biology using graphic organizer instructional strategy and lecture method.

2. METHODOLOGY

The study adopted a three group's pre-test post-test control group non-equivalent quasi-experimental design. Three groups (two experimental and one control group) from three mixed schools randomly selected were used. 151 Senior Secondary one (SS1) Biology students participated in the study. Biology performance test on growth (BPTOG) containing 20 objective questions was used to gather data after thorough validation by two experts in Department of Curriculum Studies and Educational Technology, University of Port Harcourt, Nigeria. A reliability index of 0.76 was obtained using Pearson's Product Moment Correlation Coefficient. The experimental groups were taught using Jigsaw-Puzzle and graphic organizer instructional strategy while the control group was taught using lecture method. Data obtained were analyzed using mean and standard deviation to answer the research questions while Analysis of Covariance (ANCOVA) was used to test the hypotheses at 0.05 level of significance.

3. RESULTS

The results are presented in the following tables:

Research Question one: What is the effect of jigsaw-puzzle instructional strategy and lecture method on SS1 students' performance in the concept of growth in Biology?

From Table 2, it was observed that students taught growth using Jigsaw-Puzzle had a score of 30.52 prior to treatment administration, while after treatment their post-test score was 54.80. For students in the control group who were taught using lecture method, their pretest mean performance was 32.30, while their post-test mean performance was 36.90. This result revealed that the mean gain for students in experimental group was 24.28, while for the control group it was 4.6. These results suggest that Jigsaw-Puzzle had a greater effect on students' performance in growth than lecture method.

Research Question two: What is the effect of graphic organizer instructional strategy and lecture method on SS1 students' performance in the concept growth in Biology?

From Table 3, it was observed that the pre-test mean performance of experimental group taught using graphic organizer instructional strategy was 34.90 while their post-test mean performance score was 52.75. For the control group taught using the lecture method, students had a pre-test score of 32.30 and a post-test score of 36.90. Considering the values, it can be seen that the mean gain between the pre-test and post-test mean performance of experimental group and the control group were 17.85 and 4.6 respectively. This result suggested that graphic organizer instructional strategy had a greater effect in the mean performance of students in growth than lecture method.

Table 2. Mean and standard deviation of pre-test and post-test performance of students using jigsaw-puzzle and lecture method

Group	n	Pre-test	SD	Post-test	SD	MD
JP	51	30.52	3.49	54.80	6.573	24.28
LM	53	32.30	4.52	36.90	5.60	4.6

Mean Difference

Table 3. Mean and standard deviation of pre-test and post-test performance of SS1 students using graphic organizer and lecture method

Group	N	Pre-test	SD	Post-test	SD	Mean difference
GOIS	47	34.90	3.57	52.75	7.20	17.85
LM	53	32.30	4.52	36.90	5.60	4.6

Table 4. Analysis of covariance of performance of SS1 students taught growth using Jigsaw-Puzzle and lecture method

Source	Type III sum of squares	df	Mean square	F	Sig.
Corrected Model	1502.556[a]	2	751.28	20.38	.000
Intercept	2212.39	1	2212.39	60.02	.000
PreP	120.68	1	120.68	3.27	.073
Group	1444.24	1	1444.24	39.18	.000
Error	3870.21	101	36.86		
Total	42521.00	104			
Corrected Total	5372.77	103			

Table 5. Analysis of covariance (ANCOVA) of performance of SS 1 students taught growth concept using graphic organizer instructional strategy and lecture method

Source	Type III sum of squares	df	Mean square	F	Sig.
Corrected Model	1145.148[a]	2	572.57	13.73	.000
Intercept	1966.66	1	1966.66	47.15	.000
Prep	80.09	1	80.09	1.92	.169
Group	974.53	1	974.53	23.36	.000
Error	4296.51	97	41.71		
Total	40002.00	100			
Corrected Total	5441.66	99			

Ho$_1$: There is no significant difference between the mean performance of SSI students taught the concept of growth in Biology using Jigsaw-Puzzle instructional strategy and lecture method.

The result in Table 4, revealed that the F-value of 39.183 obtained at 1 and 101 degrees of freedom had an associated p-value of .000, which is less than the chosen alpha of 0.05, it can be stated that Jigsaw-Puzzle had significant effect on the mean performance of students in growth as a concept in Biology. The null hypothesis was therefore rejected.

Ho$_2$: There is no significant difference between the mean performance of SS1 students taught the concept of growth in Biology using graphic organizer instructional strategy and lecture method.

From data analysis using (ANCOVA) in Table 5., it was seen that the F-value of 23.36 obtained at 1 and 97 degrees of freedom had a corresponding p-value of 0.000, which is less than the chosen alpha of 0.05 for the study. From this value, it was stated that there was a significant effect of graphic organizer instructional strategy on the mean performance of students in growth as a concept in Biology. The null hypothesis was therefore rejected.

4. DISCUSSION OF FINDING

From Table 1, results showed that Jigsaw-Puzzle had a greater effect on students' performance in growth as a concept in Biology than lecture. This result is in agreement with the findings of Ugwu [8] who showed that SS1 Chemistry students taught using Jigsaw-Puzzle recorded high academic performance in the mean scores than those taught using conventional method. Jigsaw-Puzzle gave students the opportunity to learn by constructing their own knowledge. Also, the result of Ayodele [9] agreed that students achieved better and retained more knowledge when taught with Jigsaw-Puzzle than demonstration method.

From Table 3, the results suggested that graphic organizer instructional strategy had a positive effect in the mean performance scores of students in growth as a concept on Biology than lecture method. This finding is in agreement with the study of Callinton [10] who found out that graphic organizers affect students' academic performance as the strategy encourages students mapping skills. However, the present finding contradicts the earlier findings of Bello [11] who found out that the strategy only has significant effect on students' academic performance when taught in combination with interactive teaching strategy.

5. CONCLUSION

The study concluded that the use of Jigsaw-Puzzle and graphic organizer instructional strategies in teaching have significant effect on the senior secondary school students' academic performance than lecture method in Growth as a

concept in Biology. The study therefore provided empirical evidence on the relative efficacy of interactive and learner centered strategy in enhancing the performance of students in Biology.

6. RECOMMENDATIONS

The study recommended that:

1. Biology teachers should adopt Jigsaw-Puzzle and Graphic Organizer Instructional Strategies in this 21st century classroom to encourage group learning among students.
2. Biology teachers should enroll and attend seminars, conferences, workshops organized by both government and non-government agencies.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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