Effects of Jigsaw-Puzzle Instructional Strategy on Secondary School Students' Performance on Growth as a concept in Biology in Abia State

Abstract

The study examined the effects of jigsaw-puzzle instructional strategy on secondary school students' performance on Growth as a concept in Biology in Ukwa West Local Government Area, Abia State. Gender effect on Biology students' performance was also investigated. Two objectives, two research questions and two null hypotheses guided the study. A quasi-experimental design was adopted in this study. One hundred and fifteen (115) Biology students from two mixed secondary schools randomly selected formed the sample size. Biology Performance Test on Growth (BPTOG) which contained twenty (20) multiple-choice questions was used for gathering data. Test re-test method was to test the instrument. The BPTOG was validated by two experts in the Department of Curriculum Studies and Educational Technology, University of Port Harcourt, Nigeria. Reliability index of 0.76 was obtained using Pearson's Product Moment Correlation Coefficient. Mean and Standard deviation was used in answering the research questions and Analysis of Covariance (ANCOVA) was used to test the hypotheses at 0.05 level of significance. The findings of the study showed that there was a significant difference between the academic performance of students in the experimental group and those in control. More so, gender has no effect on Biology students' performance in the jigsaw-puzzle group. It was recommended that Biology teachers should adopt Jigsaw-Puzzle Instructional Strategy in this 21st-century classroom to encourage group learning among students.

Keywords: Jigsaw-Puzzle, Instructional Strategy, Growth.

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Introduction

Biology is one of the three main science subjects taught and learnt at the senior secondary school level in Nigeria educational system. Biology has to do with the study of living things, their characteristics and interactions with the environment (Michael, 2017). Biology plays an important role especially in the explanation of complex life processes, structures, functions, origin, evolution and distribution of living organisms. The knowledge of Biology is needed for national development and global competitiveness in the area of Medicine, Agriculture and Physical and Health Education, especially in sports and environmental studies among others. The subject is designed to empower students with basic knowledge about the functioning of their

body system, inter-relationship between them and other living things and environmental sustainability. The Unified Tertiary Matriculation Examination (UTME) requirement for admission of students into tertiary institutions in Nigeria is a credit and above in Biology in the Senior Secondary School Certificate Examination (SSSCE) in addition to English Language, Mathematics and two other subjects.

In the Biology Curriculum document of Nigerian Educational Research and Development Council (NERDC) (FRN, 2014), it was stipulated that Biology should be taught in a way that will help students acquire adequate and relevant laboratory skills and management in the subject. In the National Policy on Education (NPE, 2014), Biology comes first under the theme: "Fields of Studies": ina sub-titled theme: "Science and Mathematics", followed by Chemistry, Physics, Further Mathematics, Health Education, Agriculture, Physical Education and Computer Studies. The learning of Biology contents should be through field studies, guided-discovery, laboratory techniques and skills coupled with conceptual skills. This requires a Biology teacher to have adequate pedagogical knowledge to facilitate the proper transmission of quality information.

A major concern in science teacher education is the development of teachers' pedagogical content knowledge for improving classroom practice and students learning. Preliminary observation has proved that Biology teachers use the conventional method to teach most of the topics in Biology, giving large notes and assignments meant to keep the learners busy without positive impact on their cognition and affection.

Education can only be functional if the knowledge acquired is applied to solve problems. In recent time, education has been given top priority in the affairs of many nations, since the desire of man over the years has been knowledge acquisition. The attraction which education enjoys stems from the fact that it equips one for life and enables an individual to master his or

her environment and acquire the necessary tools for living a worthwhile life. The aspect of education that involves the teaching of scientific principles and generalizations to the individuals of the society which aims at making them become scientifically literate citizens is referred to as Science Education. Science Education is strongly rooted in sciences. Scientific literacy is the ability to make well-informed decisions and choices based on the possession of a basic core and cognitive awareness of scientific facts, ideas, realities, principles and theories as well as the possession of fundamental technical skills in Science (Akuba, 2016). This implies that the general goal of science education is to develop scientifically literate citizens with the necessary intellectual resources, values, attitudes and inquiry skills to promote the development of man as a rational human being capable of critical thinking. The future of any nation in terms of Science and Technology depends ultimately on the performance of students in science subjects taught at the secondary school level to help students continue in science-related courses at the higher institution. Science and Technology is the pivot upon which national development rotate. Based on this, the aim of Science Education is achievable if quality attention is given to the instruction of students, especially at the secondary school level. Teaching of science subjects generally and Biology in particular at the secondary school level calls for rapt attention if the objectives of science education can be achieved.

