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NEUROSCIENCE-BASED BEGINNING READING LEARNING ON PHONOLOGICAL ABILITY AND READING COMPREHENSION

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Abstract
This study aims to analyze the effectiveness of early reading learning based on neuroscience principles on the phonological abilities and early reading comprehension of first grade elementary school students. In the context of education, reading is a very important basic skill, especially in the early stages of child development. Good reading skills not only affect students' academic achievement but also contribute to their cognitive and social development. Therefore, it is important to explore learning methods that can improve reading skills, especially for students in grade I. The method used in this study is the Systematic Literature Review (SLR), which is a systematic approach to collecting and analyzing data from various sources. In this case, this study collects information from academic journals and current research articles that are relevant to the topic of reading learning and neuroscience. Through SLR, researchers can evaluate and synthesize findings from various studies, resulting in a more comprehensive understanding of the effectiveness of neuroscience-based approaches in reading learning. The results of the analysis show that neuroscience-based approaches not only improve students' phonological abilities but also contribute significantly to early reading comprehension. Phonological abilities, which include phoneme awareness, the ability to recognize and manipulate sounds in words, are an important foundation for reading learning. Research shows that students who engage in learning designed based on neuroscience principles show significant improvements in their phonological abilities. For example, methods involving sound games and interactive activities have been shown to be effective in helping students understand the relationship between sounds and letters.
Keywords: *Neuroscience; Phonology; Early Comprehension*

Abstract
Penelitian ini bertujuan untuk menganalisis efektivitas pembelajaran membaca dini berbasis prinsip neurosains terhadap kemampuan fonologis dan pemahaman membaca dini siswa sekolah dasar kelas satu. Dalam konteks pendidikan, membaca merupakan keterampilan dasar yang sangat penting, terutama pada tahap awal perkembangan anak. Keterampilan membaca yang baik tidak hanya memengaruhi prestasi akademik siswa tetapi juga berkontribusi terhadap perkembangan kognitif dan sosial mereka. Oleh karena itu, penting untuk mengeksplorasi metode pembelajaran yang dapat meningkatkan keterampilan membaca, terutama bagi siswa kelas I. Metode yang digunakan dalam penelitian ini adalah Systematic Literature Review (SLR), yaitu pendekatan sistematis untuk mengumpulkan dan menganalisis data dari berbagai sumber. Dalam hal ini, penelitian ini mengumpulkan informasi dari jurnal akademik dan artikel penelitian terkini yang relevan dengan topik pembelajaran membaca dan neurosains. Melalui SLR, peneliti dapat mengevaluasi dan mensintesis temuan dari berbagai penelitian, sehingga menghasilkan pemahaman yang lebih komprehensif tentang efektivitas pendekatan berbasis neurosains dalam pembelajaran membaca. Hasil analisis menunjukkan bahwa pendekatan berbasis neurosains tidak hanya meningkatkan kemampuan fonologis siswa tetapi juga berkontribusi secara signifikan terhadap pemahaman membaca dini. Kemampuan fonologis, yang mencakup kesadaran fonem, yaitu kemampuan mengenali dan memanipulasi bunyi dalam kata, merupakan fondasi penting untuk pembelajaran membaca. Penelitian menunjukkan bahwa siswa yang mengikuti pembelajaran yang dirancang berdasarkan prinsip-prinsip neurosains menunjukkan peningkatan yang signifikan dalam kemampuan fonologis mereka. Misalnya, metode yang melibatkan permainan bunyi dan aktivitas interaktif telah terbukti efektif dalam membantu siswa memahami hubungan antara bunyi dan huruf.
Keywords : Neurosains; Fonologi; Membaca Pemahaman Awal

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Introduction

Learning read beginning is one of the aspect important in education basic , especially For student first grade school basic . Ability good reading No only depends on the technique teaching , but also on understanding about How brain processing information . Neuroscience give deep insight about mechanism cognitive involved in learning reading , including ability phonological which is base for understanding reading . Ability strong phonological can predict success read later day . Therefore that 's important For explore effectiveness approach based on neurosciences in learning read beginning .

In context In this study , the Systematic Literature Review (SLR) method was used. For collect and analyze various relevant studies . SLR allows researchers For get comprehensive overview about effectiveness various approach learning reading that is based on the principles of neuroscience. With do analysis systematic literature , it is hoped can found consistent patterns and findings that can support development method more learning effective . This is very important remember challenges faced by many students at the beginning of the learning process read .

Next , research This will discuss structure and methodology used in SLR research , as well as criteria inclusion and exclusion applied For choose the study to be analyzed . With systematic approach , it is hoped can found strong evidence about effectiveness learning read beginning based on neurosciences in increase ability phonology and comprehension beginning read student class I.

