

# EFFECTS OF BRAINSTORMING AND THINK-PAIR-SHARE INSTRUCTIONAL STRATEGIES ON SECONDARY SCHOOL STUDENTS ACHIEVEMENT IN BIOLOGY IN AWKA EDUCATION ZONE

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## ABSTRACT

*The study investigated the effects of brainstorming and Think-pair-share instructional strategies on secondary school students' achievement in Biology in Awka Education Zone. Three research questions guided the study and three hypotheses were tested at 0.05 alpha level of significance. A quasi- experimental design using 3×2 factorial was adopted, specifically the pretest-posttest non-equivalent control group was used. Population of the study was 4023 SS 2 students offering Biology for 2019/2020 academic section in the zone. A sample of 139 SS2 Biology students from three schools obtained using purposive and random sampling were involved in the study. The instrument used for data collection was Biology Achievement Test (BAT), validated by two lecturers in Departments of Science Education and Educational Foundations of Nnamdi Azikiwe University, Awka and one experienced secondary school Biology teacher. Reliability was established using Kuder Richardson 21(KR-21) for BAT which yielded coefficient of 0.71. The two experimental groups were taught using Brainstorming and think-pair-share instructional strategies respectively while the control group was taught using conventional strategy. This treatment lasted for six weeks. The students were given pretest, posttest and delayed posttest after two weeks of treatment. The data collected were analysed using mean and standard deviation to answer the research questions while analysis of covariance was used to test the null hypotheses. Findings of the study revealed that there was significant differences in the mean academic achievement scores of students taught using brainstorming and think-pair-share strategies than those taught using conventional strategy, but had no significant effect on male and female students. It was recommended among others that seminars, workshops and conferences should be organized by school heads to orient Biology teachers on how to use brainstorming and think-pair-share instructional strategies in teaching.*

**Keywords:** Biology, Brainstorming, Think Pair Share, Achievement

## **Introduction**

The massive growth in technology and scientific outburst is posing great pressure on the education system. The advancement of any nation depends to a large extent on the rate of her scientific and technological development especially in developing countries like Nigeria. Prior to this, the education system of Nigeria should be based on science and technology development because the future of any nation depends on her ability to provide science and technology products to outside world (Ogunyebi, 2018). According to Obikezie, Okpala and Amobi (2022) science is seen as a body of knowledge, a way of investigation and thinking in pursuit of an understanding of nature. The authors further stated that science is studied in school as science which plays a vital role in the lives of individuals and the development of a nation. Obikezie and Abumchukwu (2021) stated that sciences in senior secondary schools are done in three major subjects namely 2Biology, Chemistry and Physics.

Biology as a science subject describes how living organism carry out their life activities and how they interact with their environment (Obialor, Ezeobi & Ezenwabuchili, 2020). It is the study of living things which includes plants and animals (Michael, 2015). Biology curriculum is designed to continue students' investigation into natural phenomena, deepening their understanding into biological science and also encourage their ability to apply scientific knowledge to everyday life because of its importance to humanity. Biology also helps the individual to understand himself, his/her environment, appreciate the nature and also control environmental pollution. It exposes man on how to maintain good health through clean water, clean air, good hygiene and sanitation, balanced diet, vaccination against infection diseases, exercise and adequate rest (Obialor, 2016). Despite all these importance of Biology to humanity, the achievement of secondary school students in Biology in West African Examination Council showed poor achievement in more than a decade.

