JPPIPA 10(12) (2024)

Jurnal Penelitian Pendidikan IPA

Journal of Research in Science Education

http://jppipa.unram.ac.id/index.php/jppipa/index

Recognizing Each Student's Unique Learning Style: Adapting the Brain-Based Learning Approach in Natural and Social Science Learning

Thariq Al Ayubi[1*], Hanif Al Kadri[1], Yanti Fitria[1], Ulfia Rahmi[1]

[1] Universitas Negeri Padang, Indonesia.

Received: August 26, 2024
Revised: November 07, 2024
Accepted: December 25, 2024
Published: December 31, 2024

Corresponding Author:
Thariq Al Ayubi
yubidekan01@gmail.com

DOI: 10.29303/jppipa.v10i12.9657

Abstract: This study developed a brain-based learning (BBL) model that is adapted to students' learning styles to improve learning outcomes in Natural and Social Sciences in elementary schools. Using the ADDIE (Analysis, Design, Development, Implementation, Evaluation) development method, this research produced a learning module that was validated by material, media, and language experts, and tested for practicality and effectiveness in two schools. The results showed a significant increase in post-test scores compared to the pre-test, indicating that the BBL approach was effective in supporting students' understanding. The main conclusion of this study is that the adaptive BBL model is able to create a more inclusive learning environment and support individual cognitive needs, thus improving students' understanding and retention of information.

Keywords: Brain-based learning; Learning styles; Natural and Social science

Introduction

Individual differences in learning styles are one of the fundamental aspects of education. Each student has a unique way of processing, understanding and remembering information, which is influenced by various factors, such as sensory preferences, level of emotional engagement and cognitive structure. emotional engagement, and cognitive structure. An understanding of these differences is becoming increasingly important in modern education which seeks not only to teach students to understand the material but also to empower them in meaningful and sustainable learning meaningful and sustained learning (Bobrowicz et al., 2024; Bonte & Brem, 2024; Zhao et al., 2025).

In the context of learning science natural and social sciences, which are often perceived as subjects that are dense in information and requiring in-depth understanding (Knott et al., 2022; Schwartz & Lederman, 2002), the challenge of tailoring learning methods to the learning needs of each student becomes increasingly obvious. The uniform teaching approach, which is still often used in the classroom, risks making some students feel disconnected from the learning process or have struggling to understand the material, hindering their learning potential (Yalçin & Sadik, 2024).

The brain-based learning (BBL) approach offers an innovative and relevant solution (Sugiarti et al., 2021; Thurrodliyah et al., 2020). Contrast to conventional teaching methods that focus on information transfer, the BBL approach is based on an understanding of how the brain works to optimally process and store information (Lagoudakis et al., 2024; Rodgers & Hales, 2021). The theory seeks to create learning environments that support the brain's natural processes, including attention to factors such as stress reduction, appropriate sensory stimulation, and variety in the presentation of information. BBL not only considers cognitive aspects but also embraces the emotional and social aspects of

How to Cite:
Ayubi, T. A., Kadr, H. A., Fitria, Y., & Rahmi, U. (2024). Recognizing Each Student's Unique Learning Style: Adapting the Brain-Based Learning Approach in Natural and Social Science Learning. *Jurnal Penelitian Pendidikan IPA*, *10*(12), 10161–10168. https://doi.org/10.29303/jppipa.v10i12.9657

learning, assuming that the human brain learns more effectively in conditions that are emotionally supportive and personally relevant (Bates, 2021).

Research in the field of BBL shows that when teaching is adapted to the brain's natural processes, students tend to be more focused, motivated and able to absorb information better (Letina & Perković, 2021). However, challenges arise when BBL concepts need to be practically applied in classroom learning, especially in natural and social science contexts, which include complex and diverse topics. Achieving optimal results requires customizing BBL methods that take into account each student's unique learning style in terms of visual, auditory and kinesthetic preferences (Azzahra & Dwiputra, 2024; Kaur, 2023). This customization not only enhances the individual learning experience but also creates a more inclusive and adaptive classroom environment.

