The Implementation of the Brain-based Learning Model in Elementary Schools Studied from a Literature Review

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Abstract: *This research is to find out how the learning process of the "brain-based learning" model at the elementary school level. In this case, neuropedagogy is an interdisciplinary approach combining neuroeducation, psychology, and education by developing innovative methods, curricula, skills, and initiatives to use findings in learning, memory, language, and other fields. Cognitive neuroscience further aims to provide educators with knowledge about the best teaching and learning strategies. This study thus used a literature review using a descriptive analysis method on brain-based learning methods/models, learning models suitable to be applied in elementary education. By knowing the child's development, the brain-based learning method or model will be appropriate for teaching elementary school pedagogy.*

Keywords: *Learning Model, Brain-Based Learning (BBL), Elementary School.*

Abstrak: *Penelitian ini untuk mengetahui bagaimana proses pembelajaran model "brain-based learning" atau dapat disebut dengan pembelajaran berbasis otak pada tingkat sekolah dasar. Neuropedagogi merupakan pendekatan interdisipliner yang menggabungkan pendidikan saraf, psikologi, dan pendidikan dengan mengembangkan metode dan kurikulum yang inovatif, serta kemampuan dan inisiatif untuk menggunakan temuan dalam pembelajaran, memori, bahasa, dan bidang lainnya. Ilmu saraf kognitif bertujuan untuk memberi pengetahuan pendidik tentang strategi pengajaran dan pembelajaran terbaik. Pada penelitian ini menggunakan kajian kepustakaan (literature review) dengan menggunakan metode analisis deskriptif pada metode/model pembelajaran brain-based learning, model pembelajaran yang cocok diterapkan di pendidikan dasar. Dengan mengetahui perkembangan anak, metode atau model "brain-based learning atau pembelajaran berbasis otak cocok untuk pengajaran di dunia pedagogi sekolah dasar.*

Kata Kunci: *Model pembelajaran, Brain Based Learning (BBL), Sekolah Dasar*

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INTRODUCTION

The learning process is carried out using the interaction process between elements. Among the first group are teachers, documents, and students. The teacher plays a crucial role in the learning process in terms of facilities and infrastructure, learning methods, learning media, and learning environments to create educational and learning situations to get maximum results in achieving the determined goals (de Gagne et al., 2019). In the world of education, there have been many innovations to improve the quality of education and learning, especially for students. One is "brain-based learning," a learning model with bargaining power that must be emphasized, particularly when applied to elementary school learning (Winter, 2019).

In this study, the authors used a type of literature review using descriptive analysis techniques. In this discussion, the authors focus on literature discussing the topic of brain-based learning, i.e., the implementation of brain-based learning models in elementary schools, with articles utilizing publish or perish applications. Articles selected for the literature review were published from 2018 to 2022.

It aims to find a novelty in each strategy for using the brain-based learning model in elementary schools. It is vital to examine this study because, in reality, many teachers or prospective teachers still do not understand the brain-based learning theory and strategies. Like previous research conducted by Amaludin et al., teachers currently do not understand how to maximize the potential of each student's brain in acquiring knowledge and increasing their talents by maximizing brain-based learning strategies (Syarif & Rahmat, 2018).

The brain-based learning model is oriented toward efforts to empower the brain potential of students. Three main strategies can be developed in implementing the brain-based learning model. The first is creating a learning environment that challenges students' thinking skills (Valen & Satria, 2021). The second is creating a fun learning environment. At last, the third is creating active and meaningful learning situations for students (active processing) (Ishthifa et al., 2020). In addition, the brain-based learning model aims to develop five natural learning systems of the brain that can develop the maximum potential of the brain. These five learning systems are emotional, social, cognitive learning system, physical, and reflective. The five learnings influence each other and cannot stand alone (Fitriyani, Anna Maria Oktaviani, 2022). The participant's character education can also be attained by involving the five systems simultaneously.

Therefore, this study intends to provide a clear picture of how the learning process uses a brain-based learning model with a new pedagogical approach. It is so that this brain-based learning model can help teachers and prospective teachers maximize it for the teaching and learning process. In reality, in the field, students must improve not only their skills or abilities in exact sciences but also social sciences, arts, and others.