According to Ogbaga (2022) the percentage results of secondary school Biology students that got C<sub>6</sub> – A<sub>1</sub> in the subject from 2007 to 2018 are as follows; 2007 = 33.37%, 2008 = 33.97%, 2009 = 33.87%, 2010 = 32.88%, 2011= 38.5%, 2012 = 35.66%, 2013= 51.76%, 2014= 56.17%, 2015 = 257.42%, 2016=61%, 2017 = 41.11% and 2018= 39.11%. From the results above it could be observed that out of twelve years, students that enrolled for Biology subject where able to have above average in grade C<sub>6</sub> – A<sub>1</sub> in year 2013, 2014, 2015 and 2016 respectively in the subject while other eight years where below average. This shows that students that got admission in science related areas especially in medicine and other medical fields in various higher institutions in the country were small because no institution admits students that got below C<sub>6</sub> in any medical department in Nigeria (Ogbaga, 2022). Similarly, according to West African Examination Council Chief examiners' reports from year 2007 to 2018, individually all there reports are centered on the weaknesses of students in these areas of Biology concepts which includes (i) poor performance in ques8tions that require application knowledge (ii) inability to identify the samples skeleton parts (iii) poor knowledge in cell structure and functions of the cell (iv) poor knowledge in forms in which living cell exist (v) Basic ecological concepts,

Ecosystem: components and sizes, (vi) Local biotic communities or biomes: tropical rain forest, Northern guinea savanna, Sahel, desert, (vii) Population studies by sampling method: population size, dominance, density, factors that affect population (viii) inability to identify concept in ecological factors: aquatic, terrestrial and factors common to all habitats (ix) transport system (Blood circulation) (x) respiration and (xi) respiratory mechanism in man. One could be imagining while WAEC Chief Examiners' are reporting weaknesses in this Biology concepts every year from 2007 to 2018. The question now is what could be the causes of these under achievement in grade and weaknesses among secondary school Biology students in the subject for these twelve years?

Osuafor and Ogbaga (2016) opined that the major causes of under achievement and weaknesses of secondary school Biology students in senior secondary school examination is lack of innovative instructional strategy in teaching the students. The authors stated that innovative instructional strategies like brainstorming and think-pair-share can help to improve the achievement of secondary school students in science related subject especially in Biology. Brainstorming involves thinking freely without restriction hence guided by the following rules according to Dehghan (2013): Withhold criticism within the session, Focus on the number of ideas generated by its group or individual members, Documentation of ideas generated. Combine and improve ideas. These rules help it to be more effective when used (Dehghan, 2013). Jacob, Johnson & Smith (2016) opined that brainstorming encourages learner to express their suggestion or ideas quickly and easily without much processed thought or reflection. Osuafor and Ogbaga (2016) revealed that nominal group in technique NGT of brainstorming was effective in enhancing students' achievement and interest in Biology, but had no significant effect on male and female students. Based on the findings, the researchers concluded that brainstorming is effective in improving students' achievement in Biology. Bilal-Adel (2012) observed that there are statistical significant differences at the level of ( $\alpha = 0.05$ ) between the experimental group and the control group in the total score and the sub scores of the creative thinking in the favor of the experimental group indicating the effectiveness of using brainstorming strategy in developing creative thinking skills. Owo, Idode & Ikwut (2016) revealed there was a statistically significant difference in both mean knowledge and mean academic performance in favour of the brainstorming group and there was no statistically significant difference in the mean academic achievement of male and female students taught Biology using brainstorming instructional strategy

On other hand Think-Pair-Share (TPS) strategy is one of the group discussion strategies and diverse method of learning collaboratively. This strategy was developed by Frank Lyman in 1981. Andrew and Alexandra, (2015) defined think-pair-share as a cooperative learning strategy that encourages students to work together to solve problems or answer questions on an assigned topic. TPS is used to keep all students actively involved in class discussion and provides an opportunity for everyone to share their idea and answer to every question posed by the teacher. Some researchers believed that think pair share effectively enhances students' achievement in

science subject and in Biology most importantly. According to Ogunyebi (2018) who observed that there was a significant difference between the posttest means scores of students exposed to think-pair share and conventional strategies. The researcher revealed that there was no significant difference between the posttest means scores of male and female students exposed to think-pair and conventional strategies. Bamiro (2015) observed that students taught with guided discovery and think-pair-share strategies obtained significantly higher posttest mean scores than those in the lecture strategy,  $F(4,223) = 51.66, p < .05$ . The researcher concluded that the use of guided discovery and think-pair-share strategies had great potential for improving achievement in Chemistry and other science subjects like Biology.