Previous studies have demonstrated the benefits of brain-based learning (BBL) in aligning educational strategies with the brain's natural learning processes, particularly in enhancing engagement, comprehension, and retention among students. For example, research by Terblanche (2023) highlights that learning methods rooted in the brain's cognitive preferences can deepen understanding and sustain attention through techniques that tap into multisensory experiences and contextual learning. These studies underscore the potential of BBL to improve learning outcomes; however, they also reveal gaps in adapting BBL methods for diverse classroom needs, especially for subjects like natural and social sciences that encompass varied and complex content (Dwiputra et al., 2023).

This research seeks to fill this gap by focusing on the novelty of integrating BBL principles with customized methods tailored to individual learning styles, specifically visual, auditory, and kinesthetic (Küçükmemics, 2022; Misra, 2021). This approach aims to make BBL more accessible and practical for diverse classroom settings, enabling teachers to create more inclusive and adaptive learning environments. In doing so, the study addresses an important gap by not only testing BBL in a practical, diverse classroom context but also developing a structured model that educators can readily apply to foster a deeper understanding across different subjects.

This research aims to develop a learning model that integrates brain-based learning principles into natural and social science learning, with a focus on customizing methods for different student learning styles. The model is designed to help educators create learning strategies that are effective in improving students' overall engagement and understanding. As such, this research not only explores the application of BBL in a practical context but also provides guidance that can be used by educators to enrich their teaching approaches according to the unique needs and potential of each student.

Method

This study uses a Research and Development (R&D) approach with the ADDIE model (Analysis, Design, Development, Implementation, and Evaluation). The ADDIE model was chosen as it is suitable for systematically and iteratively developing educational products, allowing researchers to design, test, and refine a brain-based learning (BBL) model that adapts to students' learning styles. The subjects of this study are elementary school students in Padang City, representing diverse learning styles and characteristics in natural and social science learning (Yu et al., 2021).

This is a developmental study aimed at creating an effective learning model by applying BBL principles to natural and social science education, tailored to each student's individual learning style. The ultimate goal is to test the effectiveness of this model in enhancing students' understanding through classroom implementation.

The research proceeds through five main stages in the ADDIE model. The Analysis stage involves a needs analysis to understand students' learning styles and classroom learning requirements. Interviews with teachers and observations are conducted to identify the needs and constraints in natural and social science learning. These data form the basis for the instructional design.

Based on the analysis, the Design stage involves creating a learning model that integrates BBL principles tailored to students' learning styles, including strategies that support visual, auditory, and kinesthetic preferences. Designed elements also consider factors that support cognitive and emotional stimulation following BBL principles.

In the third stage, Development, the learning model is developed into modules and teaching materials, which are then validated by experts in content, media, and language. Content experts evaluate the relevance and accuracy of materials for natural and social sciences, media experts assess the alignment of instructional design with BBL principles and support for diverse learning styles, while language experts ensure the language used is appropriate for elementary students. Feedback from experts is used to revise and improve the modules before classroom implementation.

The fourth stage, Implementation, involves applying the validated learning model in classrooms with elementary students in Padang City. This implementation is conducted over several sessions

designed for natural and social science learning, with direct observation of student engagement and responses to the content presented according to their learning styles.

The final stage, Evaluation, assesses the practicality and effectiveness of the developed learning model. Practicality tests are carried out through teacher feedback and trials with students across three scales: small group, limited group, and large group testing. Small group testing provides initial feedback on the clarity and usability of the learning model; limited group testing with a larger student group assesses the consistency of model effectiveness; and large group testing in a full classroom setting evaluates the model's practicality in a real classroom scenario.

Additionally, the effectiveness of the model is measured by comparing students' learning outcomes before and after implementation using a learning achievement test, analyzed with the Paired T-Test to determine any significant improvement in student comprehension. Research instruments include a learning style questionnaire, BBL-based learning modules, learning achievement tests, observation sheets, and a Likert scale questionnaire (Alanazi, 2020). Data is collected through observations, learning outcome tests, and questionnaires to assess students' perceptions. This study is expected to demonstrate the model's effectiveness in enhancing students' understanding and provide evidence of its practicality for actual classroom application.

