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2 **Effects of Jigsaw-Puzzle and Graphic Organizer Instructional Strategies on Biology**
3 **Students' Performance in Abia State**
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8 **Abstract**

9 The study investigated the effects of jigsaw-puzzle and graphic organizer instructional strategies
10 on Biology students' performance in Ukwa West Local Government Area, Abia State. Three
11 groups pre-test post-test control group non-equivalent quasi-experimental design was employed
12 in the study. Two objectives, two research questions and two null hypotheses guided the study.
13 One hundred and fifty-one (151) Biology students from three mixed senior secondary school one
14 (SSS1) randomly selected formed the sample size of the study. Biology performance test on
15 growth (BPTOG) was used for gathering data. The instrument was tested using the test re-test
16 method and was validated by two experts in the Department of Educational Technology,
17 University of Port Harcourt, Nigeria. A reliability index of 0.75 was obtained using Pearson's
18 Product Moment Correlation Coefficient. The data were analyzed using mean and standard
19 deviation to answer the research questions while analysis of covariance (ANCOVA) was used to
20 test the hypotheses at 0.05 level of significance. The result of the study showed that Jigsaw-
21 Puzzle and Graphic Organizer are effective instructional strategies for enhancement of students'
22 academic performance in growth as a concept in Biology. It was recommended that Biology
23 teachers should adopt Jigsaw-Puzzle and Graphic Organizer Instructional Strategies to teach the
24 concept of growth in the class.
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27 **Keywords: Jigsaw-Puzzle, Instructional Strategies, Graphic Organizer.**
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30 **Introduction**

31 The knowledge of Biology is needed for economic development especially in the area of
32 Medicine, Pharmacy, Physical and Health Education and Biochemistry among others. Biology as
33 a subject is designed to empower students with basic understanding about living organisms, the
34 inter-relationship between them and other living things. Living organisms display organized
35 structures, being made up of a cell or cells, they require energy to survive or sustain their
36 existence since they possess the ability to reproduce and to grow. Biological disciplines apply a
37 significant responsibility for the protection and welfare of all living species. In the National

38 Policy of Education (NPE, 2014), Biology comes first under the Field of Studies: Science and
39 Mathematics, followed by Chemistry, Physics, Further Mathematics, Health Education,
40 Agriculture, Physical Education and Computer Studies. This means that Biology is a subject
41 which students must pass if their overall success in the examination is to have any value. A credit
42 pass in Biology is a compulsory requirement for any student seeking admission into all the
43 institutions of higher learning in Nigeria.

44 Researchers like Isidor (2015), Kalu (2014) and Nkemka (2015) had employed different
45 strategies such as demonstration method, discussion method, explorative and field trip approach
46 in teaching Biology concepts. Yet, students' performance in Biology is still dwindling.
47 Meanwhile, the Federal Republic of Nigeria (FRN, 2014) in her Biology curriculum document,
48 stipulated that Biology should be taught in such a way that it will help the students acquire
49 adequate laboratory and field skills, meaningful and relevant knowledge in Biology through field
50 studies, guided-discovery, laboratory techniques and skills.

51 In line with the above, Biology teachers are expected to ensure effective and meaningful
52 teaching of Biology concepts to the students. Nevertheless, the poor and inappropriate method
53 adopted by Biology teachers during classroom instruction has led to the poor performance of
54 students in external examinations. In an attempt to help students learn and better understand the
55 concepts of growth, jigsaw-puzzle and graphic organizer instructional strategies have been
56 employed in this study. A major concern in science education is the development of teachers'
57 pedagogical knowledge for improving classroom practice and students learning. Instructional
58 strategies for easy implementation of Biology curriculum which encompasses the affective
59 domain could be Jigsaw-Puzzle and Graphic Organizer. Jigsaw-puzzle is a cooperative learning
60 strategy. It needs a minimum of 30 to 50 minutes. Kelly (2016) explained that Jigsaw-Puzzle

61 improves social interactions in learning and supports diversity. The Jigsaw-Puzzle is comparable
62 to the workplace where each individual is expected to play a role to achieve a common goal. It is
63 a training that leaves students as experts and receivers of knowledge. In a Jigsaw-Puzzle, the
64 teacher divides learning experience into stages or sections. The teacher distributes the sub-topics
65 to individuals in a group while students from different groups who have the same topic meet to
66 have an in-between groups discussion on the sub-topic allocated for the individuals to research
67 their assigned area. Jigsaw-Puzzle is one of the strategies that teach peaceful coexistence, human
68 worth, active participation of individuals, development of critical thinking and hard work. The
69 strategy could be effective in learning a concept such as growth in Biology. It helps the teacher
70 to cover a large content area within a short time. One other strategy which could enable students
71 to achieve higher academic performance is the graphic organizer instructional strategy. Different
72 teaching strategies produce different results. The identification of the adequate teaching strategy
73 for a group of students must be carried out if the best result must be attained or accomplished
74 (Nwona and Akogun 2015).

