



## Effects of Crossover and Brainstorming Teaching Strategies on Senior Secondary School Students' Interest in Biology in Imo State

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### Abstract

The study investigated the effects of crossover and brainstorming teaching strategies on secondary school students' interest in Biology in Imo State. Two research questions were posed, and two null hypotheses formulated to guide the study. The researcher adopted a quasi-experimental research design involving pre-test, treatment, post-test and use of non-randomised intact classes. The area of the study is Imo State of Nigeria. The sample size for the study is 90 sampled from 67,543 SS2 Biology students using a multi-stage cluster, purposive and simple random sampling techniques. The instrument used for data collection is a Biology Interest Rating Scale (BIRS). The BIRS was validated by three Biology specialists in Life Science Education and two specialists in Educational Measurement and Evaluation for content and face validity. The reliability coefficients of 0.85 was obtained using Chronbach alpha. The research questions were answered with mean and standard deviation, while the hypotheses were tested using ANCOVA F-ratio at 0.05 level of significance. Among the major findings of the study made is; the mean interest score of students in both CTS and BTS in the post treatment test are approximately two times their mean interest in the pre-treatment test; the mean interest score of the students taught Biology using Brainstorming Teaching Strategy (BTS) in the post-treatment test is not significantly greater than the mean interest score of the students exposed to Biology using Crossover Teaching Strategy(CTS); the mean interest rating scores of male and female students taught biology using CTS and BTS in the post- test do not differ significantly. Based on the findings, the researcher recommends that Biology teachers employ crossover and brainstorming teaching strategies in teaching students since they have proven to improve students' interests as well as not being gender biased.

### Introduction

It is well known that Biology is an important subject in our educational system. However, the method used in teaching the subject brings poor achievement in both internal and external examinations. In Imo State particularly, the WAEC result analysis also revealed that only few of the students had credit pass and above in Biology for the year 2013 - 2018 (The West African Examination Council) Thus, a large number of the students did not perform well. Many factors have been attributed to this poor performance of students in Biology and lack of interest in it. Some of the factors are unqualified teachers, poor or outdated instructional strategies, lack of instructional materials for teaching Biology. Also, blamed is the teaching strategies adopted by the teachers. The researcher believes strongly that there could be innovative teaching strategies that teachers can adopt and which may improve their performance

in Biology. Among such teaching strategies are brainstorming and crossover teaching strategies.

Biology is seen as one of the science subjects that have been recognised by the Federal Government of Nigeria as the basic tool for industrialization and national Development (FRN 2014). Michael (2012) defines Biology as a branch of science that deals with the study of living things, which include human being. However, there is evidence to show that even though many students find Biology interesting, thereby registering for it in the senior secondary schools (WASSCE and NECO), many of them obtain poor results, year in and year out in it as shown by Okebukola and Akinbola (2018), so to improve students' interest in biology, some innovative teaching strategies has to be adopted.

Interest plays a significant role in the learning of science subjects by students. According to Wang, Xiuhong, Zhu & Dongyi (2005) interest is the kind of

awareness inclination for understanding the world and acquiring cultural and scientific knowledge. As students are interested in certain field, they may pay special attention on it, observing carefully, memorizing well and thinking actively. Only by arousing students' interest in learning biology can we enhance students' enthusiasm for learning biology; help them master biological knowledge and techniques better and form the scientific spirit and attitude. Therefore, biology teachers should try to identify a teaching strategy that can motivate or arouse students' interest, (Zengyan, 2002).

The study carried out by (Krapp, 2002) shows that interest triggered learning activity leads to a high degree of deep – level learning and achievement. Some other studies show that interest is significantly correlated with teaching strategy to enhance students' achievement in biology (Okoro, 2011; Obiekwe, 2008; and Young, 2009). Okoro, (2011) also identified lack of interest and the use of traditional teaching method such as lecture method as the major cause of students' poor achievement in biology, whereas innovative teaching method enhance achievement and promote students' interest in biology (Jensen, 2008). This study therefore intends to investigate the differential effects of crossover and brainstorming teaching strategies on students' interest in biology. Their interest may also be influenced by the gender of the students.

Crossover is a study trip taken outside the classroom to obtain direct experience from a natural setting. Crossover involves teacher posing questions on a problem in the classroom to be studied in museum visits or field trips (Bevan, Dillon, Hein, Macdonald, Michalchik, and Miller, 2010 and Weidinger, 2012). Students can learn through crossover by collecting materials, photos, taking down notes or asking other people for their own thoughts. It is organized to improve students' interest in learning, for collecting data, materials or objects for classroom lessons as well as to observe objects or phenomena not possible to bring within the classroom.

