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Systematic Literature Review: The Application of Brain-Based Learning Model on Mathematics Concept Understanding Ability

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Abstrak

Tujuan pada penelitian ini agar dapat menjelaskan dan menyampaikan informasi mengenai koneksi antara model *Brain Based Learning* terhadap kemampuan pemahaman konsep peserta didik pada pembelajaran di dalam kelas. Metode yang akan diterapkan dalam penelitian ini ialah studi pustaka yang salah satunya berbasis *Systematic Literature Review* (SLR), yang mana bertujuan untuk membahas secara mendalam terkait pembahasan serta rumusan masalah dari beberapa *literature* terdahulu yang relevan pada topik yang dibahas. Teknik yang digunakan dalam penelitian ini menggunakan *basis* protocol PRISMA. Adapun beberapa karakteristik sumber *literature* yang digunakan atau dibahas terindeks oleh Sinta dan *Scopus*, tersedia pada platform *Google Schoolar*; *Researchgate*; dan *Eric Journal* dengan tahun terbitan sumber 10 tahun terakhir. Adapun topik maupun pembahasan yang dibahas dalam penelitian ini terkait penerapan model *Brain Based Learning* terhadap kemampuan pemahaman konsep matematika siswa dan kesuksesan penerapan model *Brain Based Learning* dalam mengembangkan kemampuan pemahaman konsep matematika siswa. Dari hasil analisis ditemukan bahwa beberapa tahapan-tahapan *BBL* sendiri mampu mengarahkan peserta didik untuk dapat melatih kemampuan pemahaman konsep matematika saat pembelajaran berlangsung. Adapun *BBL* dapat mengubah kegiatan belajar peserta didik menjadi lebih baik dalam mengembangkan kemampuan pemahaman konsep matematika yang mereka miliki.

Kata Kunci: Kemampuan Pemahaman Konsep, Model *Brain Based Learning*

Abstract

The purpose of this study is to explain and convey information about the connection between the Brain Based Learning model and students' conceptual understanding abilities in classroom learning. The method that will be applied in this study is a literature study, one of which is based on the Systematic Literature Review (SLR), which aims to discuss in depth the discussion and formulation of problems from several previous literatures that are relevant to the topic discussed. The technique used in this study uses the PRISMA protocol basis. Some of the characteristics of the literature sources used or discussed are indexed by Sinta and Scopus, available on the Google Scholar platform; Researchgate; and Eric Journal with the year of publication of the source in the last 10 years. The topics and discussions discussed in this study are related to the application of the Brain Based Learning model to students' mathematical conceptual understanding abilities and the success of the application of the Brain Based Learning model in developing students' mathematical conceptual understanding abilities. From the results of the analysis, it was found that several stages of BBL themselves were able to direct students to be able to train their mathematical conceptual understanding abilities during learning. BBL can change students' learning activities to be better in developing their mathematical conceptual understanding abilities.

***Keywords**: Conceptual understanding ability, Brain Based Learning model*

INTRODUCTION

In 21st-century school education, emphasis is placed on students' thinking abilities in learning mathematics. These thinking skills include creative thinking, critical reasoning, problem-solving skills, the ability to express ideas, and collaboration in learning mathematics. These skills are referred to as the 4Cs. If these skills are well-developed by students through teachers' instruction in the classroom, then the learning process can be considered successful or effective (Harsono et al., 2016). In addition to these four skills, there is also a higher-order thinking ability that students must possess to understand the context of mathematics: the ability to understand mathematical concepts.Conceptual understanding emphasizes students' ability to restate and relate various concepts from different mathematical topics that are still interconnected. This is reflected in the objectives of mathematics education established by the Indonesian Ministry of National Education (Depdiknas), which include understanding mathematical contexts clearly and deeply, being able to convey the relationships between concepts, and being able to apply contexts and their procedures clearly and in detail to solve mathematical problems (Wulandari et al., 2020). This underscores the importance for students to develop and engage this ability in their learning activities. This skill is essential because it enhances students' mathematical literacy, which is closely tied to solving everyday problems. Conceptual understanding enables students to estimate volume or weight of objects; improves their accuracy in managing, reading, and presenting data in various mathematical representations; and trains them to solve problems by applying mathematical concepts they construct themselves (Hidayat et al., 2020).However, the reality shows that Indonesian students' mathematical literacy ranks 73rd, with an average score of 379, based on data from the 2018 PISA assessment (Hidayat et al., 2020). This suggests that Indonesian students' understanding of mathematical literacy remains low. This low performance is due to a lack of student effort in completing exercises independently—many still rely on copying from peers—students' limited understanding of mathematical properties and rules, and their unfamiliarity with questions that require comprehension of information (Giawa et al., 2022; Rismen et al., 2021). Therefore, it is necessary to select appropriate strategies to develop students' conceptual understanding and engage them fully in mathematics learning.