Instructional strategy for easy implementation of Biology curriculum which embraces affective domain could be Jigsaw-puzzle instructional strategy. Kelly (2016) defined Jigsaw-puzzle as a type of cooperative learning which improves social interactions in learning and supports diversity. The Jigsaw-puzzle is comparable to the workplace where each individual is expected to play a role to achieve a common goal. It is a strategy that leaves students as experts and receivers of knowledge. In a Jigsaw-puzzle, a teacher divides learning experience into stages

or sections. The teacher distributes the sub-topics to individuals in a group. Students from different groups who have the same topic meet together to have a between groups discussion on the sub-topic allotted for individuals to research their assigned area. Jigsaw-puzzle is one of the strategies that teach peaceful coexistence, human worth and the development of critical thinking and hard work. The strategy could be effective in learning concept such as growth in Biology.

There is, therefore, the need to use teaching strategies that encourage gender equality, positive interdependence and group work so as to motivate the students for higher academic performance. This strategy encourages male and female participation in group work and in the search for knowledge. The use of Jigsaw-puzzle for teaching allows individualization of learning and encourages students to seek out the content they like. Students interact in a traditional classroom with their colleagues in order to learn new lessons. There is, therefore, a wide gap to be filled which the use of active interactive strategy can take care of. Based on the above, the study focused on the effect of Jigsaw-puzzle instructional strategy on secondary Biology school students' performance on growth in Ukwa West Local Government Area, Abia State.

Statement of the Problem

The underperformance of Biology students in West African Senior School Certificate Examination in Nigeria has become a worrisome situation that calls for urgent attention. Chief examiners' report on West African Senior School Certificate Examination 2017 showed 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 of 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.

Table1: **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).

Students' poor academic performance to some extent is traceable to inappropriate instructional strategies used by the teachers. This concern in mind and the fact that the world is changing towards the campaign of a knowledge-based economy, teachers are expected to use interactive teaching strategies that can help students develop the capacity for world competitiveness among the committee of nations.

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Aim and Objectives of the Study

The aim of the study was to determine the effect of Jigsaw-puzzle instructional strategy on secondary school Biology students' performance on Growth in Ukwa West Local Government Area, Abia State. Specifically, the objectives of the study were to:

1. Find out the academic performance of Biology students taught Growth using jigsaw-puzzle instructional strategy and Lecture Method.
2. Compare the academic performance of male and female students taught Growth using jigsaw-puzzle instructional strategy.

Research Questions

1. What is the academic performance of Biology students taught growth using jigsaw-puzzle instructional strategy and Lecture Method?
2. What is the academic performance of male and female students taught growth using jigsaw-puzzle instructional strategy?

Hypotheses

The hypotheses were formulated and tested at 0.05 level of significance.

Ho_1: There is no significant difference in the academic performance of students taught growth using Jigsaw-puzzle instructional strategy and Lecture Method.

Ho_2: There is no significant difference in the academic performance of male and female students taught growth using Jigsaw-puzzle instructional strategy.

Methodology

The study adopted a quasi-experimental design. Two groups (experimental and control) from two mixed schools were used**.** 115 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 with a reliability index of 0.76 using Pearson Product Moment Correlation by two experts in Department of Curriculum Studies and Educational Technology, University of Port Harcourt, Nigeria. The experimental group was taught using Jigsaw-puzzle instructional strategy while the control group was taught using the

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lecture method. Data obtained were analyzed using mean and standard deviation to answer the research questions while ANCOVA was used to test the hypotheses at 0.05 level of significance.

Results

The results are presented in the following tables

Research Question 1: What is the academic performance of Biology students taught Growth using jigsaw-puzzle instructional strategy and 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	Mean Gain
JP	51	30.52	3.49	54.80	6.57	24.28
LM	53	32.30	4.52	36.90	5.60	4.6

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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 the lecture method, their pre-test mean performance was 32.30, while their post-test mean performance was 36.90. This result revealed that the mean difference for students in the experimental group was 24.28, while for the control group was 4.6. These results suggested that Jigsaw-puzzle has a greater effect on students' performance in growth than the lecture method.