RESEARCH METHODS

This study used a literature review in which the research was conducted by reading, recording, and reviewing the literature or reading material selected and considered per the subject matter and was then filtered and built theoretically (Ishifa et al., 2020). The following techniques were carried out to strengthen facts and compare differences or similarities between the theory and practice being examined by the authors. Then, the authors looked for sources from Google Scholar with the theme of the "brain-based learning" model at the elementary school level.

This study used a website and the Publish or Perish application, a software that can help researchers analyze and evaluate their published scientific publications. Both were employed so that searching websites and sites had many data and information related to research, namely sites regarding research journals on the brain-based learning model at the elementary school level. Afterward, the authors made a research matrix containing the author's name, research implementation, research method, research results, and the author's perspective to facilitate the writer's study. For the indicators for each research result, the authors examined the teacher's strategy or steps in using the brain-based learning model and reviewed the results of previous researchers.

RESULTS AND DISCUSSION

Elementary School Education

Law on National Education System regarding elementary education, Article 28 (1), states that "elementary education is given to children from birth to the age of 6 years and is not a prerequisite for attending elementary education." According to Putri et al. (2022), these stages of child development are sensitive, and their achievements can determine the quality of the child until adulthood.

All aspects of child development are all efforts that must be supported and optimized to reinforce good child development, and children can be free to sort and choose all types of activities they like (Ahmat Miftakul Huda & Suyadi, 2020). According to (Karaduman & Cihan, 2018), teachers and parents can know and analyze the diversity of children's intelligence as follows: 1) Linguistic intelligence, which is developed through listening, writing, reading, and speaking or telling stories, 2) Mathematical-logical intelligence, including counting activities, playing with counting objects, and others, which can stimulate their logic and arithmetic skills, 3) Spatial visual acuity, through stimulation of playing with blocks, puzzles, dictation, and imagination games, 4) Music intelligence, related to the ability to rhythm, pitch, bar, and various noises stimulated by applause, 5) Bodily/kinesthetic intelligence stimulation, i.e., through sports movements, traditional games that require physical movement, and dance, 6) Naturalist intelligence stimulation, which is done by observing the environment, gardening, and analyzing natural phenomena, 7) Interpersonal intelligence, through playing with and solving problems by working together and collaborating, 8) Intrapersonal intelligence, awl efficacy in which a child can control his physical and emotions well, 9) Spiritual intelligence, namely intelligence in understanding the creator's need by carrying out His commands and avoiding His prohibitions by instituting them in life.

Brain-Based Learning

Brain-based learning is an effort to develop the brain through brain empowerment. It is said that the human brain consists of three important parts: the cerebrum (neocortex), the midbrain (limbic system), and the cerebellum (reptilian brain), each of which, as Gagne explained, is unique. This theory aims to develop brain-based learning strategies, maximize students' potential, and process knowledge in various ways, including analysis, evaluation, assessment, and decision-making. Individuals only play a role in preparing an environment that encourages the learning process to be maximal and memorable (de Gagne et al., 2019).

Brain-based learning process puts forward the work of all parts of the brain. Three parts of the brain, with right and left-brain parts, work according to their specialization. In the classroom learning process, the left brain is concerned with the knowledge and information the teacher conveys, while the

right brain investigates how the knowledge is conveyed (Valen & Satria, 2021). When students listen to songs, the left brain searches for song terms while the right brain processes melodies. The cerebral or limbic system also applies emotional elements, where both brain hemispheres are actively involved in learning. Brain-based learning also means the individual as a learner and meaning in the learning process, whether knowledge is translated irrationally and logically or is influenced by social and cultural factors that shape knowledge, thereby explaining the importance of the individual as a translator and decision-maker in the interpretation of existing experiences, past experiences, and other impacts (Adi Apriadi Adiansha & Khairul Sani, 2021).

