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Review Article

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The Application of Brain-Based Learning Paradigm in Science Education, Nigeria: A Review

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Abstract The paper reviewed the application of the brain-based learning model to solve teaching and learning problems in science education. The starting point was the reviewing of the challenges to the teaching and learning in science education, and the article believed the solving of the problems is possible through the brain-based learning. The brain-based learning is strategies gleaned from research in neurology and cognitive science used to enhance teacher instruction. The authors highlighted twelve principles of the brain-based learning. The application of the paradigm was viewed in different ways to improve students' academic performance. The paper recommended investigative research in Nigeria to obtain more empirical results on the effectiveness of the brain-based learning.

Keywords brain-based learning, memory, pedagogy, neurology, cognitive

Introduction

The students' learning in science education is facing serious problems for more than two decades till now. There are proofs of these challenges, especially the students' achievement and the sexism [1]. Several studies revealed that teachers' obsolete pedagogies and students' interest contributed much to these problems.

Most science teachers are curriculum-driven. These teachers are more interested in finishing the contents of the syllabus as stipulated by the curriculum at the expense of the students' brain. Both the teachers and the students seem to forget that there is a connection between the brain and everything that goes on in school. According to [2], any attempt to disconnect this will lead to failure, frustration, and disaster in teaching and learning as witnessed in science education today in Nigeria. The students on many occasion had too much works the brain cannot cope with. It is common to see students sitting for several hours receiving lecture, at the end of the day only a few of what is learned are retained because the brain has its way of working.

The learning environment is another problem where many teachers are making mistakes. The human brain is like an individual who requires a good environment to function well. The students' brain needs a good learning condition to function. The learning condition of most Nigerian science students is deplorable and most cases the brain reacts, but we often blamed the students. Students sit for hours without a break to refresh, walk around, take snacks, drink water and take fresh air outside the classroom. [2] argued that the teacher should support more physical activity, recess, and classroom movement. The human brain needs all these to function at its best. It is true that there are many causes of learning challenges leading to poor academic performance in science education. However, the position of this article is to link this failure to the lack of understanding of how the human brain works. The starting point for this article is to properly review a few of the challenges facing science education in Nigeria. After that, conceptualize the Brain-based learning and how it could be used to solve the learning challenges in science education.

Challenges facing science education in Nigeria

Challenges in science education are not only peculiar to Nigeria it is a global problem. In the international scenario, science education in Mexico junior high school level is terrible according to [3].The only difference is the attitude and approach of the stakeholders in education to solve the problems.

Student's mode of learning: Learning science in Nigerian school is mostly memorisation, and that is why many science students were unable to function well after leaving schools. [4] observed that the mode of teaching and learning is characterised by rote memorisation and regurgitation for examination purpose. This is a serious problem that led science education graduates looking for jobs after leaving universities.

Poor teacher's pedagogies: Pedagogy of teaching is crucial in the science teaching. [5] attributed failure in science to poor pedagogy. [6] stressed the importance of teachers' teaching method in students' learning. Many of the students in the sciences are frustrated because of the poor strategies some teachers employed [7]. These had on many occasions led to the students' withdrawal from science class, and the result is the low science enrolment [8] in schools. There is no more zeal among the students to offer science as a course in higher level due to this problem. [6] agreeing with this said students are not interested in offering science. In the perception of [9] teachers made students to fear science. The belief that the teaching of science is abstract [10] is due to the teacher ways of handling the teaching. The teachers' strategies of teaching are influencing students' attitude negatively toward science and in turn affect learning outcomes [11].

Poor students' enrolment: The enrolment in science is dropping in schools every year. Enrolment, attitude, and performance in science education are poor [12; 8]. Students' enrolment is a serious problem of science education in Nigerian schools today. Many students prefer political science, medicine, law, mass communication and journalism to science. The reason for this is the job prospect and the erroneous belief that it is difficult to study [9]. The problem of enrolment had created gender gaps in science education. [13], the falling enrolment and gender gaps in science education are problems that require global attention. Research documented it that male students are more inclined to science learning than the female and this is affecting the career placement. Science mode of instruction suits more the interest and motivation of boys and observation in science classes indicate that boys and girls act out unique gender roles [14]. Student gradually loses interest in science education. The lack of interest of students to pursue scientific careers has been a worldwide concern [15]. The author further asserted that to increase the students interest in scientific disciplines and achieve science education goals for life and citizenship it is imperative to promote and develop the students' interest and preference towards scientific subjects.

