



Brain Dominance as a Tool For Fostering Positive Attitude Towards Learning of Biology: Implication for Integrating AI in the Classroom

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Abstract

This paper was on brain dominance as a tool for fostering a positive attitude towards learning biology: implications for integrating artificial intelligence (AI) in the classroom. The study was guided by three research questions and three null hypotheses. A causal-comparative (Ex-post facto) design was adopted for the study. The population of the study comprised all SSII Biology students in the Awka Education zone of Anambra state, which consisted of 5,007 students (2,259 males and 2,798 females). The sample for the study consists of 150 (58 males, 92 females) students sampled through a multistage sampling procedure. Two instruments were used for data collection, which are the Brain Dominance Test (BDT) and Biology Student Attitude Questionnaire (BSAQ). The reliability index of 0.88 was estimated for BSAQ using Cronbach's Alpha formula. Mean and standard deviations were used to answer the research question, while the null hypotheses were tested using a t-test at the 0.05 level of significance. Results obtained from the analysed data showed that there was a significant difference in the attitude scores of students in Biology according to their brain hemispheric dominance. Students with right brain hemispheric dominance had a higher attitude score than students with left hemispheric dominance in Biology. Gender has a significant influence on students' attitude towards Biology, female Biology students had a higher mean attitude towards Biology than their male counterparts. The researchers recommends that teachers be trained on the need to identify individual differences that exist in the classrooms and use instructional approaches that suit learners in terms of brain hemispheric dominance.

Keywords: Brain Hemispheric Dominance, attitude, Artificial Intelligence (AI).

Introduction

In a contemporary classroom, students come in with diverse abilities and individual differences. These diversities among students need to be considered by the teachers during the instructional delivery process to carry every individual student along during the learning process. This is aimed at achieving the objectives of the lesson. To effectively achieve this in a contemporary society that is driven by technology, there is a need to consider the integration of Artificial Intelligence (AI), which is an innovative approach in attaining the 21st-century technology skills.

Brain hemispheric dominance is 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 each person has a unique way of receiving, interpreting, and utilising information. Therefore, brain hemispheric dominance describes how the left or right side of the brain carries out specific brain activities. It is widely accepted that people have different brain dominances, which significantly influence individual differences (Mansour, El-Araby, Pandaan & Gemeay, 2017). The brain, a complex network of neurons, functions as a control centre for an organism, receiving, processing, and storing information; it is the source of human intelligence and balance. Structurally, the brain is

divided into the left and right hemispheres (Yazgan & Sahin, 2018). Studies by Soyoof and Morovat (2014), Tripathi (2016) and Giljov and Karenina (2019) have shown that while both hemispheres are equally important for overall brain function, people tend to rely more on one hemisphere than the other when processing information, particularly when learning something new. These hemispheres are known as the left and right hemispheres.

The left hemisphere is analytical, abstract, verbal, digital, logical, sequential, and rational (Pinto, Neville, Otten, Corballis, Lamme, & De Haan, 2017). The student's left-brain dominance is responsible for logical thinking processes, based on reality, and the ability to interpret abstractly and symbolically. Analytical thinking is suitable for verbal tasks, writing, and reading in detail (Handayani & Corebima, 2017). The concept of hemispheric dominance suggests that individuals who predominantly use the left side of their brain excelled in tasks that require abilities in Natural sciences (Rowson & McGilchrist, 2013; and Kumar & Sharma, 2016). Understanding how the left brain functions can help teachers design activity-based lessons that involve experimenting, learning new concepts, analysing data, and creating plans tailored to each student's left hemisphere (Tripathi, 2016). The teacher, having understanding of how brain works, can effectively guide students in following lesson plans as presented on the board.

On the other hand, the right brain processes information in an intuitive, emotive, holistic, synthesising, non-verbal, visual-spatial manner, leading to a creative or inductive style of thinking, in contrast to the analytical approach of the left brain. This means the right hemisphere sees the big picture rather than focusing on details, as it aggregates and analyses information simultaneously (Dordevic, Pavlovic, Mihajlovic & Pavlovic 2018). It excels at tasks requiring the understanding of complex configurations and patterns and the simultaneous processing of diverse information, such as pattern recognition, face recognition, or spatial relationships. This is because it deals with three-dimensional forms and images, with an emphasis on similarities rather than differences (Babcock & Vallesi, 2015; Oaksford, 2015). These individuals are believed to have a highly developed emotional and aesthetic sensitivity and often pursue careers in the arts and creative fields (Corballis, 2014; Philip, 2015; Viskontas, 2017). Therefore, educators can employ strategies like group discussions, outings,

and peer tutoring to make learning relevant and transferable for right-hemisphere learners, since right-brained students enjoy social interaction and prefer open-ended questions (Okoyefi, 2012). Teachers should highlight key themes on the board, use visual aids like wall discussions and simulations, and allocate time for group activities. Teachers should also be equipped with knowledge about both right-brain and left-brain learners and select lesson strategies that engage and suit the learner's dominance, which can enable them to develop a positive attitude towards learning.