Research Question 2: What is the academic performance of male and female students taught growth using jigsaw-puzzle instructional strategy?

Table 3: Mean And Standard Deviation of Pre-Test and Post-Test Performance of Male and Female Students using Jigsaw-Puzzle

Group	n	Gender	Pretest	SD	Posttest	SD	Mean Gain
JP	24	Male	28.62	3.03	56.22	6.01	27.60
	27	Female	33.12	3.88	52.90	7.33	19.78

From the result in Table 3, it was observed that male students taught using the Jigsaw-Puzzle had pretest and posttest mean performance of 28.62 and 56.22 respectively, resulting in a mean difference of 27.60, while female students taught with the same strategy had pretest and posttest mean performance of 33.12 and 52.90 respectively which implies a mean difference of 19.78. Jigsaw-puzzle had a greater effect on the performance of male students in growth than female students

Hypothesis 1: There is no significant difference in the academic performance of students taught using Jigsaw-puzzle instructional strategy and lecture method?

Table 4 Analysis of covariance of performance of 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	5372.76	103			

The result in Table 4 revealed that the F-value of 39.18 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 a significant effect on the mean performance of students in growth as a concept in Biology than the lecture method. The null hypothesis was therefore rejected.

Ho_2: There is no significant difference in the academic performance of male and female students taught growth using Jigsaw-puzzle instructional strategy.

Table 5: Analysis of Covariance of Performance of male and female students taught growth using Jigsaw-Puzzle.

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	99.649[a]	2	24.91	.518	.723
Intercept	2493.33	1	2493.34	51.86	.000
Pre-testP	38.74	1	38.72	.81	.372
Group	22.32	1	22.32	.46	.497
Gender	4.68	1	4.67	.09	.756
Group * Gender	39.22	1	39.22	.82	.368
Error	5144.27	48	48.08		
Total	57145.00	51			
Corrected Total	5243.92	49			

Table 5 showed the Summary of ANCOVA on the performance of male and female students taught growth using Jigsaw-puzzle instructional strategy. There was no significant difference between the performance of male and female students taught growth using Jigsaw-puzzle instructional strategy (P=.368 > 0.05). The null hypothesis was accepted at 0.05 significance level.

Discussion of Finding

From table 2, results suggested that Jigsaw-puzzle has a greater effect on students' performance in growth than the lecture method considering the mean differences. The result in table 4 revealed that the F-value of 39.18 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 a significant effect on the mean performance of students in growth as a concept in Biology. The null hypothesis was therefore rejected.

This result is in agreement with the findings of Ugwu (2015) who showed that SS1 Chemistry students taught using Jigsaw-puzzle recorded high academic performance in the mean scores than those taught using the conventional method. Jigsaw-puzzle gave students the opportunity to learn by constructing their own knowledge. Also, the result of Ayodele (2015) agreed that students achieved better and retained more knowledge when taught with Jigsaw-puzzle than demonstration method.

From the result in table 3, it was observed that Jigsaw-puzzle had a greater effect on the performance of male students in growth than female students. Table 5 showed the Summary of ANCOVA on the performance of male and female students taught Growth using Jigsaw-puzzle instructional strategy. There was no significant difference between the performance of male and female students taught Growth using Jigsaw-puzzle instructional strategy (P=.368 > 0.05). The null hypothesis was accepted at 0.05 significance level. This finding is in agreement with the study of Callinton (2016) who found out that being a male or female does not affect students' academic performance when taught using the same teaching method. However, the present finding contradicts the earlier findings of Bello (2016) who found out that gender has a significant effect on students' academic performance when taught using the same interactive teaching strategy.

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Conclusion

Based on the findings of the study, it was concluded that the use of Jigsaw-puzzle instructional strategy in teaching has a significant influence on the senior secondary students' academic performance in Growth (Biology). Also, Jigsaw-puzzle had a greater effect on the performance of male students in growth than female students. This provided empirical evidence on the relative efficacy of interactive and learner-centred strategy in enhancing the teaching and learning outcomes in Biology.

Recommendations

Based on the finding, it was recommended that:

1. Biology teachers should adopt Jigsaw-puzzle Instructional Strategy in this 21st-century classroom to encourage group learning among students.
2. Biology teachers should be retrained to improve on these interactive strategies. This can be done through seminars, conferences, workshops organized by both government and non-government agencies.

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