Therefore, according to Crebbin, learning is an emotionally embedded personal process in which implicit knowledge (conscious or unconscious) interprets information without awareness (Crebbin et al., 2021). Jean explained 12 main principles in brain-based learning: 1) The brain is a parallel processor; 2) Learning involves physiological processes; 3) The initial human desire to seek knowledge/experience; 4) Understanding occurs when a pattern/pattern can be formed; 5) The brain can handle all and part of knowledge simultaneously; 6) The brain can process all and part of knowledge at once, meaning that the learning process involves both sides of the brain simultaneously; 7) Learning involves paying attention to the perceptions around; 8) Learning involves conscious and unconscious processes; 9) There are two types of memory, namely rote and spatial; 10) Learning is a development; 11) Understanding is formed if facts are stored in spatial memory and strengthened if individuals face learning challenges/threats; 12) Every brain is unique, and every individual has differences (Paul, 2019).

The explanation above helps us understand the learning process based on the brain's workings because the BBL model is interesting. After all, it can maximize students' potential to master knowledge. "The key to the successful implementation of brain-based learning lies in everyone involved in the learning process and brain-based learning environment, materials, and teaching," consistent with the opinion expressed by Clemons.

Study of Brain-Based Learning Models in Elementary Schools

The study results found 20 articles related to the learning process of brain-based learning, as follows:

Table 1. Relevant Studies

No	Name of Researcher and Title of Research	Results and Discussion
1	Irman Syarif Rahmat (2018) conducted research with the title *"Application of the Brain-based Learning Model on Improving the Character of Class II Students."*	The brain-based learning model can develop students' character traits, such as discipline, honesty, religiousness, curiosity, independence, cooperation, integrity, and peace-loving. Irman conducted a brain-based learning model concerning five learning processes: emotional, social, cognitive, physical, and reflective. It turns out that according to Given (2007) in Irman, the five lessons are very influential and cannot stand alone (Syarif & Rahmat, 2018).
2	Imanuel et al.'s (2019) research entitled *"The Effectiveness of Brain-Based Learning Assisted*	Immanuel described that the relationship between the brain-based learning model and students' efficacy towards thinking skills was also analyzed, not in students' knowledge but in students' skills and personnel. Their research showed a relationship between the

	by Schoology towards Students' Creative Thinking and Self-Efficacy."	brain-based learning model and students' efficacy and thinking skills. The brain-based learning model always emphasizes student involvement in the learning process. Also, it is Innovative, i.e., every learning process must provide something new and different and always attract students' interest. Meanwhile, creativity means that each student must encourage student interest to produce something or solve a problem using methods, techniques, or methods self-mastered by students obtained from the learning process (Imanuel et al., 2021).
3	Dudu Suhandi et al. (2019) on *"The Application of the Brain-Based Learning Model with Nuances of the Surrounding Environment in Improving Student Understanding of Learning."*	This study analyzed students' scientific attitudes related to science subjects, and the results were quite significant because students really understood how the learning process was direct and meaningful through the brain-based learning model. In addition, students could begin to show a scientific attitude, as seen by how they explained their findings in scientific language and practiced testing their work with the scientific method. In other learning models, brain-based learning has the nuances of the surrounding environment with relaxed, constructive, and contextual learning characteristics. There was also enough time for students to reflect on the material they received, providing direct learning experiences about the natural surroundings, and students would feel that learning is meaningful to increase their learning understanding. Besides, the brain-based learning model with nuances of the surrounding environment can instill students' attitudes to love the surrounding environment (Saputra et al., 2019).
4	Putri Ridlatus Shaleha, Farida Nur Kumala2, Denna Delawanti C (2019), titled *"Critical Thinking Skills: Brain-Based Learning Models and Whole Brain Teaching Models."*	The students' learning process will be directed to think as maximally and critically as possible, so this learning method will be very appropriate for science subjects. It is also because it uses a comprehensive/metacognition learning approach oriented towards efforts to empower students' brain potential that maximizes each learner's emotional, social, cognitive potential, physical, and reflective abilities (Delawati, 2019).
5	Via Yustitia et al. (2019), titled *"The Effect of Brain-Based Learning Model On Student's Order Thinking Skills."*	The brain-based learning model proved to be more effective than conventional learning, wherein this learning can improve learning outcomes and create independence in students in elementary schools. The teacher carried out the BBL learning strategy by inviting students to face the problems around them directly, and students communicated the results of their analysis. Then, the teacher stimulated students to express their ideas about solving problems analyzed so that they felt like they were problem-solving leaders. In practice, the teacher is a motivator, facilitator, and creator to construct student knowledge (Yustitia et al., 2019).
6	Hamonangan (2020), *"Improving Memory Using Brain-Based Learning Models"*	The ability to remember has increased; the learning method refers to being divided into three parts: 1) the ability to remember, 2) the creative ability, and 3) the ability to think/reason to remember (Hamonangan, 2020).