Result and Discussion

Analysis Stage

At this stage, a needs analysis was conducted to understand the characteristics of students in both schools as well as their learning needs.

Table 1. Analysis Result

Aspects Observed	School A	School B
Number of Students	30 students	32 students
Dominant Learning Style	Visual and kinesthetic	Auditory and visual
Learning Needs	More use of visualisation, physical activity	Reinforcement of discussion activities, use of audio
Learning Constraints	Limited visual media	Limited audio equipment
Recommendations	Addition of kinesthetic activities, visual media	Addition of auditory material and active discussion

Design Stage

At this stage, the BBL learning model is designed based on the needs identified in each school, focusing on elements that support students' learning styles in each school.

Figure 1. Solar System Learning Media Display

Table 2. Design Results

Design Elements	School A	School B
Learning Media	Interactive visual modules, picture aids	Audio learning, discussion module
Learning Method	Kinesthetic activities, educational games	Group discussion, use of auditory media
Compatibility with BBL	Appropriate, supports kinesthetic and visual stimulation	Appropriate, supports auditory and visual stimulation
Design Objectives	Increases student participation and understanding	Accommodates auditory students, increases active engagement

Development Stage

The learning model is developed and then validated by material, media, and language experts.

Table 3. Material Expert Validation Results

Assessed Aspects	Score	Description
Content Appropriateness	4.5	Very Good
Relevance to BBL	4.3	Good
Depth of Material	4.4	Good
Relevance to the Curriculum	4.6	Very Good
Clarity of Learning Objectives	4.5	Very Good
Average	4.46	Very Good

The average score of the material expert validation is 4.46, indicating that the learning materials are of very good quality and in accordance with the needs of the curriculum and the concept of BBL.

Table 4. Media Expert Validation Results

Assessed Aspects	Score	Description
Visual Design	4.7	Very Good
Media Attractiveness	4.5	Very Good
Media Suitability with Learning Style	4.6	Very Good
Ease of Use	4.6	Good
Layout Suitability	4.5	Very Good
Average	4.54	Very Good

The average score of the media expert is 4.54, which means that the learning media is very interesting and in accordance with students' learning styles.

Table 5. Language Expert Validation Results

Assessed Aspects	Score	Description
Simplicity of Language	4.6	Very Good
Clarity of Instruction	4.5	Very Good
Readability	4.4	Good
Appropriateness of Language to Students' Level of Understanding	4.5	Very Good
Clarity of Concept	4.4	Good
Average	4.48	Very Good

The average score of the linguists is 4.48, indicating that the use of language in the module is very clear, simple, and in accordance with the understanding of elementary school students.

Implementation Stage

At this stage, the developed learning model was applied in the classroom at both schools. The practicality test was conducted through three scales: small group test, limited test, and large group test

Table 6. Practicality Test Results

Practicality Test	School A - Small Group (n=10)	School A - Limited Test (n=20)	School A - Limited Test (n=20) School A - Large Group Test (n=30)	School B - Small Group (n=10)	School B - Limited Test (n=22)	School B - Large Group Test (n=32)	Overall Average
Clarity of Instruction	4.4	4.5	4.3	4.5	4.4	4.2	4.38
Suitability to Learning Style	4.6	4.4	4.5	4.7	4.5	4.4	4.52
Ease of Use	4.3	4.4	4.3	4.4	4.3	4.2	4.32
Attractiveness	4.5	4.6	4.4	4.6	4.5	4.3	4.48
Overall Average	4.45	4.47	4.38	4.55	4.43	4.28	4.38

Evaluation Stage

At this stage, the effectiveness of the learning model is measured through the comparison of student learning outcomes before and after implementation using the Paired T-Test test.

Table 7. Paired T-Test Test for School A

		Mean	N	Std. Deviation
Pair 1	pre-test	64.80	30	1.65
	post-test	82.93	30	1.72
Paired Samples Correlations				
		N	Correlation	Sig.
Pair 1	pre-test & post-test	30	0.846	.000

The results of this study show that the application of a brain-based learning (BBL) model, designed to align with students' individual learning styles, significantly improves learning outcomes in Natural and Social Sciences subjects at the elementary school level (Davis & Donald, 2023). Through the ADDIE development stages, this study produced a validated learning module tested for effectiveness, showing a significant increase in the average post-test scores compared to pre-test scores across two different schools (Sharma, 2023).