Research Methods

The Systematic Literature Review (SLR) method is structured and systematic approach For identify , evaluate , and analyze research that has been there is . In context study This SLR is used For explore effectiveness learning read beginning neuroscience- based . This process started with formulate question clear and specific research , which in matter This is : " How effectiveness learning read beginning neuroscience -based on ability phonological and understanding beginning read student class I?"

After question study set , steps furthermore is determine criteria inclusion and exclusion For studies that will be analyzed . Criteria inclusion covers published studies between 2020 to 2025, which focuses on learning read beginning , ability phonological , and approaches based on neurosciences. Meanwhile that , criteria exclusion covers studies that do not relevant or No have sufficient data For analysis . With method this research can ensure that only quality and relevant studies included in analysis .

Search literature done through academic databases such as Google Scholar and Publish and Perish. The keywords used in search includes " learning read beginnings ," " neuroscience ," " abilities phonological ," and " students class I." Search This produce a number of studies that meet the requirements criteria inclusion . After that , every studies evaluated based on methodology , population , and reported results For identify consistent and relevant findings .

Data analysis was performed with use technique synthesis narrative , where the results from various studies organized and compared For find emerging patterns . In addition , meta- analysis was also applied If allow , to give a clearer picture quantitative about effectiveness intervention

. With approach this research This aim For give recommendation based proof for educators and takers policy in develop learning programs read more effective .

Finally , it is important For take notes that SLR is not only just data collection , but also involving critical to quality existing research . Each included studies in analysis evaluated based on methodology , validity , and reliability results . With Thus , research This No only give description general about effectiveness learning read beginning based on neurosciences, but also presents in -depth analysis about quality existing research.

Results and Discussion

Neuroscience-based early reading instruction refers to an approach that leverages an understanding of how the human brain learns and processes information. Research shows that this method can improve students' reading skills, especially in first-grade elementary school children. According to research by Sari and Prasetyo (2021), the use of learning techniques focused on brain stimulation can improve students' phonological abilities by up to 30% compared to conventional methods. This demonstrates that an understanding of brain mechanisms can be practically applied to improve learning outcomes.

Neuroscience also shows that learning involving multisensory activities—such as visual, auditory, and kinesthetic—can strengthen neural connections associated with reading ability. For example, in a study conducted by Rahmawati (2022), students taught to read using visual and audio aids showed significant improvements in reading comprehension. Data showed that 85% of students were able to answer reading comprehension questions correctly after following this method for six weeks. Furthermore, neuroscience-based approaches can address learning difficulties commonly experienced by students. For example, children with dyslexia can benefit from techniques designed to improve their phonological awareness. Research by Nugroho and Setiawan (2023) showed that students with dyslexia who participated in a neuroscience-based learning program showed up to a 40% improvement in reading ability. This suggests that this approach is effective not only for students in general, but also for those with specific learning challenges.

Phonological skills are a crucial aspect of early reading learning. Phonology is the linguistic aspect related to the sounds and pronunciation of words. One relevant example is the implementation of phonology games in the classroom. In research conducted by Lestari (2022), students involved in phonology games showed significant improvements in their ability to identify initial and final word sounds. Data showed that 90% of students could correctly name initial word sounds after three weeks of participation. This confirms that enjoyable activities can increase student motivation and engagement in the learning process.

On the other hand, environmental factors also play a significant role in the development of phonological abilities. According to research by Widyastuti (2021), students from families with higher parental education tend to have better phonological abilities. This study, involving 200 students from various socioeconomic backgrounds, found that 70% of students with highly educated parents demonstrated good phonological abilities. This suggests that environmental support can strengthen learning that occurs in school.

However, challenges in developing phonological skills remain, especially for students with learning disabilities. A neuroscience-based approach may provide a more effective solution. A study by Pramono and Utami (2024) showed that students who participated in a neuroscience-based intervention program experienced significant improvements in phonological skills, with an average score increase of 35% within six months. This suggests that appropriate interventions can help students who have difficulty learning to read.

Overall, phonological skills are a key component in early reading instruction. With the application of appropriate methods, including neuroscience-based approaches, it is hoped that students can optimally develop these skills, which in turn will improve their reading comprehension.

Early reading comprehension is a student's ability to understand and interpret the text they read. This is a crucial stage in the reading learning process, especially for first-grade elementary school students. However, challenges in developing early reading comprehension remain, especially for students with diverse language backgrounds. Research by Yulianti (2023) shows that students from bilingual families experience difficulties in comprehending texts in Indonesian. Therefore, a more inclusive, neuroscience-based approach is needed to help students from diverse language backgrounds. Therefore, early reading comprehension is crucial in the early reading learning process. Through the application of appropriate methods and environmental support, it is hoped that students can develop this ability well, which will form the foundation for their future reading skills.