Selecting the right learning strategy should actively involve students in their learning activities. This is especially true in mathematics, where students are required to contribute their ideas when faced with problems. Teachers must be skilled in creating innovative teaching methods that explore and foster students' potential and interest so they can fully engage in the learning process (Dwiputra et al., 2023). Moreover, learning activities should stimulate students' brain processes to enhance higher-order thinking and create enjoyable learning experiences that build meaningful memory and understanding (Rojanna et al., 2020). One effective learning model to achieve this is Brain-Based Learning. This model fosters thinking processes at each student's own rhythm, avoiding monotony and stimulating curiosity by leveraging the brain's natural functions (Handayani, 2021). It is believed that this model can enhance students' understanding of mathematical concepts and allow them to reflect on their comprehension. Brain-Based Learning encourages individuals to seek current information and combine it with their prior knowledge (Anggraini et al., 2020). Therefore, the aim of this study is to explore more deeply the use of the Brain-Based Learning model in relation to students' ability to understand mathematical concepts.

Method

This type of research is a literature study using the Systematic Literature Review (SLR) method. This method helps reduce ambiguity regarding the topic discussed, identifies relevant studies and rational articles related to the topic, and investigates heterogeneity (Nightingale, 2009). In general, as stated by Sari et al. (2023), SLR is a structured research technique used to collect, critically review, integrate, and present findings or results that answer specific questions related to a topic through various sources of literature.

The stages of this research begin with formulating the research problem, which in this case is related to: the application of the Brain-Based Learning model on students' understanding of mathematical concepts, and the success of the Brain-Based Learning model in improving students' conceptual understanding in mathematics. The next stage involves searching for relevant studies on platforms such as Publish and Perish, Google Scholar, ResearchGate, and ERIC, using journals indexed in SINTA, Scopus, and DOAJ.

Subsequent stages include selecting appropriate articles, observing and reviewing information relevant to the topic, and finally interpreting the findings.

The literature selected for this review must meet several criteria, which serve as the basis for inclusion:

Table 1. Inclusion Criteria in the Study

. Inclusion Criteria	Keterangan
Research Discussion	Relevant studies must discuss the application of Brain-Based Learning (BBL) to students' conceptual understanding of mathematics, as well as factors contributing to the success of BBL during classroom-based mathematics instruction..
Publication Period	The journals selected must have been published between 2015 and 2025.
Research Methodology	The studies may employ quantitative, mixed-methods, or qualitative approaches.
Educational Scope	The research must be conducted within the context of school education, specifically at the elementary (SD), junior high (SMP), and senior high school/vocational school (SMA/SMK)
ype of Article.	The articles may include peer-reviewed journal papers and academic conference proceedings relevant to the field of education

Based on the inclusion criteria and the selected platforms mentioned above, a total of 14 articles and previous studies were identified as samples. The selection was also based on the relevance of variables to the research being conducted and the extent to which the topics addressed the research questions previously formulated. The selected samples serve as a reference for presenting the information that will be displayed as the findings of this study.

RESULT AND DISCUSSION

Based on various collected articles and literature, findings were obtained regarding the relationship between the Brain Based Learning (BBL) model and students' conceptual understanding in mathematics. These findings are described in detail using the Systematic Literature Review (SLR) method, which provides thorough explanations in response to the previously formulated research questions. One of the main focuses is how BBL can be implemented in classrooms to improve students' understanding of mathematical concepts.The Brain Based Learning model is a teaching technique designed to enhance the way students' brains process information effectively and support their academic success (Aulia et al., 2021; Rojanna et al., 2020). In practice, BBL encourages a relaxed brain state while learning, which allows students to process and absorb information more easily (Rasmitadila et al., 2021). This model creates a more conducive and varied learning environment. It also helps guide students in acquiring updated knowledge, linking it to prior understanding, and constructing meaning from what is taught by their teacher (Anggraini et al., 2020).

