



Brain Dominance: A Panacea for Engineering Creativity Among Biology Students

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Abstract

This paper investigates the influence of brain hemispheric dominance and creativity among Biology students. Three research questions and three null hypotheses guided the study. The study adopted Ex-post facto design. The population of the study comprises all SSII Biology students in Awka Education zone of Anambra state, which consisted of 5,007 students (2,259 males and 2,798 females). The sample size was made up of 150 students (58 males, 92 females) sampled through multistage sampling procedure. Two instruments were used for data collections (BDT) and (BSCS). The reliability index of 0.92 was estimated using Cronbach's Alpha formula. Mean and standard deviations were used to answer the research question while the hypotheses were tested using t-test. Results from the analyzed data shows that students with right brain hemispheric dominance performed better than students with left hemispheric dominance in Biology. Students with high creativity performed better than students with low creativity in Biology.

Key words: Brain Hemispheric Dominance, creativity and achievement.

Introduction

Biology as a science subject taught in senior secondary schools (Federal Republic of Nigeria, 2014) studies the structure, function, and behaviors of living things as well as their evolution, distribution, and taxonomy. The present secondary school Biology curriculum in Nigeria is designed to deepen student's understanding in Biology and to make sure that the concepts they learn are applied in a way that advances their comprehension of their surroundings.

Evidence has shown that student's achievement in Biology has not been satisfactory both in internal and external examinations (Bichi, Hafiz & Abdullahi, 2017). Several factors have been linked to this unsatisfactory achievement of students in Biology examinations which include failure to use appropriate teaching techniques, the use of traditional teaching methods to instruct the students, teacher-centered approaches, inadequate classroom management, the use of gender-biased instructional materials, a lack of appropriate laboratory activities, and shortage of qualified Biology teachers (Adak, 2017; Sarican, 2018). Efforts have been made to improve students' academic achievements. Although, studies have been conducted to find alternative methods of instruction in Biology that would help improve learners understanding,

and retention, and achievement in examinations. Similarly, teachers have been encouraged to actively utilize innovative instructional methods, such as multimedia instructions approach. However, despite these efforts, West African Examination Council (WAEC) reports (2019-2023) still shows that students' achievement has not been satisfactory. Furthermore, to ensure progressive improvements in academic achievements, over the years, innovative methods found to be generally effective has been used but there has not been improvement in students' achievement. This shows that there could be other factors the researchers have not considered that could be influencing students' achievement in Biology. Factors such as students' brain hemispheric dominance and creativity.

Brain hemispheric dominance refers to an individual's tendency to process information using either the left or right hemisphere of the brain, or both. Each hemisphere plays a role in specific bodily functions, and individuals have a unique way of receiving, interpreting, and utilizing information. Thus, the dominating usage of the left or right hemisphere is thought to influence a person's personality and mode of thought (Pinto et al, 2017). This indicates that the type



of activity a person engages in or finds interests in can be used to establish their brain's hemisphere dominance.

The concept of left-brain and right-brain dominance has been thoroughly investigated in the fields of psychology and education. Based on this concept, left hemisphere is analytical, abstract, verbal, digital, logical, sequential, and rational (Pinto et al, 2017). The concept of brain hemispheric dominance suggests that individuals who predominantly use the left side of their brain excelled in tasks that requires abilities in Natural sciences (Kumar & Sharma, 2016). Understanding how the left brain functions can help teachers design activity-based lessons that involve experimenting, learning new concepts, analyzing data, and creating plans tailored to each student's left hemisphere (Tripathi, 2016). When students are guided according to their individual differences, their academic performance can improve significantly.