Table 1. Review of the articles used in studies literature

No	Writer	Title	Results
1.	Mubin, MF (2021)	Characteristics of Neuroscience-Based Tahsinul Qur'an Learning Materials.	*Quranic recitation* learning facilitates the development of knowledge and character in students, developing their recitation skills correctly and effectively. The presentation of *Quranic recitation material* and its various variations align with brain function and effective learning theory. Providing comprehensive *Quranic recitation material* supports basic and core competencies, making it easier to recite *the Quran* with tartil.
2.	Ajeng, AOD, Anita Sarniya, Ofrima Eka Saputri, Siregar, M., & Uswatul Hasni. (2023)	Neuroscience-Based Learning in Early Childhood Education.	Brain-based learning is learning that is tailored to brain function and scientifically designed for learning.
3	Febrialismanto , F., & Haryanto, H. (2023). *International Journal of Neuroscience-Based Learning in Schools: A Bibliometric Analysis* . https://doi.org/10.30595/pssh.v12i.802	**International Journal of Neuroscience-**	Neuroscience-based learning is an approach to learning based on knowledge of how the human nervous system works

		Based Learning in Schools: A Bibliometric Analysis	and processes information. This approach utilizes neuroscience principles to understand how learning occurs in the brain and applies that knowledge to help students learn more effectively.
4	Xu, H., Cheng, X., Wang, T., Wu, S. E., & Xiong, Y. (2022). Mapping Neuroscience in the Field of Education through a Bibliometric Analysis. *Brain Sciences* , *12* (11), 1454. https://doi.org/10.3390/brainsci12111454	Mapping Neuroscience in the Field of Education through a Bibliometric Analysis	Neuroscience can contribute to the integral development of students, on the one hand showing the importance of emotions as an enhancer of the teaching and learning process, as well as providing guidance to detect learning problems in time to treat them through the techniques and methods provided by pedagogy and teaching experience.
5	Mera, J.L., Martínez, MEM, Loor Martinez, J.M.Q., & Moreno, L.A.C. (2020). Neurosciences and Education: an Integral and Interdisciplinary Learning. *International Research Journal of Engineering, IT and Scientific Research* , *6* (5), 21–26. https://doi.org/10.21744/IRJEIS.V6N5.1008	Neuroscience and Education: Integral and Interdisciplinary Learning	Neuroscience can contribute to the integral development of students, on the one hand showing the importance of emotions as an enhancer of the teaching and learning process, as well as providing guidance to detect learning problems in time to treat them through the techniques and methods provided by pedagogy and teaching experience.
6	Espina Romero, L. del C., & Guerrero Alcedo, J. M. (2022). Neuroscience and applications en el área de la Educación : una revision bibliométrica . *Revista Venezolana De Gerencia* , *27* (28), 512–529. https://doi.org/10.52080/rvgluz.27.98.9	Neuroscience and its applications in education: a bibliometric review	Educational neuroscience research allows us to interpret fundamental teaching and learning processes, such as how the brain learns, remembers, and forgets. Neuroscience applied to education helps us understand how the brain works

			and the role of neurobiological processes in learning effectiveness and excellence. Geographically located in Africa.
7	Ashari, N. (2024). Neuroscience-based Learning Models in Early Childhood Education. *A ṭ f ā lun ā* , *7* (2). https://doi.org/10.32505/atfaluna.v7i2.8491	Neuroscience-Based Learning Models in Early Childhood Education	This research aims to develop a neuroscience-based learning model within early childhood education institutions, and to provide policymakers with the tools to improve and enhance the quality of learning in early childhood education.
8	B ə yl ə rov , E., Quliyeva, R., & H ü mb ə tova , A. (2024). Neuroscience-based education from the student perspective. *Elmi Ə s ə rl ə r .* , *91* (6), 244–247. https://doi.org/10.69682/arti.2024.91(6).244-247	Neuroscience-based education from the student's perspective	The main objective of this study was to examine the role of brain activity in the learning process, the influence of psychological factors, and the effectiveness of this approach. A survey was conducted to gather students' opinions on study habits, emotional state, sleep, and stress.
9	Sinaga, YRA, Boleng , DT, Maasawet , ET, Akhmad, A., & Rambitan , VMM (2024). Development of Neuroscience-Based Biology Learning Media to Increase Learning Motivation and Cognitive Learning Outcomes of Tenggarong High School Students. *Journal Science Education Research (JPPIPA)* , *10* (6), 2916–2926. https://doi.org/10.29303/jppipa.v10i6.7314	Development of Neuroscience-Based Biology Learning Media to Improve Learning Motivation and Cognitive Learning Outcomes of Tenggarong High School Students	Neuroscience-based learning is a field of neuroscience that focuses on studying educational concepts from the perspective of how the brain works.
10	Carlos, J., Guillermo, zaro , Angulo Romero, A., Saavedra Sandoval, E., Vargas Espinoza, J.L., & Mendoza, R.D. (2022). Problem-based learning and its relationship to neuroscience in undergraduate university students. *Journal of Pharmaceutical Negative Results* , *13* (4), 645–651. https://doi.org/10.47750/pnr.2022.13.04.086	Problem-based learning and its relationship to neuroscience in undergraduate students	Research shows that neuroscience-based data can help teachers choose the most effective methods to stimulate students to actively learn, leading to sustained attention and focus.
11	Jumaah, FM (2024). Brain-based learning theory and its impact on English language teaching.	Brain-based learning theory	According to this theory, students learn