Attitudes reflect an individual's feelings towards something, whether favourable or unfavourable. Khan and Ali (2012) define attitude as a mindset or disposition towards a person or subject. Just as attitude is important for academic success, fostering positive attitudes in science students is essential for their achievement. Attitude of learners helps students to manifest behaviours and interests in a particular subject (Adejimi, Nzabairwa, 2022). Teaching methods dominated by the teacher, which do not consider the students, affect students' learning outcomes, including attitudes towards sciences (Bizimana & Mwesigye; 2022). In order to foster a positive attitude towards learning biology, the learning styles of the students, which are embedded in the preferences in the use of brain dominance, should be considered during teaching and learning of biology. However, research indicates that the current methods of teaching science may not engage students effectively. Since students' attitude towards science impacts their success, it is important to identify and address their attitude to improve their performance in specific subjects through the use of technology-based learning.

The attitude of learners helps students to manifest behaviours and interests in a particular subject (Adejimi, Nzabairwa, 2022). Teaching methods dominated by the teacher, which does not consider the students, affects learners' outcomes, including negative attitudes towards science, including biology (Bizimana & Mwesigye; 2022). In order to foster a positive attitude towards learning biology, the learning styles of the students, which are embedded in the preferences in the use of brain dominance, should be considered during teaching and learning of biology. Attitudes can be neutral, negative, or positive, and they reflect an individual's feelings towards something, whether favourable or unfavourable. Khan and Ali (2012) define attitude as a mindset or disposition towards a person or subject. Just as attitude is important

for academic success, fostering positive attitudes in science students is essential for their achievement. However, research indicates that the current methods of teaching science may not engage students effectively. Since students' attitude towards science impacts their success, it is important to identify and address their attitude to improve their performance in specific subjects through the use of technology-based learning.

In an increasingly advanced digital era, technological developments have brought significant changes in various fields, including education. One technology that is receiving great attention is artificial intelligence (AI) (Abdel-Hameed, Rasheed & Yousef, 2020). According to Russell and Norvig (2016), artificial intelligence (AI) is the capacity of a machine to mimic intelligent human behaviour, including learning, reasoning, problem-solving, and comprehending natural language. AI has the potential to greatly improve education by offering individualised, adaptive, and interactive training that is customised to meet the needs of each student (Ivette, Elena & Marquez, 2024). This suggests that it takes into account each learner's unique characteristics. The term artificial intelligence (AI) in education describes the application of clever algorithms and machine learning methods to speed up and improve learning. These systems are capable of analysing huge amounts of educational data to find trends and insights, which makes it possible to create personalised learning pathways that address each student's particular strengths and limitations (Chen, Chen, Lin, 2020). To ensure complete understanding and subject mastery, artificial intelligence (AI) in teaching and learning can deliver real-time feedback, modify the level of difficulty of the material, and provide more resources. Because it gives students a basic knowledge of living things and life processes, biology is a vital science topic that helps students succeed in the sciences and science-related fields at the tertiary level. Understanding biology enhances critical thinking and informed decision-making in non-scientific communities, enabling individuals to engage with science-based issues like climate change and biotechnology effectively (Kelp, McCartney, Sarvary, Saffer, 2023). Despite its importance, biology often faces challenges such as students' lack of interest, difficulty in understanding difficult concepts, and poor teaching methods. Traditional biology teaching methods, which primarily rely on textbooks, lectures, and rote memorisation, may not effectively address the diverse learning needs of students.

The use of AI in classroom instruction can offer a promising solution to these challenges by utilising technology to enhance the teaching and learning process. The use of AI in teaching and learning can incorporate features such as intelligent tutoring, virtual laboratories, interactive simulations, and gamified learning activities to make learning biology more engaging and effective. Furthermore, the use of AI strategies promotes equal access to science education by personalising learning experiences and providing real-time feedback, addressing disparities in educational access (Chima, Olabisi, & Idowu, 2024). For example, intelligent tutoring systems can provide personalised instruction and practice opportunities, helping students to master difficult biological concepts at their own pace (Jagjit, Rudra, 2024). Furthermore, the use of AI instructions can assist teachers in identifying students who may be struggling and provide targeted interventions to support their learning (Leovigildo, Mallillin, 2024). This can also enable the teacher to use an instructional method that suits the learner's abilities, thereby considering their different brain hemispheric dominance.