75 Graphic organizer has to do with the use of charts, concept mapping, pictures, diagrams
76 or a table of relationship formulated by the teacher to teach students in the class. It is used to help
77 students reflect on what they have learnt, the easy recollection of facts or points and to clarify
78 gaps in knowledge. It is an effective tool in acquiring and retaining knowledge. A graphic
79 organizer guides students' thinking as they fill in and builds upon a visual map or diagram. The
80 graphic organizer is an effective visual learning strategy for students and is applied across the
81 curriculum to enhance learning and understanding of subject matter content. It can be used in a
82 variety of formats dependent upon the task. Also, the graphic organizer facilitates students'
83 learning by helping students identify areas of focus within a broad topic such as growth in

84 Biology. Furthermore, it helps the students make connections and think constructively. Students
85 often turn to a graphic organizer for writing projects.

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

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98 **Statement of the Problem**

99 The reports of chief examiners of the West African Senior School Certificate
100 Examination Council (WASSCEC) on Biology results at the national level for the years 2016
101 and 2017 showed that though enrolment at the West African Senior Secondary Certificate
102 Examination (WASSCE) by candidates may be high, the percentage failure has also remained
103 consistently high. The report clearly pointed out that the performance of Biology students in
104 2017 was slightly poorer with a raw mean score of 31 and standard deviation of 11.92 when
105 compared with the raw mean score of 31 and the standard deviation of 10.91 of WASSCE 2016.

106 The West African Examination Council (WAEC) Chief Examiner's Report 2013, 2014, 2015,
107 2016, 2017 and 2018 noted that students' performance in Biology as seen on table 1 is very poor.

108 **Table1.1 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

109
110 **Source: WAEC Office (2018).**

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

116 **Aim and Objectives of the Study**

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

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

124

125 **Research Questions**

126 The study sought to provide answers to the following research questions

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

131

132 **Null Hypotheses**

133 **H₀₁:** There is no significant difference between the mean performance of SS1 students taught
134 the concept of growth in Biology using Jigsaw-Puzzle instructional strategy and lecture
135 method.

136 **H₀₂:** There is no significant difference between the mean performance of SS1 students taught
137 the concept of growth in Biology using graphic organizer instructional strategy and
138 lecture method.

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141 **Methodology**

142 The study adopted a three group's pre-test post-test control group non-equivalent quasi-
143 experimental design. Three groups (two experimental and one control group) from three mixed
144 schools randomly selected were used. 151 Senior Secondary one (SS1) Biology students
145 participated in the study. Biology performance test on growth (BPTOG) containing 20 objective
146 questions was used to gather data after thorough validation by two experts in the Department of
147 Curriculum Studies and Educational Technology, University of Port Harcourt, Nigeria. A
148 reliability index of 0.76 was obtained using Pearson's Product Moment Correlation Coefficient.

149 The experimental groups were taught using Jigsaw-Puzzle and graphic organizer instructional
150 strategy while the control group was taught using the lecture method. Data obtained were
151 analyzed using mean and standard deviation to answer the research questions while Analysis of
152 Covariance (ANCOVA) was used to test the hypotheses at 0.05 level of significance.

153
154 **Results**

155 The results are presented in the following tables

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

158 **Table 1: Mean and Standard deviation of pre-test and post-test performance of students**
159 **using Jigsaw-Puzzle and Lecture Method.**

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

160 **Mean Gain**

161 From table 1, it was observed that students taught growth using Jigsaw-Puzzle had a
162 score of 30.52 prior to treatment administration, while after treatment their post-test score was
163 54.80. For students in the control group who were taught using the lecture method, their pretest
164 mean performance was 32.30, while their post-test mean performance was 36.90. This result
165 revealed that the mean gain for students in the experimental group was 24.28, while for the
166 control group it was 4.6. These results suggest that Jigsaw-Puzzle had a greater effect on
167 students' performance in growth than the lecture method.