In research conducted by MacKenzie and White (2010), the effects of crossover on retention levels were examined with one hundred and fifty (150) students among eighth and ninth graders in Australia. Three groups of students were involved. Five research and five hypotheses guided the study. The same general learning programme was employed in all treatments, but with different approaches to the excursion phase; there was an active processing excursion group which comprises 50 students, a traditional passive excursion group, 50 students in a group that did not have crossover. The study adopted

quasi-experimental research design. Two tests were given, one on achievement of unit objectives and the other on formation of episodes and linking them with other knowledge items. Both tests were given prior to formal instruction; posttests were given during the summer holidays, just prior to the beginning of the new school year. Mean and standard deviation were used to answer the research questions, while the ANOVA F-ratio was used to test the hypotheses. Posttest results indicated that the students who had crossover performed better than did students who did not have either field component of instruction. Retention was superior in the group that participated in the active excursion program. While this study investigated the effect of crossover on students' retention levels, the present study will investigate the effects of crossover and brainstorming teaching strategies on students' interest in Biology.

Another active teaching strategy that is very crucial in the teaching of science related subjects like Biology is brainstorming teaching strategies. According to Al-Shammari (2015) brainstorming teaching strategy is an activity that stimulates the mind and produces multiple ideas around the topic. It is a strategy used to generate a number of ideas to help solve a particular problem. Al-Shammari went on to say that it is a teaching strategy generally used in an individual or group setting, to quickly generate a large number of ideas about a specific problem or topic. Brainstorming teaching strategy can help to encourage creative thinking and generate enthusiasm in learning, encourage participation and building on the ideas of others.

Odoh (2013) investigated effects of brainstorming strategy on senior secondary students' achievement in chemistry in zone 'B' educational area of Benue state. One hundred and fifty-six senior secondary 2 chemistry students randomly drawn from four schools formed the sample for the study. Two schools each were randomly assigned to experimental and control groups. Four research questions and four hypotheses were generated and tested. The brainstorming strategy was used as treatment for the experimental group while the lecture method was used for the control group. A validated chemistry Achievement Test (CAT) was used to obtain data. The descriptive statistics of mean, standard deviation and t-test were used to analyze the data. The result showed that students taught using brainstorming strategy achieved significantly higher than those taught using lecture method. The study recommended the adequate training of teachers on how to use brainstorming strategy for classroom instruction. The study by Odoh used brainstorming teaching method and used Chemistry as a teaching subject but the

present study will compare brainstorming teaching strategy with crossover teaching strategy and will use Biology as a teaching subject.

The following research questions were posed for the study;

1. What are the mean interest rating scores of students taught Biology using crossover and brainstorming teaching strategies in the pre-treatment and post-treatment administrations?
2. What are the mean interest rating scores of male and female students taught Biology using crossover and brainstorming teaching strategies in the post-treatment administration?

The following hypothesis were tested at 0.05 level of significance.

H<sub>01</sub>: The mean interest rating scores of students taught Biology using crossover and brainstorming teaching strategies in the pre-treatment and post-treatment administration do not differ significantly.

H<sub>02</sub>: The mean interest rating scores of male and female students taught Biology using crossover and brainstorming teaching strategies in the post-treatment administration do not differ significantly.

## Method

The study made use of quasi-experimental research design involving non randomised pretest, posttest and treatment design. The population of the study consist of the entire 67,543 SS2 students in Imo State public schools. The sample consist of 90 senior secondary two (SS2) students in Owerri education zone 1 and Orlu education zone 1 of Imo State. Two education zones were randomly sampled from the six education zones of Imo State. This was done by writing the names of the zones on piece of papers; the piece of papers were folded and placed in a container. After, thoroughly shaking the container, one piece of paper was drawn from the container at a time. In this way, two Education Zones (Owerri Education Zone I and Orlu Education Zone I) were sampled from the six zones. Purposive sampling was used to draw only the co-educational schools from the two Education Zones. Also, using purposive sampling the researcher drew only the Secondary Schools in the urban areas of the sampled zones. This is to ensure uniformity in the characteristics of the Biology students. From

these co-educational schools the researcher sampled two secondary schools using simple random sampling (by balloting). This was done by writing the names of the co-educational schools on pieces of papers; the pieces of papers were folded and placed in a container. After, thoroughly shaking the container, one piece of paper was drawn from the container at a time, until two schools were drawn. All the students in SSS2 of the sampled schools made up the sample size for the study. The selected schools were randomly assigned crossover group (consisting 43 students) and Brainstorming group (consisting 47 students).