This suggests that dominance of the left or right brain can offer significant advantages when using artificial intelligence (AI), which encourages a positive attitude toward learning biology. According to brain dominance theory, left-brained people may be better at tasks requiring structured decision-making, rule-based information processing, and in-depth data analysis. This notion is supported by research by Filyushkina, Porpov and Ushakov (2021); Merrick, Dixon, Breska, Lin, Chang, King-Stephens, Laxer, Weber, Carmena, Knight, & Ivry (2022) which demonstrates that the left hemisphere typically performs better in activities requiring the application of algorithms and a linear approach. However, those who are right-brained perform exceptionally well on tasks requiring creativity, intuition, and holistic thinking.

In contrast, right-brain dominant individuals may have an advantage in situations that require creativity, intuition, and innovative problem-solving with the help of AI. The study by (Wang & Xu, 2021) suggests that the right brain tends to be more effective at recognizing complex patterns in data, understanding ambiguous contexts, and generating insight-based solutions. These findings highlight the importance of considering both hemispheres of the brain in decision-making processes, as each may offer unique strengths in different situations in teaching and learning of Biology. By utilising the strengths of both hemispheres,

individuals can enhance their overall decision-making abilities and adapt to a variety of challenges in learning biology in the classroom and outside the classroom. Thus, teaching and learning strategies can be tailored to harness the strengths of each type of brain dominance in optimising the use of AI in various applications (Gadanidis, 2017; Shen, 2023), irrespective of their gender.

Gender is a socio-cultural construct that determines behaviours, perspectives, and responsibilities considered appropriate for each sex (Godpower-Echie & Owo, 2019). According to Dawal (2021), gender disparities exist in students' attitudes towards science. Dawal observed that while female students generally have a positive attitude towards Biology, male students tend to have a positive attitude towards Physics, Chemistry, and Mathematics.

Purpose of the Study

The main purpose of this study was to examine the influence of brain hemispheric dominance on attitude towards learning Biology using Artificial Intelligence (AI)

The specific objectives of this study were to determine the influence of;

1. Brain hemispheric dominance on students' attitudes towards Biology.
2. Gender on students' attitude towards Biology.

Hypotheses

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

Ho₁ There is no significant influence of brain hemispheric dominance on students' attitude towards Biology using Artificial Intelligence (AI)

Ho₂ Gender does not significantly influence the mean attitude scores of students towards Biology using Artificial Intelligence (AI)

Methodology

The study adopted a causal-comparative (Ex-post facto) design. The population of the study comprises all SSII Biology students in the 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 a multistage sampling procedure. Two instruments were used for data collection, which are the Brain Dominance Test (BDT) and the Biology Student Attitude Questionnaire (BSAQ). The instruments were face validated by three experts, one from the Biology unit, one from the measurement and evaluation and one from psychology. The instruments were trial-tested, and a reliability index of 0.88 was estimated using Cronbach's Alpha formula.

The researcher established a rapport with the school principals and subject teachers who serve as research assistants. The Biology teachers were briefed on the procedures for administering the instruments, which were administered and collected on the spot to ensure maximum return.

Mean and standard deviations were used to answer the research question, while the hypotheses were tested using a t-test at the 0.05 level of significance.

Table 1

A t-test Summary Table on Attitude Rating Scores of Right and Left Hemispheric Dominance of students in Biology

BDH	n	Mean	SD	t	df	P-value	decision
Right	76	34.26	6.06	3.054	148	.003	significant
Left	74	31.45	5.19				

Table 1 revealed that the mean attitude score of students with right brain hemispheric dominance was (\bar{x} = 34.26, SD = 6.06) while those with left brain hemispheric dominance were (\bar{x} = 31.45, SD = 5.19). The students with right brain hemispheric dominance,

therefore, had positive attitude than students with left brain hemispheric dominance in biology. The standard deviation indicated that scores obtained from students with left brain hemispheric dominance are closer to the mean than those from the right brain dominance. Below is the result of the hypothesis

An independent “samples t-test was conducted to compare the mean attitude scores for students with right and left brain hemispheric dominance. The right brain hemispheric dominance group ($M = 34.26$, $SD = 6.06$) compared to the left brain hemispheric dominance group ($M = 31.45$, $SD = 5.19$) demonstrated a significantly positive attitude in Biology, $t(148) =$

3.054 , $p = .003$. The magnitude of the differences in the mean (mean difference = 2.81 , $95\% CI$: -4.63 to 4.64) was very small (Cohen’s $d = .06$). The null hypothesis, therefore, was rejected, indicating that there was a significant difference in the mean attitude scores of students with different brain hemispheric dominance (Right and Left) in Biology.

