IMPACT OF BRAIN HEMISPHERIC DOMINANCE ON STUDENT'S ACADEMIC ACHIEVEMENT AND INTEREST IN BIOLOGY

Ibenegbu, Queendaline Obiajulu (PhD)[1], Abasi-Ibiangake Ezekiel Ukoh[1], Okafor Blessing Ifeoma[2], & Chukwunta Regina Ugochi[1]
[1]Department of Science Education, University of Nigeria, Nsukka
Queendaline.ibenegbu@unn.edu.ng
[2]Department of Science Education, Federal College of Education (Tech.)
Umunze

Abstract
This study explored the influence brain hemispheric dominance on students' academic achievement and interest in biology. To guide the study, three research questions were posed and three null hypotheses were formulated and tested at a 0.05 probability level. Expos-facto design was adopted for the study. The study was carried out in Oruk Anam Local Government Area of Akwa Ibom state. The population of the study consisted of 2736 and a sample size of 175 SSII Biology students was used for the study. Three instruments were used for data collection in this study namely: Brain Dominance Test (BDT), Biology Student Interest Questionnaire (BSIQ),) and Biology Achievement Record (CBAR) Proforma. Areliability index of 0.96 was obtained from the instruments while analysis of variance (ANOVA) was used to test the hypotheses at a 0.05 level of significance. The results of the study revealed that there was a statistically significant difference in the mean interest rating of students with different brain hemispheric dominance $F(1, 174) = 58.445$, $p<.000$, there was a significant difference in the mean achievement score of students with different learning styles $F(1, 174)= 2.085$, $p<.042$. Also, there was a significant influence in the mean interest score of students with different brain hemispheric dominance, $F(1, 174) = 3.938$, $p>.010$. There was a significant difference in the mean achievement score of male and female students in biology $F(1, 174) = 9.249$, $p>.003$, there was a significant difference in the mean interest rating of male and female students in biology $F(1, 174) = 8.659$, $p<.004$. Recommendations were equally proffered among others that teachers should ensure that they first determine the brain hemispheric dominance and learning styles of their students so as to ensure they incorporate proper instructional approach that will ensure that diverse learning styles and brain hemispheric dominance of their students are taken care of during instruction in other to improve on students' achievement and interest in Biology. The limitations of the study and suggestions for further studies were equally made.

Keywords: Brain Hemispheric dominance, achievement and interest.

Introduction

Science is the study of our natural physical environment its composition and components, it has many branches such as chemistry, Physics and Biology. Biology is a branch of natural science that deals with the study of a living organism, its structure, functions, evolution, distribution and interrelation with other organisms and the environment. In Nigeria, the secondary school biology curriculum is designed to help students investigate natural phenomena, deepen students' understanding and interest in biological sciences, and to encourage student's ability to apply scientific knowledge to everyday life in a matter of personal and communal health and agriculture Nigerian Educational Research and Development Council (NPE, 2013). Based on the objectives of the Biology curriculum, researchers have shown that the achievement and interest of students in Biology and science, in general,are poor and not up to expectations, and the need to pay greater attention to this problem of poor achievement and interest. Researchers have come up with findings on the approaches to improve student achievement in Biology such as the use of innovative teaching methods, the use of instructional materials and the use of practical approaches in the teaching of science, despite these research findings achievement and interest of Biology students is still below expectation and at a state of dwindling. This paper further helps us look beyond approaches and materials to see if individual

differences such as Brain Hemispheric Dominance and Learning Styles have influenced Biology students' interest and achievement.

Brain hemispheric dominance is the ability of an individual to use the left or the right hemisphere or in combination in the processing of information. The use of different halves of the brain by individuals is a widely accepted and known fact, in which each hemisphere of the brain contributes to certain body functions. Each person has a unique way of perceiving, interpreting and utilization of given information, (Mansour, El-Araby, Pandaa & Gemeay, 2017). The reality is that individuals use different approaches to learning which generally result in the use of the whole mind, intuition, belief and subjectivity intact. Yazgan and Sahin, (2018), showed that each brain hemisphere preference affects individuals' academic achievement and interest. Therefore, when a student understands how students learn and their spatial ability, the student is more favoured on also trying to inculcate an understanding of different ways other students learn: it is expected that such students have gotten balanced in science instruction and have acquired the necessary science processes that will enable such learner developed the basic problem-solving skills in science.