Most of the study studies reviewed were done under other science subject areas that are not Biology. Biology is seen by science educators to be one of the important science subjects as it cuts across several disciplines. However, despite its importance and usefulness, the achievement of Biology students at senior secondary school level has been below average. The evidence of poor and below average results is shown by the WAEC chief examiner's report (2007-2018) where only four years out of twelve years can boast of crossing 50% of grade point  $C_6 - A_1$  which is the only acceptable grade to be admitted in any Nigeria university to study medicine other medical related courses. One of the major contributing factors to this ugly state of learning as revealed by most studies and WAEC chief examiner's report is the teachers' instructional strategy of instruction. The conventional instructional strategies adopted by most Biology teachers fail to help students make connections between what is learnt and the real. The resultant effect is further decline in academic achievement after learning Biology. Brainstorming and TPS instructional strategies have been found effective in improving students' achievement of learning materials in some subjects like Mathematics, Chemistry, Nutrition science, Computer science and Integrated Science but no such study known to the researchers has been carried out in Biology. The need therefore arose to determine the effects of brainstorming and TPS instructional strategies on students' achievement in Biology in Awka Education zone of Anambra State.

### **Purpose of the Study**

This study determined the effects of brainstorming and Think-pair-share strategies on secondary school students' achievement in Biology in Awka education zone. Specifically, the study determined the;

1. Difference in the mean achievement scores of three groups of students taught Biology using brainstorming strategy, think-pair-share (TPS) strategy and those taught using conventional strategy.
2. Difference in the mean achievement scores of male and female students taught Biology using brainstorming strategy.

3. Difference in the mean achievement scores of male and female students taught Biology using TPS strategy.

### **Research Questions**

The following three research questions guided this study;

1. What is the difference in the mean achievement scores of three groups of students taught Biology using brainstorming strategy, think-pair-share (TPS) strategy and those taught using lecture instructional strategy?
2. What is the difference in the mean achievement scores of male and female students taught biology using brainstorming strategy?
3. What is the difference in the mean achievement scores of male and female students taught Biology using TPS strategy?

### **Hypotheses**

The following null hypotheses were tested in this study at 0.05 alpha level of significance. They are:

1. There is no significant difference in the mean achievement scores of three groups of students taught Biology using brainstorming, think-pair-share methods and that of those taught using lecture instructional strategy.
2. There is no significant difference in the mean achievement scores of male and female students taught Biology using brainstorming.
3. There is no significant difference in the mean achievement scores of male and female students taught Biology using TPS.

### **Methods**

This study employed a quasi-experimental design that involves 3X2 factorial study. Quasi-experimental design is an experiment where a random assignment of subjects to experimental or control group is not possible (Nworgu, 2015). In this case, intact classes were used. The 3 × 2 factorial indicates the three levels of treatment (brainstorming, think-pair-share and conventional strategies) and two levels of gender (male and female). The sample consists of 139 SS 2 Biology students selected from Awka education zones. Multi-stage sampling technique was used to draw three co-educational public secondary schools from the sixty co-educational public secondary schools in Awka Education Zone. First, the co-educational was listed out according to locations. Secondly, three co-educational schools were purposively selected. The purpose of selection choice of school was based on coeducational to ensure a balanced representation of gender variable in study. Finally using three ballot papers representing each of the three schools,