The instrument for data collection was Biology interest rating scale (BIRS). It consists of fifteen (15) items. The student participants in the experiment were required to indicate their degree of agreement or disagreement with each of the statements in a four-point rating scale of strongly Agree (SA), Agree (A), Disagree (D) and Strongly Disagree (SD). The instrument was validated by two specialists in Biology Education and one in measurement and evaluation. A trial test was conducted on the instrument using 30 students who are not part of the sampled population and Chronbach alpha formula was employed to determine the reliability index of the instrument which yielded a coefficient of 0.85. The BIRS was administered to the students before the treatment which lasted for six weeks. At the end of the treatment, the BIRS was reshuffled and re-administered. To control for extraneous variables, the researcher specifically trained the Biology teachers of the participating schools on the methods for use and the teachers did the teaching themselves to prevent bias. Also, the experiment was done in two different schools which meant that there was no chance of communication among the students. Finally, ANCOVA was used to give account for initial differences of the groups. The scores for both the crossover and brainstorming teaching strategies groups were recorded accordingly. The research questions were answered with mean and standard deviation while the hypotheses were tested using Analysis of Covariance (ANCOVA) F-test, at 0.05 level of significance. **Decision Rule:** Mean scores of 25 and above are considered high interest rate, while mean scores below 25 are considered low interest rate. If  $F_{Cal} > F_{Crit}$  reject the null hypothesis and uphold the alternative hypothesis. Also, if  $p\text{-value} < 0.05$  reject null hypothesis and uphold alternative hypothesis.

**Table 1**

**Mean Biology Interest Scores of Students exposed to Crossover Teaching Method (CTS) Brainstorming Teaching Method (BTS)**

Group	n	Pre-test		Post-test		mean gain
		$\bar{X}$	S.D	$\bar{X}$	S.D	
CTS	43	23.33	2.81	49.23	3.96	25.90
BTS	47	24.91	3.01	50.00	3.75	25.09

Presented in Table 1 are the mean and standard deviation Biology interest scores of the students taught Biology using crossover teaching method (CTS) and brainstorming teaching method (BTS) in the pre-treatment and post-treatment tests. The mean interest score of the students in the CTS and BTS in the pre-treatment test are 23.33 and 24.91 respectively. Their respective standard deviations are 2.81 and 3.01. Similarly, in the post-treatment test, the mean interest scores of the students exposed to

CTS and BTS are 49.23 and 50.00 respectively. Their respective standard deviations are 3.96 and 3.75.

The results showed that the mean interest scores of the students in both CTS and BTS in the post-treatment tests are approximately two times their mean interest in the pre-treatment tests. Also, the mean interest score of the students taught Biology using BTS in the post-treatment test is slightly higher than the mean interest score of the students exposed to Biology using CTS. This shows that the BTS improved students' interest in Biology than the CTS.

**Table 2**

**Summary ANCOVA F-ratio Table for Testing Hypothesis one**  
Tests of Between-Subjects Effects

Dependent Variable: Post-Test					
Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	171.632 <sup>a</sup>	4	42.908	3.173	.018
Intercept	2023.777	1	2023.777	149.679	.000
Pretest	98.302	1	98.302	7.270	.008
Treatment	1.170	1	1.170	.087	.769
Gender	.194	1	.194	.014	.905
Treatment * Gender	31.949	1	31.949	2.363	.128
Error	1149.268	85	13.521		
Total	223033.000	90			
Corrected Total	1320.900	89			

a. R Squared = .130 (Adjusted R Squared = .089) S= Significant

Presented in Table 2 are the calculated F-ratio and the p-value for testing the null hypothesis one. The calculated F-ratio of 0.087 (reading along the treatment row) is lower than the critical F-ratio of 3.92. The p-value is given as .769 which is greater than .05. The researcher, therefore, does not reject the

null hypothesis one. Thus, the mean interest rating scores of students taught Biology using crossover and brainstorming teaching strategies in the pre-treatment and post-treatment administration do not differ significantly. This shows that the effects of CTS and BTS on students' interest in Biology do not differ.