7	Soleimani et al. (2020) aim to provide a brain-based reading teaching method in primary schools and compare its effectiveness with the current teaching method.	Brain-based reading teaching methods are quite an effective combination of methods for the progress, accuracy, and speed of reading and understanding of students (Soleimani, D. G., KHORMAEE, F., JOKAR, B., & HOSSEIN, n.d.).
8	Vihokpaibul (2020), *"Brain-based Learning Materials and Mathematics Learning Skills of Primary 1–3 Students"*	Teachers should determine the appropriate time and supervise students closely when using brain-based math learning media until they thoroughly understand it. Principals and teachers can organize coaching activities where older students teach younger students to use any instructional media. In this way, older students can review the media they are studying. In addition, the forms and processes used in producing learning media can be applied when producing other learning media for students at a higher grade level (Vihokpaibul, 2020).
9	Adi Apriadi Adiansha & Khairul Sani (2021). *"The Effect of Brain-Based Learning and Problem-Based Learning Models on Mathematical Complex Thinking Skills in Terms of the Creativity of Elementary School Students in Bima Regency"*	Learning had a positive effect on increasing complex mathematical thinking skills compared to the problem-based learning model. Students with high creativity could achieve better results if they were given a brain-based learning model than if they were given a problem-based learning model (Adi Apriadi Adiansha & Khairul Sani, 2021). Bates (2021) explored teachers' confidence levels, preparedness, and professional development for brain-based learning. To overcome teacher unpreparedness in learning, it is necessary to hold training in brain-based learning by professionals. Recent findings by brain-based researchers have changed the classroom design of teaching and learning, including brain-based learning (Adi Apriadi Adiansha & Khairul Sani, 2021).
10	Ishthifa et al. (2020) *"The Influence of the Brain-Based Learning Model Assisted by Audio Media on Nurul Ishthifa's Skills."*	The learning process in brain-based learning contains a concept to package learning that focuses on efforts to empower the brain's potential in students. Much attention can be given to brain-based learning with multiple variables to become more comprehensive. Listening learning can use audio media because it contains messages in auditive form (vocal cords or sound discs) to stimulate thoughts, concerns, feelings, and students' willingness during the learning process at school. In addition, this media can be received personally where the learning tends to be in one direction, so students will start imagining and focusing attention to survive until the end of learning. Audio media can also attract students to participate in listening learning since they will listen to something through the media by finding interesting things in the sound they listen to. As a result, students' enthusiasm for learning is high (Ishthifa et al., 2020).
11	Rihanah et al. (2021) *"Development of Thematic Learning Modules with the Brain-Based*	They tried to apply the BBL model by developing learning modules that refer to brain-based learning (BBL) steps. Applying Jensen's theory, the stages are the same as research (Luh Seri Juliantini, I Nyoman Jampel, 2020). Among others are a) pre-exposure stage: at this stage, students will be given a review of new learning; b) in