The right brain hemisphere deals with nonverbal, holistic, tangible, creative, analogical, and aesthetic functions are its primary area of expertise. When it comes to creativity, imagination, intuition, holistic thinking, the arts, feeling visualization, non-verbal cues, rhythm, daydreaming, emotions, and performing and pursuing careers in fields like graphic design, pure and applied art, communication art, theater art, and social work, a person with a right hemisphere brain is an expert in these areas. This brain region is also known as the analogue brain (College & Hoshiarpur, 2015). When it comes to teaching, teachers can use strategies like peer tutoring, field trips, and discussions to make learning relevant and transferable for right-hemisphere learners, unlike left-hemisphere learners who learn best through experiments and discoveries. According to brain theory, creativity is a product of right brain hemisphere. Creative people are considered "right brain thinkers" engaging this part of the brain by the teacher in the classroom through the use of teaching strategies that suits right brain hemispheric dominance encourages and engineers' creativity.

Creativity is a process that involves the interplay of multiple interactive, cognitive and affective components. Creativity can all be considered forms of innovation (Bunawan & Sipayung, 2018). This is helpful to the teacher since it eliminates the requirement to evaluate students solely on theory and experiment repetition in favor of assigning projects or other tasks that will encourage original thought because that is what the current generation needs.

Creativity of students can be shown during teaching and learning process. In the context of this

study, creativity of students was classified as high or low creativity because it is assumed that nature of instruction can increase students' creativity or not. Research shows that student's exhibit low creativity due to learning process that does not accommodate their creativity (Zuhriya, Augustina & Fajarina, 2018). It is shown that the teachers have not optimized pedagogical strategies in the classroom this has contributed to students' low creativity development (Birsa, 2018). Therefore, to enhance students' creativity, changes need to be made by encouraging students to actively participate in classroom discussions, undertake active learning procedures that will aid in their knowledge construction (Reigeluth & Carr-Chellman 2012), and foster collaboration that indirectly affects students' creativity (Romero, Hyvonen & Barbera 2012). Therefore, fostering creativity in students can enhance their academic achievement.

Academic achievement is defined as a successful outcome or performance in a specific subject. Grades, "marks, and the results of the descriptive commentary serve as indicators. It is noted that no learning process is complete without assessing the achievement of the student in line with stated objectives of such learning process (Adak, 2017). According to Bicer and Le (2019) ascertained that academic achievement has very many factors that influence it such as learning environment, teaching methods, learners' attitudes and materials for teaching and learning. If these factors are properly managed it will result to high academic achievements of students irrespective of gender.

Gender is a socio-cultural construct that determines behaviors, perspectives, and responsibilities considered appropriate for each sex (Godpower-Echie & Owo, 2019). Numerous studies have examined gender, Cutumisu and Bulut (2017); Bicer and Lee (2019); and others indicated that male students tend to perform better academically in Biology in senior secondary schools compared to female students. While studies by Akpoghol, Ezeudu, Adzape & Otor (2016), and Diana (2014) have found that female students outperform male students in Biology. These differing viewpoints suggest that more work is needed to address student achievement in science education, particularly in Biology.

Since Biology is one of the preferred science subjects among senior secondary school students with great importance in other fields of science, students' achievement is expected to be high. Evidence has shown that students perform inconsistently and below

expectation in Biology both in internal and external examination. The report of the West African Examination Council (WAEC) chief examiners report (2019-2023) revealed that students' achievement in Nigeria has continued to dwindle as shown by their mean scores and standard deviations (2019-2023) respectively (31, 9.43) (26, 10.68) (22, 9.38) (37, 9.54) (31, 10.91). Therefore, there is felt need to improve on teaching and learning of Biology by exploring the use of some innovative learners-centered method of teaching to see if the academic achievement will be consistent and improve. Hence the researcher considers the students' brain hemispheric dominance and creativity during classroom instructions to see its influence on achievement of Biology students.

Research Question

The following questions were generated to guide the study;

1. What is the influence of brain hemispheric dominance on students' achievement in Biology?
2. What is the influence of creativity on students' achievement in Biology?
3. What is the influence of gender on students' achievement in Biology?

Hypotheses

The following null hypotheses guided the study and were tested at 0.05 level of significance.