It is a generally held belief that the brain controls the cognitive abilities of an individual. This includes the way the individual perceives information and processes the information received. The brain is the complex connection of the neuron to form a control unit that receives, processes and stores information in an organism, it is the seat of intelligence and balance in humans. In terms of structure, there exists the right and left hemispheres in the human brain (Yazgan & Sahin, 2018). Findings from Giljov and Karenina (2019); Soyoof and Morovat (2014) and Tripathi (2016), have proven that the different halves of the brain process information uniquely and differently though both hemispheres are equally important in terms of whole brain functioning, individuals rely more on one information-processing mode than the other, especially when they approach new learning. These two halves of the brain are called the left and right brain hemispheres. The left-brain hemisphere controls the right part of the body and is predominantly suited for scientific pursuit while the right brain controls the left part of the body which is suited for art and humanity career pursuit. The left part of the brain encourages Biology students to involve in hands-on activities while the right brain part encourages the students to perform various spatial functions, tactile perception of complex structures, musical ability, prosody, non-verbal thinking, and memory (Dordevic, Pavlovic, Goran & Pavlovic 2018). The brain controls the cognitive and affective domain of teaching without the brain being able to retrieve information stored and interpreting the feelings of biology students achievement and interest in Biology education will be hard to determine. In our various schools and lesson teachers, educators and curriculum planners pay little attention to individual differences such as Brain Hemispheric Dominance not knowing that it can to a certain extent influence student academic achievement and interest(Iusca, 2014).Hence the knowledge of brain hemispheric dominance is important to both the teachers and the students to understand individual differences and bring about improvement in the achievement and interest of Biology students.

Interest means having or showing a positive feeling of emotion about something or someone. Individual interest describes a person's relatively enduring predisposition to engage in particular activity over time as well as to the immediate psychological state when this predisposition has been activated (Hendrickson, 2019). Individual interest describes a person's relatively enduring predisposition to engage in particular activity over time as well as to the immediate psychological state when this predisposition has been activated (Hendrickson, 2019). In a classroom setting, interest is required to meet students' intellectual as well as emotional needs of the learner (Suryati, 2019).

Achievement is the extent to which students have mastered and can transfer the knowledge, skills and attitude presented to them during the teaching-learning process in solving real-life problems. Achievement is described by Adewale, Nzewuihe and Ogunshola (2016) as the mark obtained by a student at the end of a test or examination. It is noted that no learning process is complete without assessing the achievement of the student in line with the stated objectives of such a learning process (Adak, 2017). Gender is a role assigned to the different sexes of humans by society. The role assignment means that every society has specific functions that are for males and females respectively. Gender being a topical issue in the educational system has received serious attention. Various studies have been carried out on gender for example study conducted by Bichi, Ibrahim and Ibrahim (2019); Cutumisu and Bulut (2017); Bicer and Lee (2019) pointed to the fact that biology student academic achievement in senior secondary schools is in favour of male students while Akpoghol, Ezeudu, Adzape and Otor (2016), Diana (2014) based on this contrasting view of different authors it is ascertained that the achievement of students in science education has not been resolved particularly in regards to achievement and interest in biology. Also, researchers including (Awla, 2019; Bosman, 2015 & Beyazsacli, 2017) pointed out that both male and female students have a low interest in

biology. In this study, the researcher seeks to find out if this poor academic achievement and interest in biology could be a result of differences in term of brain hemisphere. Hence the need for this study.