**Table 3**

**Mean ( $\bar{X}$ ) and Standard Deviation (S.D) of Biology Interest Rating Scores of Male and Female Students exposed to Crossover Teaching Method (CTS) Brainstorming Teaching Method (BTS)**

Group	n	Male		n	Female	
		$\bar{X}$	S.D		$\bar{X}$	S.D
CTS	23	49.25	3.65	20	50.78	3.78
BTS	24	50.04	3.64	23	48.30	4.21

From Table 3, the mean interest scores of male students taught Biology using crossover teaching

method (CTS) and brainstorming teaching method (BTS) are 49.25 and 50.04. Their respective standard



deviations are 3.65 and 3.64. For the female students, the mean interest scores for those in CTS and BTS groups are 50.78 and 48.30 respectively. Their respective standard deviations are 3.78 and 4.21. The results showed that the mean interest score of male students exposed to BTS is greater than the mean interest score of the male students exposed to CTS. Also, the mean interest score of female students

exposed to CTS is higher than that of female students exposed BTS. Similarly, the mean interest score of female students in CTS group is slightly higher than that of their male counterparts in the same group. In the BTS group, the mean interest score of the male students is slightly higher than that of their female counterparts exposed to the same treatment.

**Table 4**  
**Summary ANCOVA F-ratio Table for the Test of Hypothesis two**

<i>MS</i>	<i>df<sub>1</sub></i>	<i>df<sub>2</sub></i>	<i>F<sub>cal</sub></i>	<i>p – value</i>	<i>F<sub>crit</sub></i>	<i>η<sup>2</sup></i>	<i>Decision</i>
0.194	1	85	0.014	0.905	3.92	0.00	H <sub>02</sub> is accepted

In Table 4 the calculated F-ratio of 0.014 is less than the critical F-ratio of 3.92, while the p-value of 0.905 is greater than the significance value of 0.05. Thus, the researcher do not reject the null hypothesis. Therefore, the mean interest rating scores of male and female students taught Biology using crossover and brainstorming teaching strategies in the post-treatment administration do not differ significantly. Also, the Partial Eta Squared ( $\eta^2$ ) value of 0.00, shows that the gender of the students contributed nothing to the interest of the students in Biology

### Discussion of Finding

The result of the study revealed that the mean interest scores of the students in both CTS and BTS in the post-treatment tests are approximately two times their mean interest in the pre-treatment tests. This finding showed that both crossover teaching method and brainstorming teaching improved students' interest in Biology and as a result they should be adopted by biology teachers to boost students' interests in the subject.

However, the finding of the study showed that the mean interest score of the students taught Biology using BTS in the post-treatment test is slightly higher than the mean interest score of the students exposed to Biology using CTS. This shows that the BTS improved students' interest in Biology than the CTS. This finding buttresses what Al-Mutairi (2015) said about BTS, that it is a teaching method that engages students with significant ideas, and encourages them to connect what they are learning with their prior knowledge and with current issues, to think critically and creatively about what they are learning and to apply that learning to authentic situations.

The findings also revealed that the mean interest rating scores of male and female students taught Biology using crossover and brainstorming teaching strategies in the post-treatment administration do not differ significantly. Also, the Partial Eta Squared ( $\eta^2$ )

value, shows that the gender of the students contributed nothing to the interest of the students in Biology. This finding shows that both CTS and BTS are not gender biased and as well could be used to teach both male and female students and still have the same improvement of their interest in Biology. Even though it was found that the mean interest score of female students in CTS group is slightly higher than that of their male counterparts in the same group and that in the BTS group, the mean interest score of the male students is slightly higher than that of their female counterparts exposed to the same treatment. These slight differences in the mean interest rating scores of the students in Biology were found to insignificant. This shows that two teaching strategies are not gender biased.

### Recommendations

Based on the findings of the study, the following recommendations were made;

1. Both CTS and BTS should be used by the Biology teachers to enhance students' interest in the subject, since both teaching strategies were found to be equally effective in improving students' interests.
2. Since CTS and BTS were not gender biased in improving students' interest in Biology, the secondary school Biology teachers could use the two teaching strategies to instruct the students irrespective of their gender.

### Conclusion

The study investigated the effects of crossover and brainstorming teaching strategies on senior secondary students' interest in biology in Imo State. The results showed that both crossover and brainstorming strategies were effective in enhancing students' interest in biology. However, the crossover strategy had a more significant impact on students' interest. The findings suggest that the use of crossover and brainstorming strategies can improve students' motivation,

engagement, and enthusiasm for learning biology. These strategies encourage active participation, critical thinking, and collaboration among students, which are essential for developing a deeper understanding of biological concepts. The study recommends that teachers in Imo State and beyond consider incorporating crossover and brainstorming strategies into their teaching practices to promote students' interest in biology.

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