Table : 2

A t-test Summary Table on Attitude Scores of Biology Students According to Gender

Gender	n	Mean	SD	t	df	p-value	decision
Male	66	31.12	5.02	-3.390	148	.001	significant
Female	84	34.25	6.03				

Table 2 revealed that the mean attitude scores of male students were ($M = 31.12$, $SD = 5.02$), while for female students was ($\bar{x} = 34.25$, $SD = 6.03$). The female students, therefore, had positive attitude than male students in biology. The standard deviation indicated that scores obtained by female students are closer to the mean than scores obtained from male students. Below is the result of the hypothesis. Below is the result of the hypothesis.

An independent samples t-test was conducted to compare the attitude scores for male and female students in Table 12. The male students ($M = 31.12$, $SD = 5.02$) compared to female students ($M = 34.25$, $SD = 6.03$) demonstrated significantly positive attitude, $t(148) = -3.390$, $p = .001$. The magnitude of the differences in the mean (mean difference = -3.12 , $95\% CI$: -1.34 to 1.30) was very small (Cohen’s $d = .04$). The null hypothesis, therefore, was rejected, indicating that there was significant difference in the mean achievement scores of male and female students in Biology.

Discussions

The result from this study indicates that students with right brain hemispheric dominance showed positive attitude than students with left brain hemispheric dominance in Biology. Further analysis revealed that there was a significant difference in the mean attitude scores in favour of the right hemispheric dominance learners. This difference could be as a result of the fact that right brain learners are characterised to be visually oriented, imaginative, artistic and dominant in interactive activities such as discussion and field trips. These interactive approaches

can result in students’ positive attitude towards Biology. Because attitude tends to improve positively by learners by what they can see and feel, also it could be attributed to the teachers use of instructional approach that best suit the right brain hemispheric dominance since learners can acquire from teacher’s disposition to form positive attitude towards a subject because right brain dominance specializes in recognition and expression of emotions which relates to attitude. The result of this study is in line with the findings of Mawn (2014), the study showed that learners’ positive attitude tends to improve with brain-compatible instructions, which favours right-brain learners towards science subjects to the results of the study.

The result of this study showed that female students had positive attitude than male students in Biology. The corresponding null hypothesis was therefore rejected, indicating that there was a significant difference in the mean attitude scores of male and female students in Biology. Gender is a socio-cultural construct that assigns roles, attitudes and values considered appropriate for each sex, gender stereotypes hinder females from participating in science, thereby making them develop a negative attitude towards learning about the sciences. But from the result the female have a positive attitude than males means that female students have begun to receive support from educational environment which allows them learn and gets fully involved in science and practices through curriculum that breaks the barrier of them participating in sciences in the classroom and also having equal opportunities with males who are

believed to be more science inclined and with positive attitude towards learning of sciences.

The findings of this study are in agreement with the findings of Nasir & Muhammad (2020), which state that females have positive attitude than males in Biology, but in contradiction to the study of Nasr (2022), whose results show there is no significant difference between male and female attitudes towards Biology.

Conclusion

The evidence from the findings of the study showed that students with right hemispheric dominance had higher attitude means towards Biology. Also, it was concluded that the gender of the student is a significant factor in students' attitude towards biology, meaning that female students had higher attitude mean scores than male students.

Educational Implications

1. For students, this implies that different brain hemispheric dominance exists among learners, and this can influence the way they perceive and process information while using AI in teaching and learning biology.
2. For teachers, it implies the use of teaching methods that are student-centred rather than teacher-centred which will engage the brains actively. It also implies that teachers use technology-based methods in teaching learners while considering their differences.

Recommendations

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

1. The findings of this study recommend the use of AI in biology classrooms; teachers should encourage students to use their various strengths in learning while using AI.
2. Science teachers should be trained on the need for proper classroom management to suit learners' differences in terms of brain hemispheric dominance and the use of AI in classroom instruction.

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