Biology which is one of the science subjects has many advantages attached to it. Many males and female students choose this subject with the perception that biology is an easy subject but is available evident (WAEC average biology student achievement 2017-2019) and research from different authors have indicated poor achievement and imbalance in male and female biology students achievement. These students' poor achievement in biology could be attributed to so many factors such as the under-utilization of teaching materials, the sociocultural background of the student, teaching methods and strategies utilized by the teacher. This study helps to find out if student achievement and interest could be improved by teaching students to use their preferred brain hemisphere in the teaching and learning of biology.

Purpose of the Study

The general purpose of this study is to investigate the influence of brain hemispheric dominance and learning styles on biology students' academic achievement and interest. Specifically, this study intends to determine: the influence of

1. brain hemispheric dominance on Students' Achievement in Biology
2. brain hemispheric dominance on Students' Interest in Biology
3. gender on student's interest in Biology
4. gender on student achievement in Biology

Research Questions

The following research question guided the study.

1. What is the influence of brain hemispheric dominance on students' achievement in biology?
2. What is the influence of brain hemispheric dominance on students' interest in biology?
3. What is the influence of gender on student's interest
4. What is the influence of gender achievement in biology?

Hypotheses

The following null hypotheses were formulated and tested at an alpha level of 0.05.

Ho_1: There is no significant difference in the mean achievement scores of students with different brain hemispheric dominance in biology.

Ho_2: There is no significant difference in the mean interest rating of students with different brain hemispheric dominance in biology.

Ho_3: Gender does not significantly influence the mean interest ratings of students in biology

Ho_4: Gender does not significantly influence the mean achievement scores of students in biology

Methodology

The design used was an Expos-facto research design which involves the use of existing data. The population of the study was 2,736 Biology students from Oruk Anam Local Government area of Akwa Ibom state and a sample size of 175 Biology students Drawn from purposive sampling technique. Instruments used for data collection were Brain Dominance Test, Biology student interest Questionnaire and a proforma for collecting students' previous year's academic record, theinstrument was face and content validated by three experts from the Department of science education one from measurement and evaluation, and two from biology using. The instruments were trial tested and a reliability index of .96 was gotten through Cronbach Alpha.

The researcher established rapport with the school administrators and subject teachers.Through interaction with the administrator subject teacher on the reason for the researcher's visit to the school. With the help of their class teachers the questionnaire and other instruments were administered after responses from the students the instruments were collected and the results were analyzed.Research questions were answered using mean and standard deviation. Hypotheses were tested using analysis of variance at 0.05 level of significance.

Results

Research Question 1: What is the influence of brain hemispheric dominance on students' achievement in Biology?

Table 1: Meanand Standard Deviation (SD) on the influence of brain dominance on students' achievement in biology

Brain Dominance	n	SD	X
Left Brain Dominance	21	49.22	19.22
Right Brain Dominance	154	60.93	22.45

The result in Table 1 indicates that Biology students with left and right brain dominance had a mean achievement scores of 49.22 and 60.93 with standard deviations of 19.22 and 22.45 respectively. This showed that students with right brain dominance have the highest achievement in Biology followed by students with left brain hemispheric dominance with the lowest achievement in Biology. The standard deviation indicated that scores got from students with left brain dominance were closer to the mean than those with right brain dominance.

Research Question 2: What is the influence of brain hemispheric dominance on students' interest in biology?

Table 2: Mean and Standard Deviation (SD) of brain dominance on students' interest in biology

Learning Styles	n	SD	X
Left Brain Dominance	21	45.33	14.45
Right Brain Dominance	154	69.34	14.86

The result in Table 2 indicates that Biology students with left and right brain dominance had mean interest of 45.33 and 69.34 and standard deviation of 14.45 and 14.86 respectively. This showed that students with right-brain dominance have the highest interest rating in Biology followed by left-brain dominance students with the lowest interest in Biology. The standard deviation gotten showed that the interest rating of students with left brain dominance was closer to the mean than the interest rating of students with right brain dominance.

Research Question 3: What is the influence of gender on students' interest in biology students?