The problems mentioned above and many more are affecting the quality of science teaching which also leads to poor students' academic achievement. Quality teaching is a serious problem in science education [16]. There is, therefore, an urgent need to tackle this problem holistically because of the importance of science education in any nation. Science education is an essential vehicle to provide human resource development, modernisation and overall development of any nation [17]. Science knowledge is good, but it is better if the knowledge can be applied practically. Science must go beyond the acquisition of knowledge, understanding but the doing of science [18].

There had been several efforts at solving the above problems. For many years, one of the most persistent challenges which teachers have tried to solve is how to achieve maximum results with the minimum but the active medium of instruction [19]. [20] worried about scientific illiteracy among the students and called for its alleviation to improve job opportunities in science-related careers. The author suggested the increase in students' achievement through the teacher implementation of different instructional strategies that can result in the academic success of students in science. The inquiry-based learning is one of the efforts at solving poor achievement in science education and increase scientific literacy among science students [21].

Given the problems and the various efforts made to confront these challenges and the problems remain unsolved, the need for a practical approach as the brain-based model might work out better. The discussing of brain-based learning below and its application to solving the science education learning problems is imperative.

The Brain-based learning model and its application to science education learning

Jensen (2008) in [22] defined brain-based learning as learning aligned with how brains naturally learn: learning with the brain in mind. According to [23], the brain-based learning instructional model is a learner-centered and

teacher-facilitated method that employed learners' cognitive gifts (endowments). It is learning viewed as techniques gathered from research in neurology and cognitive science used to enhance teacher instruction [24]. Brain-based learning is learning that aligned with the workings of the brain and designed naturally to learn [25]. Research documents are showing that many countries have been using brain-based learning in their schools for instructions these nations include the USA, Turkey, Chile, England, Thailand, and others [24].

The brain-based learning utilizes twelve principles listed below to work according to [26]. These are

- The brain is a parallel processor
- Learning engages the entire physiology
- The search for meaning is innate
- The search for meaning occurs through patterning
- Emotions are critical to patterning
- Every brain simultaneously perceives and creates parts and whole
- Learning involves both focused attention and peripheral perception
- Learning always involves conscious and unconscious processes
- We have two types of memory systems: spatial and rote learning
- The brain understands and remembers best when facts and skills are embedded in natural spatial memory
- Learning is enhanced by challenge and inhibited by threat
- Every brain is unique

For the teacher to give the students the best opportunities to succeed in science learning require that the teacher know how the brain works [27]. The brain works like an individual to perform excellently in a positive emotional state. The students' brain will only be ready to learn when the students are physically and emotionally safe. The teacher makes this happens by creating positive environments through motivation and praising students' efforts. According to [27], the brain will always work at a scheduled time. There should be a time students will need to rest their brain from learning activities. Increasing the students' focus demand that they are permitted to have an off-task time between lesson segments. Research documents suggest that students should be encouraged to drink water during learning time to avoid dehydration. Dehydration increases the level of salt in the body and leads to the pressure of the blood which may lead to the loss of attention and lethargy.

Physical activities, recess and movement support learning and are critical to learning [2]. Students should not be confined to a class for an extended period without exercises. Teaching contents in smaller chunk magnitudes are the most appropriate for the brain. The teacher should not give too many contents for the students' learning. Breaking the contents into smaller chunk to teach and let the students have time for refreshing to rest the brain for processing information is imperative in the brain-based learning.

The brain-based learning valued interactions during the class teaching very useful. These could be teacher-student or students-students interactions. [28] identified three crucial interactive teaching strategies which are

1. Orchestrated immersion: Provide a learning environment that surrounds the student with interesting, related, hands-on activities.