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

170 **Table 2: Mean and Standard deviation of pre-test and post-test performance of SS1**
 171 **students using graphic organizer and lecture method.**

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

172 From table 2, it was observed that the pre-test mean performance of the experimental
 173 group taught using graphic organizer instructional strategy was 34.90 while their post-test mean
 174 performance score was 52.75. For the control group taught using the lecture method, students
 175 had a pre-test score of 32.30 and a post-test score of 36.90. Considering the values, it can be seen
 176 that the mean gain between the pre-test and post-test mean performance of the experimental
 177 group and the control group were 17.85 and 4.6 respectively. This result suggested that the
 178 graphic organizer instructional strategy had a greater effect on the mean performance of students
 179 in growth than the lecture method.
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181 **H₀₁:** There is no significant difference between the mean performance of SSI students taught the
 182 concept of growth in Biology using Jigsaw-Puzzle instructional strategy and lecture method.

183 **Table 3 Analysis of Covariance of Performance of SS1 students taught growth using**
 184 **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			

185 The result in table 3, revealed that the F-value of 39.183 obtained at 1 and 101 degrees of
 186 freedom had an associated p-value of .000, which is less than the chosen alpha of 0.05, it can be
 187

188 stated that Jigsaw-Puzzle had a significant effect on the mean performance of students in growth
 189 as a concept in Biology. The null hypothesis was therefore rejected.

190 **H₀₂**: There is no significant difference between the mean performance of SS1 students taught the
 191 concept of growth in Biology using graphic organizer instructional strategy and lecture method.

192 **Table 4 Analysis of Covariance (ANCOVA) of Performance of SS 1 students taught growth**
 193 **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			

194
 195 From data analysis using (ANCOVA) in table 4., it was seen that the F-value of 23.36
 196 obtained at 1 and 97 degrees of freedom had a corresponding p-value of 0.000, which is less than
 197 the chosen alpha of 0.05 for the study. From this value, it was stated that there was a significant
 198 effect of graphic organizer instructional strategy on the mean performance of students in growth
 199 as a concept in Biology. The null hypothesis was therefore rejected.

200
 201 **Discussion of Finding**

202 From table 1, the result suggested that Jigsaw-Puzzle has a greater effect on students'
 203 performance in growth than the lecture method considering the mean gain. The result in table 3
 204 revealed that the F-value of 39.183 obtained at 1 and 101 degrees of freedom had an associated

205 p-value of .000, which is lesser than the chosen alpha of 0.05, it can be stated that JP had a
206 significant effect on the mean performance of students in growth as a concept in Biology. The
207 null hypothesis was therefore rejected.

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

214 From the result in table 2, it was observed that the pre-test mean performance of the
215 experimental group taught using graphic organizer instructional strategy was 34.90 while post-
216 test mean performance score was 52.75. For the control group taught using the lecture method,
217 students had a pre-test score of 32.30 and a post-test score of 36.90. Considering the values, it
218 can be seen that the mean gain between the pre-test and post-test mean performance of the
219 experimental group and the control group were 17.85 and 4.6 respectively. This result suggested
220 that the graphic organizer instructional strategy had a greater effect on the mean performance of
221 students in growth than the lecture method. In table 4, it was seen that the F-value of 23.36
222 obtained at 1 and 97 degrees of freedom had a corresponding p-value of 0.000, which is less than
223 the chosen alpha of 0.05 for the study. From this value, it was stated that there was a significant
224 effect of graphic organizer instructional strategy on the mean performance of students in growth
225 as a concept in Biology. The null hypothesis was therefore rejected. This finding is in agreement
226 with the study of Callinton (2016) who found out that graphic organizers affect students'
227 academic performance as the strategy encourages students mapping skills. However, the present

228 finding contradicts the earlier findings of Bello (2016) who found out that the strategy only has a
229 significant effect on students' academic performance when taught in combination with
230 interactive teaching strategy.

231 232 **Conclusion**

233 The study concluded that the use of Jigsaw-Puzzle and graphic organizer instructional strategies
234 in teaching have a significant effect on the senior secondary students' academic performance in
235 Growth (Biology). This provided empirical evidence on the relative efficacy of interactive and
236 learner-centred strategy in enhancing the teaching and learning outcomes in Biology.

237 238 **Recommendations**

239 The study recommended that:

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

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