These findings reinforce that a BBL approach, responsive to individual differences, can create more effective learning tailored to students' cognitive needs. In this study, students using the BBL model showed higher engagement and a better understanding of learning concepts. They also demonstrated stronger information retention, a result of the multisensory methods and brain connections leveraged by this approach.

Table 8. Paired Samples Test

Paired Differences									
					Lower	Upper	t	df	Sig. (2-tailed)
Pair 1	pre-test – post-test	-18.13333333	0.937102406	0.1710907	0.000	-17,78341	-105,9867	29	0.00

Table 9. Paired T-Test Test for School B

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	pre-test	65.09.00	32	1.422	0.0251
	post-test	83.41.00	32	1.682	0.297
Paired Samples Correlations					
Pair 1	pre-test & post-test	N	Correlation	Sig.	
		32	0.900	0.000	

Table 10. Paired Samples Test Paired Differences

		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference		t	df	Sig. (2-tailed)
					Lower	Upper			
Pair 1	pre-test - post-test	-18.312	0.738	0.130	-18.579	-18.046	-140.405	31	0.000

These findings are consistent with other relevant studies showing BBL's effectiveness in creating meaningful learning experiences aligned with students' natural thinking processes. For example, Jayasankara Reddy et al. (2021) found that brain-based learning strengthens neurological connections through contextual and multisensory approaches that make it easier for the brain to assimilate new information. This study also supports findings from other research on the benefits of personalized learning, which conclude that learning styles tailored to individual preferences can reduce students' mental strain when facing new material, thus improving focus and retention (Bada & Jita, 2022).

Research by Caine & Caine (1991) found that learning processes based on the brain's natural functioning, such as BBL, tend to be more effective in helping students understand complex concepts compared to traditional teaching methods. By providing deep learning experiences, BBL creates a learning environment that supports each student's unique learning style and motivates them to engage actively in the learning process (Handayani & Corebima, 2017; Lagoudakis et al., 2022; Laksana et al., 2019; Yangzom, 2013).

The implications of these findings include the potential of BBL to help teachers accommodate diverse learning styles within the classroom, creating more effective learning and enhancing educational quality. By

integrating BBL, teachers can efficiently manage students' varying learning styles, enabling a more inclusive learning experience. Additionally, implementing this model could positively impact developing critical thinking skills and connecting conceptual understanding with real-life contexts, which is highly important at the elementary education level.

However, this study also identifies certain challenges, such as limited time and teachers' skills in consistently implementing the BBL approach. The module requires appropriate adjustments for each learning style, which poses a challenge in large class settings. Furthermore, limited facilities or supporting media may hinder BBL implementation effectiveness, especially in resource-limited schools (Wardani et al., 2022).

Based on these findings and challenges, recommendations include: teacher training to enhance understanding and skills in applying BBL; developing supporting media such as visual and interactive aids suited to this approach; flexible time adjustments and curriculum adaptation; and institutional policy support to provide adequate resources. Further research is also recommended to explore BBL applications in a broader educational context and its long-term impact. It is hoped that, with more in-depth implementation and adequate support, the brain-based learning approach can further enhance educational quality and establish a better foundation for student learning in the future.

Conclusion

This study demonstrates that a brain-based learning (BBL) model tailored to students' unique learning styles significantly improves learning outcomes in Natural and Social Sciences subjects in elementary school. Through the application of the BBL model, students show improved understanding and information retention, while both teachers and students experience practical benefits in the learning process. These results underscore the importance of approaches that consider each student's cognitive needs and characteristics, showing BBL's potential as a more effective and inclusive teaching method in elementary education. This study also highlights the need for institutional support and teacher training to optimize the broad and sustainable implementation of BBL in educational settings.

Acknowledgments
We would like to thank all the authors and those involved in this research for their support so that this research can be completed properly.