2. Relaxed alertness: Remove fear while creating a challenging learning environment.

3. Active processing: Link information to prior learning and allow the student to process the information actively.

Thus, it is apparent that the brain-based learning functions based on the constructivist theory. The theory hinged on the understanding that the students should be able to use the previous experience to construct new information and knowledge. This theory is essential for learning in science education as [29] explained in his paper "Developing a constructivist model for effective Physics learning." Thus, the brain assists the students to actively process the new information as a result of the storage in the spatial memory system. The students will naturally remember the experience without any rehearsal because it is in the spatial memory system and connect with the new information to learn. This exemplifies the principle that the brain understands and remembers best when facts and skills are embedded in natural spatial memory.

Research studies documented various learning potentials the brain-based learning offers students irrespective of the field of studies. Based on this, the paper reviewed some of the possible applications of the learning to science education in Nigeria.

Application of Brain-Based Learning in Science Education

Between May and June 2018, we demonstrated some components of brain-based learning in a Physics class in a College of Education. The teacher observed that the students do fail PHY 321 (Electromagnetism III) from the records. The reason for this was that the course looked difficult because it contains abstract concepts and mathematical calculations. The time allocated for the teaching of the course was two hour at stress. On many occasions before the expiration of the two hours lecture, the students are tired, fatigued not responding well to the teacher.