one of the schools was used as the first experimental group, second one was used as the second experimental group, while and the third was used as control group. First School was assigned as the brainstorming (1<sup>st</sup> experimental group, 28 male and 26 female). Second was assigned as TPS (2<sup>nd</sup> experimental group, male 21 and female 25) and third was assigned as control group (20 male and 25 female) using flip of a coin. The study covered a period of five weeks. First week was for familiarizing visit and training of the Biology teachers in the selected schools who act as research assistants. First day of the second week was used to administer a pretest achievement test of the Biology students involved in the study. Second day of the second week was used to teach the Biology concepts of transport system (Blood circulation), respiration and respiratory mechanism in man in three selected schools using brainstorming instructional strategy, TPS instructional strategy and control group using lecture instructional strategy for three weeks. The Biology teachers were given detailed information and instructions concerning the study. The teachers in the three groups used lesson plan prepared by the researchers for brainstorming, TPS and lecture instructional strategies. At the end of the fifth week, both experimental groups and control group was post tested base on what they are taught. Marks were awarded to each question prepared for both experiment test groups and control group achievement test which constituted twenty five (25) multiple choice questions. If all the questions were answered correctly by the student, his/she is entitled to hundred (100) marks that is four marks per questions. The pretest score as well as post test scores in two experimental groups and one control group in each sitting had 100 marks. The pre test scores were recorded as achievement of the students in the three groups. Post test scores were recorded also as achievement of the students when taught with brainstorming, TPS and lecture instructional strategies in the three groups. The instrument for data collection was designed by the researchers named Biology Achievement Test (BAT) which was adopted from West Africa Examination Council (WAEC) past questions from (June 2007 - June 2018). The BAT was produced base on the Biology concept of transport system (Blood circulation), respiration and respiratory mechanism in man. To ensure the reliability of the instrument, the twenty five (25) objective achievement questions were administered on a group of twenty five students in Aguata education zone which is outside the place of study. The results were subjected to Kuder- Richardson 21 (KR-21). A mean coefficient of 0.71 was obtained indicating that the instrument was reliable. The data obtained from the pretest and post test were analyzed using mean, standard deviation for research questions and Analysis of Covariance (ANCOVA) to test the hypotheses.

## **Results**

The result of this study was presented in line with the research questions and the hypotheses as follows.

**Research Questions One:** What is the difference in the mean achievement scores of three groups of students taught Biology using brainstorming strategy, think-pair-share (TPS) strategy and those taught using lecture instructional strategy?

**Table 1: Mean and Standard Deviation of the Mean Achievement Scores among the Groups**

Groups	N	Pretest		Posttest		Mean Gain
		Mean	SD	Mean	SD	
Brainstorming	48	47.08	10.48	61.33	11.03	14.25
Think-Pair-Share	46	44.00	9.03	63.30	11.94	19.30
Conventional	45	43.33	9.84	50.20	5.38	6.87

2

The result presented in Table 1 reveals the pretest and posttest mean achievement scores of the students taught Biology using think-pair share, brainstorming and conventional strategies. The pretests mean scores for the groups in the brainstorming, think-pair share, and conventional strategies are 47.08, 44.00, and 43.33 respectively. The posttest mean scores are 61.33, 63.30, and 50.20 respectively. The mean gain for the three groups are 14.25, 19.30, and 6.87 respectively, which depicts that the students in the think-pair share strategy have the highest mean achievement score, followed by those in the brainstorming strategy; while the students in the conventional method have the lowest mean achievement score.

**Research Questions Two:** What is the difference in the mean achievement scores of male and female students taught Biology using brainstorming strategy?

**Table 2: Mean and Standard Deviation of the differences in the mean Achievement Scores of Students in the Brainstorming group based on Gender**

Gender	N	Pretest		Posttest		Mean Gain
		Mean	SD	Mean	SD	
Male	28	47.14	12.29	61.93	12.43	14.79
Female	20	47.00	7.55	60.50	8.94	13.50

Table 2 reveals the mean pretest and posttest scores of the male and female students taught Biology with brainstorming methods. The pretest mean score for the male and female students in the group are 47.14 and 47.00 respectively. The posttest mean scores are 61.93 and 60.50 respectively. The mean gains for male and female students are 14.79 and 13.50 respectively. This

implies that the male students have higher mean achievement score than the female students in the brainstorming strategy.

