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OPTIMIZATION OF JUNIOR HIGH SCHOOL BIOLOGY LEARNING THROUGH THE EXAIR MODEL BASED ON BRAIN-BASED LEARNING AND WHOLE BRAIN TEACHING

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Abstract
The purpose of this study is to optimize junior high school biology learning through the EXAIR model, which integrates Brain-Based Learning and Whole Brain Teaching principles. The research employs a quasi-experimental design with pretest-posttest involving 106 students in Malang, Indonesia. Learning outcomes were assessed using multiple-choice tests to measure cognitive achievement and critical thinking skills. The ANCOVA analysis demonstrated a significant effect of the learning model on student learning outcomes ($p < 0.05$), with the experimental class outperforming both positive and negative control classes. The EXAIR model was proven effective in activating both hemispheres of the brain, fostering engagement, and enhancing critical thinking skills. However, limitations were observed during the auditory learning stage due to insufficient student interaction. This study underscores the importance of brain-balanced learning strategies to improve biology education outcomes.

1. Introduction

Learning is fundamentally influenced by environmental aspects. The success of a learning system is dynamic and requires deliberate human intervention, particularly by teachers. Teachers are not only tasked with delivering subject matter but also with designing and implementing strategies that enable students to learn effectively and enjoyably. In biology learning, the emphasis is placed on direct engagement to foster competencies that allow students to understand concepts, apply scientific processes, and engage in scientific work (Lombardi et al., 2021). Biology education encourages students to be active, independent, and flexible in developing their full potential, encompassing their cognitive, emotional, and psychomotor domains (Savitri & Susanti, 2024). This is achieved through an active, interactive, and contextual learning process that supports meaningful learning experiences (Technol et al., 2023). Such experiences are most effective when they involve the optimal potential of the brain.

However, according to Arias et al., (2000) the full potential of the human brain is often underutilized in solving problems and generating new ideas. Traditional learning approaches frequently emphasize the left hemisphere of the brain, which governs verbal skills, logical reasoning, and sequential processing, thereby dominating academic activities (Voznyuk, 2021). Conversely, the right hemisphere, responsible for creativity, rhythm, visualization, emotions, and imaginative thinking, is often overlooked. This imbalance can limit students' overall cognitive and creative capacities.

The integration of both hemispheres offers significant benefits in creating balanced learning experiences. When students utilize both hemispheres equally, they are less likely to experience boredom and disengagement in the classroom. According to Banks, (2014), achieving such a balance involves creating a pleasant learning environment where students are free from undue pressure. A stress-free atmosphere enhances students' ability to focus, process information, and retain knowledge effectively.

To address these challenges, the EXAIR model, grounded in Brain-Based Learning and Whole Brain Teaching principles, offers an innovative approach to optimize junior high school biology learning. This model combines strategies that activate both hemispheres of the brain, fostering an engaging and holistic learning experience. By leveraging the principles of brain-based learning, the EXAIR model aligns teaching methods with how the brain naturally learns, ensuring students are motivated and actively involved in the learning process. Whole Brain Teaching further complements this approach by encouraging the integration

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of multiple modalities, such as visual, auditory, and kinesthetic learning, to accommodate diverse learner needs.

Recent studies highlight the importance of fostering student engagement through methods that integrate neuroscience principles into education. Brain-based learning emphasizes the significance of emotions, patterns, and contextual learning in shaping how information is processed and retained by students (Erişti & Akdenis, 2016). Similarly, Whole Brain Teaching focuses on leveraging all areas of the brain to ensure a comprehensive learning experience, promoting collaboration, creativity, and critical thinking skills (Handayani & Corebima, 2017). By merging these two approaches, the EXAIR model not only targets cognitive enhancement but also supports students' emotional and social development. This integration is particularly relevant in biology education, where understanding complex concepts often requires a multifaceted learning approach that combines analytical reasoning with creative problem-solving. Therefore, the EXAIR model holds promise as a transformative educational strategy that aligns with the diverse demands of modern biology curricula.

Integrating both hemispheres of the brain is crucial for creating balanced and effective learning experiences. When both hemispheres are activated, students experience reduced boredom and disengagement, as a balanced approach fosters greater focus and retention (Pekrun et al., 2010). Achieving this balance requires a stress-free and stimulating learning environment that aligns with the brain's natural learning processes. This paper explores the application of the EXAIR model in junior high school biology education, emphasizing its potential to optimize learning outcomes by activating and balancing the full range of students' cognitive abilities. The study aims to provide insights into how this innovative model can transform traditional biology education into a dynamic and brain-friendly learning experience.