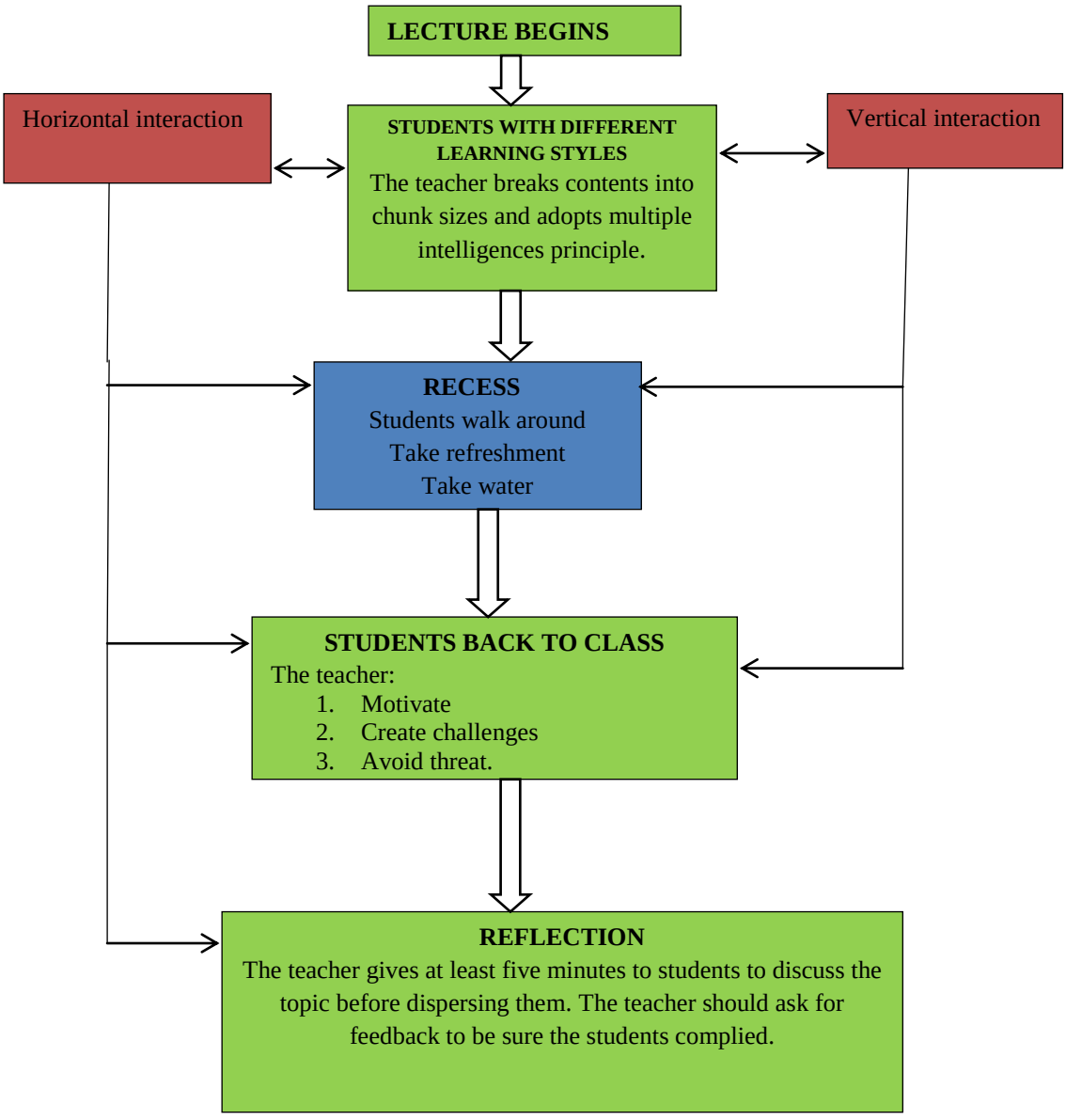

Figure 1: The Brain-Based Learning Flow Chart

The teacher decided to introduce the brain-based learning model by bringing water and refreshment to the class. The teacher allowed the students to go on recess for about five minutes, walk around, take water and light refreshment and come back for the lecture. Observation shows the students were more vibrant and contributed to the learning process better after the recess. Some students who had not been alive to learning woke up and

contributed meaningfully. Additionally, the end of the semester examination result shows that more than 95% of the students who attended the brain-based learning class scored above 50% in the course. Nearly all who failed the course were those who never participated in the brain-based learning. The result shows better scores among those recorded in the past ten years since the teacher has been teaching the course. The figure 1 above summarizes the brain-based learning procedure as explained above.

Based on the narrative given above in PHY 321 class the chart in figure 1 above could be of great help for implementing the brain-based learning for any class. Once the class began, the teacher should know he or she is dealing with students of different learning styles. The teacher should, therefore, adopt the principle of multiple intelligences to reach all the students. Two types of interaction are crucial: vertical and horizontal interactions. Student-student is horizontal while teacher-student is vertical. The class resumes after the short period of the recess,and the teacher should make the students physically and emotionally safe through motivation, creating learning challenges and avoid the threat. Finally, before the students leave the class, they must reflect on their learning. The teacher allows the students to spend at least five minutes on discussing among themselves the topic of the day. The teacher may request for feedback from the class through the class representative to be sure the students observed the section. This section is processing time and reflection which is essential for learning environment [27]. It should be of note that horizontal interaction is throughout class activities while vertical interaction does not include reflection time.

The narrative above was not investigative research; nonetheless, the result is a conjecture upon which we based the application of the brain-based learning in science education. The application of the brain-based learning in science education will solve most of the challenges in the teaching and learning as mentioned in this paper.

The teacher should ensure science teaching is not approach with a single teaching strategy but with different pedagogies as students have different learning styles [30], and every brain is unique [24]. The infusion of the recess, refreshment, drinking water and physical activities into classroom teaching is imperative [12; 27]. The classroom should be lively, motivating and free of tension. It is equally essential that the teacher avoid threatening the students. Some teacher tells students that science is complicated and that if they do not work hard, they will fail. The teacher could create challenges that will make them work hard not saying they will fail. For instance, tell the brief story of the achievers in science and how they made it. Give them riddles or puzzle to unravel in science. The teacher should bear in mind that according to [31], learning is enhanced by challenge and inhibited by threat.

Given the twelve principles of brain-based learning, these could be applied in science education. The application of the brain-based learning in the teaching and learning of science will solve many problems especially the poor academic performance.

Conclusion

The article reviewed some challenges the teaching and learning in science education are facing. These problems revolved around the pedagogy of teaching which culminated in the problem of poor students' academic performance. The paper succinctly argued that the problems are solvable through the brain-based learning model which other countries had implemented and worked. The brain-based learning is from research in neurology and cognitive science used to enhance teacher instruction. Twelve principles act as a cynosure for the paradigm. Research studies indicate that brain-based learning enhances and improve students' academic achievement.

Recommendation

Based on this review, it was suggested that investigative research should be conducted in Nigeria to have more empirical results on the use of the brain-based learning.

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