H₀₁: There is no significant influence of brain hemispheric dominance on students' achievement in Biology.

H₀₂: There is no significant influence of creativity on students' achievement in Biology.

H₀₃: Gender does not significantly influence the mean achievement scores of students in Biology.

Methodology

The study adopted (Ex-post facto) design because the independent variables (brain hemispheric dominance and creativity) cannot be manipulated. The

population of the study comprises all SSII Biology students in Awka Education zone of Anambra state, which consisted of 5,007 students (2,259 males and 2,798 females). The sample size was made up of one hundred and fifty 150 (58 males, 92 females) students sampled through multistage sampling procedure. Firstly, simple random sampling technique was used to draw two (2) Local Government Areas (LGAs) out of five (5) LGAs in Awka Education zone by balloting without replacement with use of folded paper.

Secondly, simple random sampling technique was also used to sample four (4) co-educational schools, from the two (2) chosen LGAs; 2 schools from Awka south LGA, 2 schools from Njikoka LGA. Also, schools with only two (2) streams of SSII classes were also sampled purposively. The researcher purposely used the schools with lesser population with only two streams of SSII classes in the area.

Finally, purposive sampling technique was used to sample all the SSII Biology students in eight (8) intact classes; two (2) streams from each of the four (4) schools was sampled which gave the sample of 150 students consisting of approximately 19 students in each class. Two instruments were used for data collections which are Brain dominance test (BDT) adopted from Jorgenson (2015) e.g. (A) I complete one project at a time or (B). I like to start many different projects, but do not like to finish them. Biology student creativity scale (BSCS) adapted and modified from Kumar & Holman (1997) e.g. I am engaged in originating changes on a regular basis in biology classroom. To establish the reliability of the instruments, the researcher administered the instruments to 30 Senior Secondary School Biology Students for trial testing. The responses obtained from the students were used to establish the reliability of the instrument using Cronbach's Alpha Formula and it yielded an internal consistency reliability index of 0.92. Research questions was answered using mean and standard deviation while hypotheses were tested using t-test to determine the difference between group of means and standard deviations.

Results

Table 1

Mean (\bar{x}) and Standard Deviation (SD) Achievement Scores of students in Biology with different brain hemispheric dominance

Brain Hemispheric Dominance	N	Mean	SD
Right	76	59.42	15.72
Left	74	43.86	12.58



Table 1 revealed that the mean achievement score of students with right brain hemispheric dominance was (\bar{x} = 59.42, SD = 15.72) while those with left brain hemispheric dominance was (\bar{x} = 43.86, SD = 12.58). The students with right brain hemispheric dominance therefore, performed better than students

with left brain hemispheric dominance in biology. Below is the result of the hypothesis. The standard deviation indicated that scores gotten from student with left brain hemispheric dominance closer to mean than those from the right brain dominance. Below is the result of the hypothesis.

Table 2

Independent Samples t-test of Students' Biology Achievement Scores

	T	df	Sig.
Equal variances assumed	6.681	148	.000
Equal variances not assumed	6.700	142.699	

An independent samples t-test was conducted to compare the mean achievement scores of the student with right and left brain hemispheric dominance. The right brain hemispheric dominance group compared to left brain hemispheric dominance demonstrated significantly higher achievement scores in Biology. The magnitude of the differences in the mean (mean

difference = 15.56, 95% CI: - 20.15 to 20.16 was very large (cohen's d = .23). The null hypothesis, therefore, was rejected, indicating that there was a significant difference in the mean achievement scores of students with different brain hemispheric dominance (Right and Left) in Biology.

Table 3

Mean (\bar{x}) and Standard Deviation (SD) Achievement Scores of students in Biology with different creativity

Creativity	n	Mean	SD
High	87	57.20	15.65
Low	63	44.22	13.88

Table 3 revealed that the mean achievement score of students with high creativity was (\bar{x} = 57.20, SD = 15.65) while those with low creativity was (\bar{x} = 44.22, SD = 13.88). The students with high creativity therefore,

performed better than students with low creativity in Biology. The standard deviation indicated that scores gotten from student with low creativity clustered around the mean than those with high creativity. Below is the result of the hypothesis.