2. Method

The research method was conducted by quasi-experiment. There were pretests and posttests conducted. The subjects in this study were 106 students conducted in one of the high schools in Malang city, East Java, Indonesia. Data analysis was performed with Ancova. The independent variable is the learning method carried out, namely the learning model that teachers usually use, the Exair-Brain Based Learning learning model, and the Brain-Based Learning learning model. The dependent variable is learning outcomes from C1-C6.

3. Result and Discussion

We measure learning outcomes using multiple-choice questions both before and after learning. We obtained data by treating the learning model in three classes. The three classes consist of a positive control class, a negative control class, and an experimental class. Table 1 displays the results of the ANCOVA analysis. The results of the analysis show that there is a significant effect of the learning model on student learning outcomes. It is established that the significance level is less than 0.05, specifically 0.00. Furthermore, Table 2 displays the results of the BNT test of learning outcomes.

Table 1. Ancova Test

Dependent Variable:Posttest						
Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	2766.977[a]	2	1383.488	28.740	.000	.358
Intercept	394587.370	1	394587.370	8196.930	.000	.988
Modelbelajar	2766.977	2	1383.488	28.740	.000	.358
Error	4958.259	103	48.138			
Total	403250.000	106				
Corrected Total	7725.236	105				

a. R Squared = .259 (Adjusted R Squared = .245)

Table 2. BNT test

Kelas	*Pretest*	*Posttest*	Difference	Improvement (%)	Corrected Mean	Notation
Positive Control	41.21	56.50	15.29	37.10	55.98	a
Negative Control	37.14	58.42	21.28	57.29	58.31	a
Experiment	29.93	68.12	68.12	127.59	68.73	b

According to Table 2, the learning model significantly influences the student learning outcomes in the experimental class compared to the positive control and negative control classes, while the student learning outcomes in the positive control and negative control classes do not significantly differ.

The results of hypothesis testing using ANCOVA in this study show that both learning outcome variables have a significant influence on the learning model. Based on the data from the research hypothesis test results, it is known that the significance value on learning outcomes is 0.00. The significance value falls below the p-value of 0.05, indicating the acceptance of the research hypothesis. Based on the BNT test, the experimental class has critical thinking skills that are significantly different from the control class students. Multiple-choice tests measure the cognitive learning outcomes of students, while descriptions measure their critical thinking skills. The ANCOVA analysis reveals a significant variation in the impact of the student learning model on learning outcomes. This is in line with Lidiastuti et al., (2019), which states that the learning model emphasizes brain-based learning that can improve learning. The BNT test revealed a significant difference in the student learning outcomes between the experimental class and the positive control and negative control classes. This statistical test concludes a significant influence on the dependent variable, specifically critical thinking skills and cognitive learning outcomes in students.

The BNT test results indicate that the Exair learning model, which combines Brain-Based Learning and Whole Brain Teaching, or Exair-Brain Learning, is more influential in improving critical thinking skills. The intriguing aspect of this study is that while the results of the negative control class outperform those of the positive control class, the experimental class maintainss its superiority. This suggests that the brain-based learning Exair model suffers from insufficient student engagement; playing classical music during the auditory stage induces drowsiness and discourages students from interacting. The results of studies related to brain-based learning (Exair research) show that in learning activities at the auditory stage, the teacher explains the material without a certain movement or code (Lidiastuti, 2020). Humans use codes in learning at the sensory store stage, where pattern recognition determines the information they will remember (Wolff, 2019). Therefore, movement can enhance the significance of codes in learning. We can divide other influencing factors into two categories: external and internal factors (Chen et al., 2023). Internal factors originate from an individual's own learning process. These factors can be physical, psychological, or fatigue-related. Factors from within can manifest as family dynamics, parental education methods, familial relationships, friend relationships, and student involvement in community activities (Ying & Kutty, 2023)

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4. Conclusion

Based on the findings, the EXAIR model, which integrates Brain-Based Learning and Whole Brain Teaching, effectively optimizes junior high school biology learning. The experimental class achieved significantly better learning outcomes and critical thinking skills compared to the control classes. This success highlights the importance of balanced brain activation in the learning process, where both hemispheres contribute to cognitive and creative growth. However, challenges such as limited interaction during auditory stages suggest the need for further refinement of implementation strategies. Future research should focus on enhancing student engagement and addressing potential external and internal factors influencing learning outcomes. This model provides a promising framework for creating dynamic, student-centered biology education.

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