Table 3: Mean and Standard Deviation (SD) of gender on mean interest score of biology students

Gender	n	SD	X
Male	88	69.35	16.60
Female	154	63.53	16.41

The results in Table 3 indicated that male students have a mean achievement score of 69.35 while their female counterparts have a mean achievement score of 63.53 with SD of 16.60 and 16.41 respectively. This showed that male students have the highest achievement in biology followed by their Female counterparts with the lowest interest score in Biology. The standard deviation also indicated female students' interest rating was closer to the mean

Research Question 4: What is the influence of gender on student achievement in biology students?

Table 4: Mean (and Standard Deviation (SD) on the influence of gender on mean achievement scores of biology students

Gender	n	SD	X
Male	88	66.51	20.96

Female	87	52.48	21.63

The result in Table 3 indicated that male students have a mean achievement score of 66.51 while their female counterparts have a mean achievement score of 52.48 with SD of 20.96 and 21.63 respectively. This shows that male students have the highest achievement in biology followed by their Female counterparts with the lowest achievement score in Biology. The standard deviation indicated that female students' score was closer to the mean than the male students' scores.

Hypothesis One

There is no significant difference in the mean achievement scores of students with different brain hemispheric dominance in biology.

Table 5: Analysis of Variance of Students' Mean Achievement Scores in Biology

Source	Type III Sum of Square	df	Mean Square	F	Sig
Corrected model	275057.451[a]	13	21158.265	6.698	.000
Intercept	1627890.878	1	1627890.878	515.201	.000
BrainD	12890.630	1	12890.630	4.080	.045
Learning style	26592.078	3	8864.026	2.085	.042
Gender	29225.726	1	29225.726	9.249	.003
BrainD* Learning style	9509.340	3	3169.780	1.003	.393
BrainD* gender	1744.392	1	1744.392	.552	.459
Learning styles* Gender	73862.605	3	24620.868	7.792	.000
BrainD*Learning styles * Gender	8774.955	1	8774.955	2.777	.980
Error	508714.743	161	3159.719		
Total	6365558.00	175			
Corrected total	783772.194	174			

The result in Table 5 shows a statistically significant difference in the mean achievement score of students with different brain hemispheric dominance in biology F (1, 174) = 4.080, p<.045. 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.

Hypothesis Two

There is no significant difference in the mean interest scores of students with different brain hemispheric dominance in biology.

Table 6: Analysis of Variance of Students' Mean Interest Scores in Biology

Source	Type III Sum of Square	df	Mean Square	FSig
Corrected model	17499.967[a]	3	1346.151	6.962 .000
Intercept 190745.639	1	190745.639	986.463 .000	
BrainD	11301.157	1	11301.157	58.445 .000
Learning style	2284.416	3	761.472	3.938 .010
Gender	1674.312	1	1674.312	8.659 .004
BrainD* Learning style	2010.383	3	670.128	3.466 .0.18
BrainD* gender	512.194	1	512.194	2.694 .106
Learning styles* Gender	409.724	3	136.574	.706 550
BrainD*Learning styles * Gender	23.070 1	23.070	.119 .730	
Error	31131.461	161	193.363	
Total 821528.00	175			
Corrected total	48631.429	174		

The result in Table 6 shows a statistically significant difference in mean interest scores of students with different brain hemispheric dominance in biology F (1, 174) = 58.445, p<.000. The null hypothesis therefore, was rejected, indicating that there was a significant difference in the mean interest scores of students with different brain hemispheric dominance.

Hypothesis Three

Gender does not significantly influence the mean achievement score of students in biology

The result in Table 5 shows a statistically significant difference in the mean achievement scores of male and female students in biology F (1, 161) = 9.249, p<.003. The null hypothesis, therefore, was rejected, indicating that there was a significant difference in the mean achievement scores of student's male and female students in biology.

Hypothesis 4

Gender does not significantly influence the mean interest score of students in biology

The result in Table 6 shows a statistically significant difference in the mean achievement score of students in biology F (1, 161) = 8.659, p<.004. The null hypothesis, therefore, was rejected, indicating that there was a significant difference in the mean interest scores of students with different learning styles.