Author Contributions
The authors listed in this article contributed to the development of the article, and have read, approved the published manuscript.

Funding
This article did not receive any external funding.

Conflicts of Interest
In writing this article, the authors do not have any conflict of interest.

References

Alanazi, F. H. (2020). Brain-based learning as perceived by Saudi teachers and its effect on chemistry achievement of 7th graders. *Journal of Baltic Science Education*, *19*(6), 864–874. Retrieved from https://www.ceeol.com/search/article-detail?id=944942

Azzahra, W., & Dwiputra, D. F. K. (2024). Unraveling the Evolution of Brain-Based Learning in Indonesia: An In-Depth Exploration through Systematic Literature Review. *International Journal of Educational Reform*, 10567879241258134. https://doi.org/10.1177/10567879241258134

Bada, A. A., & Jita, L. C. (2022). Integrating brain-based learning in The science classroom: A systematic review. *International Journal of Pedagogy and Teacher Education*, *6*(1), 24–36. https://doi.org/10.20961/ijpte.v6i1.57377

Bates, S. (2021). *Exploring Teachers' Confidence Levels, Preparedness and Professional Development for Brain-Based Learning: A Qualitative Narrative Inquiry Study* [Northcentral University]. Retrieved from https://shorturl.asia/pkXzF

Bobrowicz, K., López-Pernas, S., Teuber, Z., Saqr, M., & Greiff, S. (2024). Prospects in the field of learning and individual differences: Examining the past to forecast the future using bibliometrics. *Learning and Individual Differences*, *109*, 102399. https://doi.org/10.1016/j.lindif.2023.102399

Bonte, M., & Brem, S. (2024). Unraveling individual differences in learning potential: A dynamic framework for the case of reading development. *Developmental Cognitive Neuroscience*, 101362. https://doi.org/10.1016/j.dcn.2024.101362

Caine, R. N., & Caine, G. (1991). *Making connections: Teaching and the human brain.* ERIC. Retrieved from https://eric.ed.gov/?id=ED335141

Davis, J., & Donald, R. (2023). *The Impact of Achievement From Brain-Based Learning Resources on Primary Grade Students of Title I Schools* [University of St. Thomas (Houston)]. Retrieved from https://shorturl.asia/mNnv8

Dwiputra, D. F. K., Azzahra, W., & Heryanto, F. N. (2023). A Systematic Literature Review on Enhancing the Success of Independent Curriculum through Brain-Based Learning Innovation Implementation. *Indonesian Journal on Learning and Advanced Education (IJOLAE)*, *5*(3), 262–276. https://doi.org/10.23917/ijolae.v5i3.22318

Handayani, B. S., & Corebima, A. D. (2017). Model brain based learning (BBL) and whole brain teaching (WBT) in learning. *International Journal of Science and Applied Science: Conference Series*, *1*(2), 153–161. https://doi.org/10.20961/ijsascs.v1i2.5142

Jayasankara Reddy, K., Hunjan, U., & Jha, P. (2021). Brain-Based Learning Method: Opportunities and Challenges. *Neuro-Systemic Applications in Learning*, 295–307. https://doi.org/10.1007/978-3-030-72400-9_15

Kaur, A. (2023). *New Science of Teaching and Learning*. Notion Press.

Knott, E., Rao, A. H., Summers, K., & Teeger, C. (2022). Interviews in the social sciences. *Nature Reviews Methods Primers*, *2*(1), 73. Retrieved from https://www.nature.com/articles/s43586-022-00150-6

Küçükmemics, M. D. (2022). *The Impacts of Brain-Based Vocabulary Teaching on Young Adults* [Maltepe University (Turkey)]. Retrieved from https://shorturl.asia/ylGke

Lagoudakis, N., Vlachos, F., Christidou, V., & Vavougios, D. (2022). The effectiveness of a teaching approach using brain-based learning elements on students' performance in a Biology course. *Cogent Education*, *9*(1), 2158672. https://doi.org/10.1080/2331186X.2022.2158672