	Learning Model Class III East Masbagik State Elementary School in the Academic Year 2021/2022."	the preparation stage, the teacher will convey the learning objectives to be achieved and an initial explanation of the material to be studied as a stimulus and link it in the context of everyday life; c) initiation and acquisition stage: at this stage, students will be allowed to develop their abilities through direct learning and indirect learning; d) in the elaboration stage, the teacher with a role as a facilitator will help students in exploring related learning activities that they have experienced to relate to the subject so that learning becomes more meaningful; e) incubation stage and memory coding: at this stage, the teacher invites students to give them time to rest while repeating lessons that have been carried out; f) verification and checking stage, in which the teacher evaluates students to measure the achievement of learning objectives; g) celebration and integration stage, where the teacher will design learning that directs students to love learning that has a role in their life now and in the future. The results revealed that the BBL model encouraged students' brain abilities to integrate several materials that led students to think critically and foster students' activeness and participation in learning. Apart from developing the BBL module, the seven stages of BBL were also implemented (Rosalina et al., 2019) to increase the mathematical literacy of class V elementary school. The results also showed an increase in mathematical literacy skills that applied the brain-based learning model, which was higher than in students who did not apply the brain-based learning model. The brain-based learning model could also improve students' mathematical literacy skills in accordance with the development of the current prototype curriculum, where numeracy literacy is a special concern of teachers in providing more meaningful learning.(Rihanah et al., 2021)
12	Adi Apriadi Adiansha (2019) *"The Effect of Brain-Based Learning and Problem-Based Learning Models on Mathematical Complex Thinking Skills in Terms of Creativity of Elementary School Students in Bima District"*	Comparing the application of the BBL model, the study used the Jensen stages (seven stages) with the problem-based learning model (five stages). It consisted of 1) initial problems, 2) grouping students, 3) directing students both individually and in groups, 4) developing learning results, and 5) analyzing and evaluating learning. Compared to the problem-based learning model, there was a positive effect on complex mathematical thinking skills. In this regard, learning interactions occur on complex mathematical thinking skills that hone student creativity. Thus, both provided a significant influence. Students with high creativity would also get good results if the learning were given using the BBL model compared to the PBL model (Adi Apriadi Adiansha & Khairul Sani, 2021).
13	Saputra et al. (2019) *"Application of the Nuanced Brain-Based Learning Model Surrounding Environment in*	The brain-based learning model applies to the nuances of the surrounding environment. The brain-based learning model with the nuances of the surrounding environment used in his research has the characteristics of relaxed, constructive, contextual learning and the freedom of time for students to reflect on the material they have received. Hence, it will provide a learning experience directly

82

Improving Students' Understanding of Science Learning in Class V Elementary School"	related to the natural surroundings. Besides, students will get meaningful learning according to the characteristics of this BBL model. It will have an impact on increasing student understanding. Another impact of implementing the environment-based BBL model is that it can instill and foster an attitude of loving the environment in students. It is consistent with the character reflected in the profile of Pancasila students (Rachmawati et al., 2022). There are many opportunities that students get by using this environment-based BBL model, and they will further optimize the potential of their brains when learning takes place. As a result, there will be a balance of how the brain works, both the right brain and the left brain, with the stimulus provided by the teacher. Here, the teacher seeks to provide direct experience in this model. The experience is related to the environment around them so that children will remember more, and learning will become more meaningful. Students also get the opportunity to combine the theory they have learned with real conditions in the field that will be useful for their lives in the present and the future (Saputra et al., 2019).

According to (Crebbin et al., 2021), based on the views and opinions of experts and specialists such as Stellern, Diamond, and Jensen and by researching and combining educational and scientific research on the brain and how they are used in curriculum development, 12 general principles for brain-based learning have been developed. Introduced into the education system, the study seeks to provide a way to teach reading and test in the early stages of reading based on the "cognitive-metacognitive aspect" of brain-based learning, whose constituent concepts are the 12 principles of Caine and Caine.

It has taken steps to improve reading methods. Because one of the most important factors influencing learning and successful reading and comprehension performance and overcoming learning problems is the cognitive-metacognitive strategy, they also noted that, so far, no research has been conducted on how to use brain-based learning to initiate reading, and no research by other researchers is in the early stages of reading and teaching. Meanwhile, brain-based and its effect on learning and reading has been carried out at a higher stage related to the stages of reading and teaching other topics and has nothing to do with the early stages of reading, and the authors of the study try to use learning for the first time, with the learning-based brain by teaching people to start reading at the second stage of teaching reading (Soleimani et al., 2020). Koşar & Bedir (2018) explain that BBL uses 12 principles, and the implications for education are listed in the table.