Discussions

Results of the study showed that students with accommodating learning styles had the highest mean achievement in Biology followed by converging, assimilating and diverging learning style with the lowest achievement in biology, further result showed a statistically significant difference on mean achievement scores of students with different learning styles in biology in biology. The finding of this study could be as a result of the fact that accommodating learners learn through feeling and learn more when they are exposed to experiences that help built their knowledge of the concepts in biology, and also could be as a result of the learner's curiosity to learn more through experimentation and interaction with people and materials during biology instruction, also it could be due to the fact that the teacher utilized approaches that aligned with the accommodating learners way of receiving and processing information during biology lesson, which could lead to their high academic achievement in the subject. Results of the study showed that students with accommodating learning styles had higher mean interest in Biology while diverging learning style had the lowest interest in biology, further result showed a statistically significant difference on mean interest scores of students with different learning styles in biology. This difference in interest of biology student in favor of the accommodating learners could be as a result of this set of learners prefer to work with others to get assignments done, set goals, do field work, and to test out different approaches to completing a project. Since interest is a dynamic state that arises through an ongoing transaction among goals, context, and actions.

Results of the study showed that students with accommodating learning styles had higher mean interest in Biology while diverging learning style had the lowest interest in biology, further result showed a statistically significant difference on mean interest scores of students with different learning styles in biology. This difference in interest of biology student in favor of the accommodating learners could be as a result of this set of learners prefer to work with others to get assignments done, set goals, do field work, and to test out different approaches to completing a project. Since interest is a dynamic state that arises through an ongoing transaction among goals, context, and actions. Interest in a subject of study has positive influence on their learning and even the choice of careers. This could also be because knowledge of students' learning style preferences could improve students' interest in learning, it could be as a result of the ability to align biology instruction mostly to the accommodating learners than to diverging, converging and assimilating learners.

The result from this study is in line with the findings from other researchers Maisyara and Saragi (2019),Diana (2014), Essien and Obot (2015), and Adu-Gyamfi (2016) who found out that interest is inherent and yet can be improved by external forces which include such factors as the way the learners perceive and process information which is embedded in the characteristics of the accommodating learner. Also, The finding of this study is in line with the Kolb & Kolb (2017) learner styles theory which showed that student in accommodating learning styles perform better in sciences especially biology.

Conclusion

From the results obtained in the study on the influence of brain hemispheric dominance and learning style on students' achievement and interest in Biology, it was found that: Students with right hemispheric dominance had higher achievement and interest in biology than students with left brain hemisphere dominance, the result of the study also showed that Male students had higher mean achievement and interest in biology than their female counterparts therefore, the result of the finding showed that gender influence students achievement and interest.

Educational Implication

The implication of this could be that teachers have not been paying great attention to these individual differences among their students in the classroom to use approaches that can accommodate these differences among learners. Also, teachers may have been using activities that enhance gender stereotypes in the classroom, this may have influenced the findings of this study.
The implication of this study to the curriculum planners could be that they have not provided enough teachers and learners activities that will capture and help address the issue of individual differences.

Recommendations

The following recommendations were made based on the findings of this study

a. The findings of this study showed that gender was a significant factor in the achievement and interest of students; hence, teachers should use instructional approaches as identified in the literature that can streamline gender differences in science classrooms.

b. Science teachers should be trained on the need for proper classroom management to suit learners' differences in terms of brain hemispheric dominance and learning styles. Furthermore, teachers should provide a variety of activities and opportunities for students to use their skills continuously during biology lessons irrespective of gender.

c. Establishment of in-service training for teachers on the best approach to identify these individual differences in the learners.