Lagoudakis, N., Vlachos, F., Christidou, V., Vavougios, D., & Batsila, M. (2024). The Use of Brain Based Learning Elements in a Teaching Approach for Scientific Understanding of Biology Concepts. *American Journal of Educational Research*, *12*(7), 247–253. https://doi.org/10.12691/education-12-7-5

Laksana, A. D. S., Prihatin, J., & Novenda, I. L. (2019). The Development of Collaborative Learning Cell Based on Brain-Based Learning (BBL) Model for The Junior High School Science Learning in The Agroecosystem Area. *Bioedukasi*, *17*(2), 82–91. https://doi.org/10.19184/bioedu.v17i2.14999

Letina, A., & Perković, M. (2021). Brain-based learning in primary science. *EDULEARN21 Proceedings*, 4438–4447. https://doi.org/10.21125/edulearn.2021.0931

Misra, P. K. (2021). *Learning and teaching for teachers*. Springer. https://doi.org/10.1007/978-981-16-3077-4

Rodgers, D. L., & Hales, R. L. (2021). Brain-Based Learning. *Comprehensive Healthcare Simulation: ECMO Simulation: A Theoretical and Practical Guide*, 43–50. https://doi.org/10.1007/978-3-030-53844-6_5

Schwartz, R. S., & Lederman, N. G. (2002). "It's the nature of the beast": The influence of knowledge and intentions on learning and teaching nature of science. *Journal of Research in Science Teaching: The Official Journal of the National Association for Research in Science Teaching*, *39*(3), 205–236. https://doi.org/10.1002/tea.10021

Sharma, A. (2023). Effect of Self-Developed E-Content Modules in Biology to Enhance Learning Agility: An Experimental Analysis. *Indian Journal of Natural Sciences*, *14*(79), 58711–58720. Retrieved from https://shorturl.asia/tfXjD

Sugiarti, L., Purwanto, A., & Sumantri, M. S. (2021). Literature study of the application of Brain Based Learning (BBL) learning models to environmental science literacy. *International Journal of Multicultural and Multireligious Understanding*, *8*(2), 374–384. https://doi.org/10.18415/ijmmu.v8i2.2349

Terblanche, H. A. (2023). *The Development of a Technology-Enhanced, Brain-Based Framework for Science Education: A South African Case Study* [University of Pretoria (South Africa)]. Retrieved from https://shorturl.asia/ICJbT

Thurrodliyah, N. I., Prihatin, J., & Novenda, I. L. (2020). the development of brain-based learning model based on socio-scientific issues (Bbl-Ssi) for Biology Learning in Senior High School. *ScienceEdu*, *3*(1), 32–42. https://doi.org/10.19184/se.v3i1.17697

Wardani, G. D., Suyanti, R. D., & Saragi, D. (2022). The Effect of Brain-Based Learning (BBL) Model with Audiovisual Media on Student's High-Level Thinking Ability. *Nazhruna: Jurnal Pendidikan Islam*, *5*(3), 1253–1265. https://doi.org/10.31538/nzh.v5i3.2509

Yalçin, O., & Sadik, F. (2024). Examining the cognitive and affective changes in students through the implementation process of the physics curriculum based on an interdisciplinary context-based learning approach. *Thinking Skills and Creativity*, *54*, 101672. https://doi.org/10.1016/j.tsc.2024.101672

Yangzom. (2013). *Effects of brain-based learning on physics academic achievenment and learning atmosphere of the ninth grade students, Bhutan* [Rangsit University]. Retrieved from https://rsuir-library.rsu.ac.th/handle/123456789/1815

Yu, S.-J., Hsueh, Y.-L., Sun, J. C.-Y., & Liu, H.-Z. (2021). Developing an intelligent virtual reality interactive system based on the ADDIE model for learning pour-over coffee brewing. *Computers and Education: Artificial Intelligence*, *2*, 100030. https://doi.org/10.1016/j.caeai.2021.100030

Zhao, W., Liu, S., Tian, X., Li, B., Shanks, D. R., Yang, C., & Luo, L. (2025). Individual differences in the reactivity effect of judgments of learning: Cognitive factors. *Journal of Memory and Language*, *140*, 104574. https://doi.org/10.1016/j.jml.2024.104574