Table 4

Independent Samples t-test of Biology Achievement scores with high or low Creativity

	t	Df	Sig.
Equal variances assumed	5.251	148	.000
Equal variances not assumed	5.353	141.957	.000

An independent samples t-test was conducted to compare the mean achievement scores for students with high and low creativity. The high creativity group compared to the low creativity group demonstrated significantly high achievement scores in Biology. The magnitude of the differences in the mean (mean

difference = 12.97, 95% CI: - 17.76 to 17.85 was very high (cohen's d = .16). The null hypothesis, therefore, was rejected, indicating that there was a significant difference in the mean achievement scores of students with different creativity (High and Low) in biology.

Table 5
Mean (\bar{x}) and Standard Deviation (SD) Achievement Score of Students According to Gender

Gender	N	Mean	SD
Male	66	51.29	15.53
Female	84	52.11	16.81

Table 5 revealed that the mean achievement scores of male students was (\bar{x} = 51.29, SD = 15.53) while for female students was (\bar{x} = 52.11, SD = 16.81). The female students therefore, performed better than male students

in biology. The standard deviation indicated that scores gotten by male students are closer to mean than scores from female students. Below is the result of the hypothesis.

Table 6
Independent Samples t-test of Students' Biology Achievement Scores by Gender

	T	df	Sig.
Equal variances assumed	-.306	148	.760
Equal variances not assumed	-.309	144.113	.758

An independent samples t-test was conducted to compare the mean achievement scores for male and female students. The male students compared to the female students demonstrated significantly high achievement scores in Biology; ($t(148) = -.306, p = .760$, two-tailed). The magnitude of the differences in the mean (mean difference = $-.81$, 95% CI: -4.41 to 4.46) was very small (Cohen's $d = .002$). The null hypothesis, therefore, was rejected, indicating that there was no significant difference in the mean achievement scores of male and female students in Biology.

Discussions

The results of the study stated that students have a higher score in Biology when they had a dominant right hemisphere. This resulted in rejection of null hypothesis and suggest that mean achievement scores significantly differ across brain hemispheric dominance. The disparity in results may be due to the fact students do not recognize their brain hemispheric dominance and as a result they are hindering the proper processing of information. This study supports Mansour (2017) and Faizah's claims on the brain dominance of students who was found that students when they have a right brain dominance then more influence in their STEM subjects.

It also demonstrated a positive correlation of creativity with academic scores in Biology. The null

hypothesis was rejected, indicating there was a significant difference in the achievement scores of each group. This is likely because extremely creative students have highly developed critical-thinking skills and a knack for solving problems in new ways (which translates into good grades). These results are in line with previous findings of Sarika and Anita (2017) who estimated creativity as the most significant predictor of academic success.

Except in Biology, for which the null hypothesis was rejected; a difference was observed between male and female students' performance (gender effect). Equality in the classroom is closing the gender gap and enabling girls to outperform boys, often associated with an advantage in science disciplines. This conclusion aligns with Dawal (2021), who observed that female students usually do better in Biology, and Miakano (2022) suggested that there is no gender difference in academic performance.

Conclusion and Recommendations

Based on the result obtained in the study, it was concluded from the research that a creative mind and right brain hemispheric dominance of students is greatly responsible for their achievement in Biology. Gender too seems to be a significant variable that impacts student performance in the subject. The following



recommendations were made based on the findings of this study;

1. Educators must be able to effectively manage a classroom that suits the unique needs of each student based on their brain hemispheric dominance, and creativity.
2. In Biology lessons, teachers should also provide a variety of activities to be completed by students in order to apply their creative skills in all gender categories.

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