Table 2. BBL Principles and Implications in Education

No	Principle	Implications in Education
1	All learning involves physiology.	Use of different senses and bodies
2	The brain or mind is social.	Stimulating social interaction
3	The search for meaning is innate.	Improving understanding by taking into account the interests of the target learners and the idea
4	There is a search for meaning.	Eliciting perception and pattern creation through pattern and associating the new pattern with what

83

		they already understand
5	Emotions are crucial for bringing up the pattern.	Eliciting the right emotions before, during and after their experience with text
6	The brain or mind processes parts.	Details are embedded into the whole and the whole simultaneously the part.
7	Learning involves both focused.	Deepening students' attention and peripheral perception and learning from context unconsciously
8	Learning is conscious and unconscious.	Giving sufficient time to reflect and the experiential process
9	There are at least two approaches to memory.	Engaging in various ways to remember
10	Learning is development.	Taking into account individual differences in maturation, learning, and experience previously
11	Complex learning enhanced by and/or fatigue.	Supporting, empowering, and challenging Inhibited by intrinsic threats Challenging environment Helplessness
12	Every brain is organized uniquely.	Integrating individual talents into teaching

After carrying out learning with the 12 principles, the results revealed that building a learning environment compatible with brain-based learning allows knowledge retention. The findings also uncovered that organizing teaching according to the principles of brain-based learning helped participants retain the knowledge they had acquired during the intervention. In contrast to the findings (Juliantini et al., 2020), the strategies for the BBL model in learning include: (1) creating learning situations that challenge students to think, (2) being able to create a fun learning environment, and (3) creating an active and meaningful learning environment for students. The research results conducted by Luh et al. also stated that there were significant differences in the ability to solve mathematical problems between groups of students who were taught with the brain-based learning model using concrete media and groups of students whose learning did not use concrete media-based BBL models. The effect of applying the media-based brain-based learning model is that students are happier, more active, and enthusiastic about participating in learning. Therefore, this model is very suitable for elementary schools to improve mathematical problem-solving abilities.

Moreover, BBL theory is a strategy that addresses the importance of the learning environment for encouraging neurological activity, and the BBL technique focuses directly on students' abilities as learners (Nurasiah et al., 2022). Crebbin et al. (2021) stated that BBL is intended to match brain functionality and is founded on previous observations and research related to humans (Paul, 2019). Triana et al. (2019) also asserted that learning mathematics that applies the BBL approach with autographs contributes to developing students' mathematical communication skills. It is because BBL can assist teachers in guiding students to learn meaningfully. Nevertheless, applying the BBL approach in the classroom must consider the following components: involving students in-depth, having non-binding awareness, and processing activation (Rihanah et al., 2021). Learning is described as a situation where students can make patterns and think in their way when facing problems so that the concept will become students' long-term memory. Hence, teachers should be able to facilitate learning

activities that sharpen students' thinking skills to help build their knowledge. Meanwhile, Koşar & Bedir (2018) explain that BBL uses 12 principles, and the implications for education are presented in the above table.

The study results that the authors analyzed demonstrated that teachers need knowledge and training on how to apply the brain-based learning model, especially at the elementary school unit level, where students really need to develop their brain potential, not only in terms of knowledge but in skills and attitudes, which support success in learning. However, according to (Ishthifa et al., 2020), the BBL model requires teacher preparation and readiness to maximize all steps or syntax in this model. Learning also occurs from time to time. Therefore, teachers must create various models to stimulate students' brain development.

CONCLUSIONS AND RECOMMENDATIONS

Based on the research results in several studies, the authors can conclude that brain-based learning implemented in elementary schools uses seven stages. First is the pre-exposure stage; at this stage, students will be given a review of new learning. The second is the preparation stage, where the teacher will convey the learning objectives and an initial explanation of the material to be studied as a stimulus and relate it to the context of everyday life. The third is the initiation and acquisition stage, in which students can develop their abilities through direct and indirect learning. The fourth is the elaboration stage; here, the teacher, as a facilitator, will assist students in exploring related learning activities that they have experienced to relate to the subject so that learning becomes more meaningful. The fifth is the incubation stage and memory coding; at this stage, the teacher invites students to give them time to rest while repeating the lessons carried out. The sixth stage is verification and checking, where the teacher evaluates students to measure the achievement of learning objectives. Finally, the seventh stage is celebration and integration; at this stage, the teacher will design learning that directs students to love learning, which has a role in their life now and future.

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