References

Adak, S. (2017). Effectiveness of constructivist approach on academic achievement in science at the secondary level. *Educational Research and Reviews Full*, *12*(22), 1074–1079. https://doi.org/10.5897/ERR2017.3298

Adewale, A. M., Nzewuihe, G., & Ogunshola, F. (2016). Academic Performance in Biology at Secondary School Certificate Examination (SSCE) and the Influencing Factors among Students in Owerri Municipal of Imo State, Nigeria. *International Journal of Education and Evaluation*, *2*(1), 1–10.

Akpoghol, T, V., Ezeudu, F. ., Adzape, J. ., & Otor, E. . (2016). *Effects of Lecture Method Supplemented with Music and Computer Animation on Senior Secondary School Students ' Academic Achievement in Electrochemistry*. *7*(4), 75–86.

Awla, H. A. (2019). *Learning Styles and Their Relation to Teaching Styles Learning styles and their relation to teaching styles*. *January 2014*. https://doi.org/10.11648/j.ijll.20140203.23

Bicer, A., & Lee, Y. (2019). *Effect of STEM PBL Embedded Informal Learning on Student Interest in STEM Majors and Careers*. *12*(1), 57–73.

Bichi, A. A., Ibrahim, F. B., & Ibrahim, R. H. (2019). Assessment of students' performances in biology : Implication for measurements and evaluation of learning Assessment of students' performances in biology : Implication for measurements and evaluation of learning. *Journal of Education and Learning*, *13*(3), 301–308. https://doi.org/10.11591/edulearn.v13i3.12200

Cutumisu, M., & Bulut, O. (2017). Problem-Solving Attitudes and Gender as Predictors of Academic Achievement in Mathematics and Science for Canadian and Finnish Students in the PISA 2. *Journal of Educational Multimedia and Hypermedia*, *4*(26), 352–342.

Diana, P. O. (2014). Effect of Gender on Students Academic Achievement in Secondary School Social Studies. *Journal of Education and Practice*, *5*(21), 78–85.

Đorđević, J. R., Pavlović, D. M., Mihajlović, G., & Pavlović, A. (2018). *Cerebral Brain Hemisphere. December 2013*.

Giljov, A., & Karenina, K. (2019). Differential roles of the right and left brain hemispheres in the social interactions of a free-ranging ungulate. *Behavioural Processes*, *168*. https://doi.org/10.1016/j.beproc.2019.103959

Hendrickson, P. (2019). effect of active learning techniques on student excitement, interest, and self-efficacy. *Journal of Political Science Education*, *12*(8), 1–15. https://doi.org/10.1080/15512169.2019.1629946

Iuşcă, D. (2014). Brain Hemisphericity and Music Performance Level in Undergraduate Music Students and Philharmonic Musicians. *Procedia - Social and Behavioral Sciences*, *142*, 59–63. https://doi.org/10.1016/j.sbspro.2014.07.588

Mansour, E. A., El-Araby, M., Pandaan, I. N., & Gemeay, E. M. (2017). Hemispherical Brain Dominance and Academic Achievement among Nursing Students. *IOSR Journal of Nursing and Health Science*, *06*(03), 32–36. https://doi.org/10.9790/1959-0603083236

NPE. (2013). *national education policy* (Sixth). NERDC.

Soyoof, A., & Morovat, E. (2014). *The Effects of Learners ' Brain Hemisphericity on their Degree of Vocabulary Retention : A Case Study of Iranian High School Students ScienceDirect International Conference on Current Trends in ELT The Effects of Learners ' Brain Hemisphericity on their*. *May*. https://doi.org/10.1016/j.sbspro.2014.03.614

Suryati, T. (2019). the effect of e-learning based on Schoology and student interest to metacognitive thinking skill of vocational high school students in the archival subject. *International Journal for Research and Review*, *6*(December), 397–404.

Tripathi, P. (2016). *Individual Diversity needs to know Brain Hemisphericity*. *978*, 930–940.

Yazgan, Y., & Sahin, H. B. (2018). Relationship between brain hemispheric and non-routine problem-solving skills of prospective teachers. *Universal Journal of Educational Research*, *6*(9), 2001–2007. https://doi.org/10.13189/ujer.2018.060919