**Research Questions Three:** What is the difference in the mean achievement scores of male and female students taught Biology using TPS strategy?

**Table 3 :Mean and Standard Deviation of the differences in Pretest and Posttest Scores of Students in the Think-Pair-Share Group based on Gender**

Gender	N	Pretest		Posttest		Mean Gain
		Mean	SD	Mean	SD	
Male	21	44.48	8.76	61.71	12.43	17.23
Female	25	43.60	9.42	64.64	11.59	21.04

Table 3 reveals the differences in the pretest and posttest mean scores of the male and female students taught Biology with think-pair-share instructional strategy. The pretest mean score for the male and female students in the group are 44.48 and 43.60 respectively; while the posttest mean scores are 61.71 and 64.64 respectively. The mean gain for male and female students are 17.23 and 21.04 respectively, which indicates that the female students have the higher mean achievement score than the male students taught Biology with think-pair share instructional strategy.

### Hypothesis 1

There is no significant difference in the mean achievement scores of three groups of students taught Biology using brainstorming, think-pair-share methods and that of those taught using lecture instructional strategy.

**Table 4: The ANCOVA Results of Achievement Scores among the Groups**

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	4637.023 <sup>a</sup>	3	1545.674	15.685	.000	.258
Intercept	18524.945	1	18524.945	187.982	.000	.582
Pretest	91.838	1	91.838	.932	.336	.007
G2roup	4402.099	2	2201.049	22.335	.000	.249

Error	13303.768	135	98.546
Total	491705.000	139	
Corrected Total	17940.791	138	

Data shown in Table 4 reveals the ANCOVA results on the effect of brainstorming, think-pair-share and lecture strategies on students' academic achievement in Biology. The results show a significant difference  $F(2, 135) = 22.335, p = .000 < .05, \eta^2_p = .249$  in pretest and posttest mean scores of the students taught Biology with the three strategies. In all, the null hypothesis is rejected. The result shows that there is a significant difference in the effect of the three strategies on the students' academic achievement in Biology.

### Hypothesis 2

There is no significant difference in the mean achievement scores of male and female students taught Biology using brainstorming.

**Table 5**

**The ANCOVA Results of Mean Achievement Scores of Students in the Brainstorming Group based on Gender**

	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	48.968 <sup>a</sup>	2	24.484	.194	.824	.009
Intercept	7442.278	1	7442.278	59.111	.000	.568
BS Pretest	25.159	1	25.159	.200	.657	.004
BS Gender	23.477	1	23.477	.186	.668	.004
Error	5665.698	45	125.904			
Total	186280.000	48				
Corrected Total	5714.667	47				

The data presented in Table 5 shows the ANCOVA results on the effect of brainstorming between male and female students in Biology. The results reveal no significant difference in the pretest and posttest mean scores of between the male and female students taught Biology with

brainstorming strategy  $F(1, 45) = .186, p = .668 > .05, \eta^2_p = .004$ . Therefore, the null hypothesis is not rejected. Hence, the result shows that there is no significant difference in the pretest and posttest mean cores between male and female taught biology with brainstorming method

### Hypothesis 3

There is no significant difference in the mean achievement scores of male and female students taught Biology using TPS.

**Table 6: The ANCOVA Results of Mean Achievement Scores of Students in the Think-Pair Share Group based on Gender**

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	295.268 <sup>a</sup>	2	147.634	1.038	.363	.046
Intercept	9773.396	1	9773.396	68.731	.000	.615
TPS Pretest	197.575	1	197.575	1.389	.245	.031
TPS Gender	84.375	1	84.375	.593	.445	.014
Error	6114.471	43	142.197			
Total	190752.000	46				
Corrected Total	6409.739	45				

The data presented in Table 6 shows the ANCOVA results on the effect of think-pair share strategy between male and female students in Biology. The results reveal no significant difference in the pretest and posttest mean scores of between the male and female students taught Biology with think-pair share strategy,  $F(1, 43) = .593, p = .445 > .05, \eta^2_p = .014$ . Therefore, the null hypothesis is not rejected. Hence, the result shows that there is no significant difference in the pretest and posttest mean cores between male and female taught Biology with think-pair share strategy.