BBL helps teachers understand how each student receives information and processes it during learning. It emphasizes active involvement and meaningful contributions from students. Additionally, BBL encourages students to apply what they have learned in real-life situations. Students are invited to explore, observe, and analyze the information they obtain through literature and experimentation. As a result, learning becomes more optimal through discussion and collaboration, making the process more enjoyable and effective.Several principles underpin the implementation of BBL in the classroom. These include: the brain's ability to process multiple things simultaneously, the role of the whole body in learning, and the importance of emotional involvement in memory and learning. The brain functions holistically, and learning is influenced by conscious and subconscious processes. There are two types of memory (spatial and rote), and each brain has

unique characteristics (Aisya, 2020; Nurasiah et al., 2022; Pertiwi, 2018). These principles guide teachers in understanding students' behaviors and preferences before applying BBL in the classroom.

Teachers must consider student characteristics, such as how they use their senses while learning, how they interact socially, their interests and goals, and how they emotionally respond to learning activities. Teachers should also assess how students focus, recall information, and develop personal learning strategies. Understanding these factors allows educators to adapt the BBL model according to the classroom context, ultimately creating a more enjoyable and supportive learning environment.To implement BBL effectively, teachers can follow seven general stages. These are: (1) Pre-exposure, where the teacher prepares concept maps or flowcharts; (2) Preparation, where material is introduced with real-life relevance; (3) Initiation, where students are given problems to observe and discuss; (4) Elaboration, where students share and analyze solutions; (5) Incubation, where students relax through motivational videos or music; (6) Verification, where understanding is reviewed through questions or exercises; and (7) Integration, where students reflect on the meaning and benefits of the lesson (Kuswidi, 2015; Pertiwi, 2018; Sukoco & Mahmudi, 2016).

Several studies support the success of BBL in improving conceptual understanding. Khasanah & Ayu (2017) found that students showed significant improvement in solving math problems, organizing answers systematically, and engaging in enjoyable learning environments. Similarly, Widyantari et al. (2020) observed that students became more active in discussions and critical thinking, especially during verification and incubation stages supported by music to improve mood and focus.Fikriyah et al. (2021) concluded that students taught with BBL outperformed those taught with conventional methods. These students were able to model math problems, extract key information, transform it into tables, and contribute actively in discussions. Their engagement was further enhanced through ice-breaking activities and educational games. Suharja et al. (2024) also confirmed that BBL supports students' thinking processes and increases their interest and information processing abilities.In addition, Yatim et al. (2022) demonstrated that integrating BBL with Geogebra significantly enhanced students' understanding. Students were able to generate ideas, follow instructional modules, apply math concepts using technology, and relate lessons to everyday life. Overall, these findings suggest that BBL is a valuable approach in enhancing students' conceptual understanding in mathematics. It fosters active participation, critical thinking, and meaningful learning, making it an innovative solution in modern classroom instruction.

CONCLUSION

The Brain Based Learning (BBL) instructional model has proven to effectively enhance students' conceptual understanding in mathematics. This is due to the shift towards more active learning, as well as the more structured responses presented by students. Rather than focusing solely on memorizing formulas or content, this model guides students to express their ideas and achieve meaningful understanding, particularly in solving problems that are relevant to real-life contexts. The structured stages of the BBL model also help create a conducive and engaging learning environment. Moreover, it incorporates activities that allow students to temporarily relax their cognitive load, which helps them recall previously learned information more effectively.

Previous studies have shown that BBL outperforms conventional teaching methods. These studies report improvements in students' mathematical conceptual understanding scores, their ability to transform problem statements into mathematical representations, and their active engagement in group discussions where all members contribute ideas. Students were also found to be capable of presenting multiple solution strategies and articulating their ideas clearly to classmates. These findings indicate that the BBL model is highly effective in training and improving students' ability to understand mathematical concepts.

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