### Discussion

The result in table 1 shows that the students taught Biology using brainstorming and think-pair-share strategies achieved significantly better in Biology Achievement Test (BAT) than those

taught with conventional method. The difference may be as a result of the fact that both brainstorming and TPS provides an opportunity for students to take active role in building their own knowledge. This finding is in consonance with the research of Bilal-Adel (2012) who view brainstorming as a lateral thinking process by which students develop ideas or thoughts on solution to problems based on layout criteria. It may also be as a result of new useful ideas and creative thinking that the techniques bring to problems. The result from the lecture strategy suggested the need to also adopt other teaching strategies in addition that would likely develop adequate content understanding in Biology in our secondary schools. This implies that the students in the treatment groups have significant higher gain in their content understanding than those in the control group. Also, the ANCOVA analysis indicated that there is a significant difference between the treatment groups and control group. The findings of this study is not surprising because brainstorming and think-pair-share encourages students to move from one level of understanding to another as they think out the solution to their problem. Hence, one would be in a position to say that the students taught using brainstorming and think-pair-share shifted in their level of understanding as they construct their own knowledge of Biology concepts.

The result of this study also indicated that gender is not significant difference in the performance of male and female students taught Biology using brainstorming. The finding is in line with some researchers' assertion who observed that there was no significant effect on male and female students when taught with brainstorming instructional strategy (Hidayanti et al 2018; Osuafor and Ogbaga 2016). While the mean gain score of males taught with brainstorming in this study is presenting a slight mean difference of 1.29 in favour of male student, the slight difference may be as a result level of interaction between the male while learning. But then, brainstorming has reduced the male domination to the barest minimum by encouraging equal participation.

The result of this research also shows that there is no significant difference in the performance of male and female students taught Biology using Think-pair-share. The finding is in consonance with Ogunyebi (2018) observation who revealed that there was no significant difference between the posttest means scores of male and female students exposed to think-pair and conventional strategies. Also the findings of this study is in line with that of Nwaubani et al (2016) who revealed that both the Think-pair-share (TPS) and student teams-achievement (STAD) significantly improved students' achievement in some subjects. While the mean gain score of males taught with TPS in this study is presenting a slight mean difference of 2.81 in favour of female students, the slight difference may be as a result level of interaction between the male while learning. But then, think-pair-share has reduced the male domination to the barest minimum by encouraging equal participation.

### **Conclusion**

The findings of the study revealed that brainstorming and think-pair-share significantly improved achievement of students in Biology irrespective of gender. The conclusion is that both brainstorming and think-pair-share strategies are effective strategies for the teaching and learning of Biology concept. It can also be concluded that when Biology teachers adopt any or both strategies, student to student interaction increases thereby making students to take responsibility for their learning.

### **Recommendations**

The researcher formulated the following recommendations based on the findings and conclusions made from the study.

1. Teachers should be encouraged by curriculum planners to employ brainstorming and think-pair-share more often in teaching and learning situation.
2. Higher Institutions involved in teacher education should help to propagate these instructional strategies so as to promote brainstorming and think-pair-share among the student-teachers of science
3. Curriculum planners and developers in science should include brainstorming and think-pair-share strategies in restructuring Biology curriculum in our secondary schools in order to help the students to be creative and retentive in learning.
4. Ministry of education should help teachers through seminars, conferences, support supervision and journal publication to improve their competencies in the use of brainstorming and think-pair-share strategies for effective teaching of Biology.
5. Teachers should direct the presentation of Biology lessons away from the traditional methods to a more students-centered approach like brainstorming and think-pair-share strategies.

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