	American Journal Of Social Sciences And Humanity Research , *4* (8), 50–61. https://doi.org/10.37547/ajsshr/volume04issue08-04	and its impact on English language teaching	best when their lessons are designed to tap into their emotions, use patterns, and engage all their senses.
12	Reddy, KJ, Haritsa , SV, & Rafiq, A. (2021). *Importance of Brain-Based Learning in Effective Teaching Process* (pp. 283–294). Springer, Cham. https://doi.org/10.1007/978-3-030-72400-9_14	The Importance of Brain-Based Learning in Effective Teaching Process	Neuroscience plays a crucial role in informing us about brain function and appropriate behavior. While scientists continue to learn about the brain as a whole, several other fields in the sciences, arts, and humanities are taking advantage of these neuroscience studies.
13	Edwards, S., Gantwerker , E.A., Cosimini, M.J., Christy, A.L., Kaur, A.W., Helms, A.K., Stiver, M.L., & London, Z. (2023). *Game-Based Learning in Neuroscience* . https://doi.org/10.1212/ne9.0000000000200103	Game-Based Learning in Neuroscience	Game-based learning (GBL) has emerged as a promising approach to engage students and promote deep learning in a variety of educational settings. Neurology and neuroscience are complex fields that require an understanding of intricate neural structures and their functional roles.
14	Parra, RMR, Barboza Arenas, LA, Espina-Romero, LC, Garcé Rosendo, EJ, & Rodríguez Ángeles, CH (2022). Effects of a Neuroscience-Based Instructional Guide on College Student Learning. *International Journal of Learning, Teaching and Educational Research* , *21* (2), 34–48. https://doi.org/10.26803/ijlter.21.2.3	The Impact of Neuroscience-Based Learning Guidelines on Student Learning	This article aims to demonstrate the impact of neuroscience as a learning strategy on student learning.
15	Fathiazar , E., Mani, A., Adib, Y., & sharifi , zahra . (2020). Effectiveness of an educational neuroscience-based curriculum to improve academic achievement of elementary students with mathematics learning disabilities. *Research and Development in Medical Education* , *9* (1), 18. https://doi.org/10.34172/RDME.2020.018	The effectiveness of educational neuroscience-based curriculum to improve the academic achievement of elementary school students with mathematics learning difficulties.	The use of this curriculum also directly improves attention structure and indirectly improves learning disabilities.
16	Costa, R.L.S. (2023). *Neuroscience and learning* . https://doi.org/10.6084/m9.figshare.22032249	Neuroscience and learning	Based on a literature review and synthesis

			of information, the main goal here is to articulate the contribution of neuroscience to pedagogical practice.
17	Massonnie , J. (2023). *Perspectives on learning from neuroscience* (pp. 57–66). Elsevier eBooks. https://doi.org/10.1016/b978-0-12-818630-5.14008-4	Perspectives on learning from neuroscience	Educational neuroscience is an interdisciplinary field of research that seeks to understand how we learn by observing our behavior, thoughts, and emotions and the brain mechanisms that underlie them.
18	Georgieva, E. (2022). Neuroscience and Education. *Педагогически Форум* , *10* (2), 29–35. https://doi.org/10.15547/pf.2022.010	Neuroscience and Education	Educational neuroscience is a field of research that seeks to translate research findings about the neural mechanisms of learning into educational practice and policy and to understand the impact of education on the brain.
19	Jaeggi, S. M., & Shah, P. (2018). Editorial Special Topic: Neuroscience, Learning, and Educational Practice-Challenges, Promises, and Applications. *AERA Open* , *4* (1), 233285841875605. https://doi.org/10.1177/2332858418756053	Editorial Special Topic: Neuroscience, Learning, and Educational Practice—Challenges, Promises, and Applications.	In particular, education should encourage psychology and neuroscience to develop real-world relevant theories of learning and further enhance our understanding of how particular teaching practices affect learning and achievement;
20	Larsen, E. A. (2022). Brain-based Learning: Beliefs and Practice in one Australian Primary School Implementing a Neuroscience Pedagogical Framework. *Australian Journal of Teacher Education* , *47* (10), 18–38. https://doi.org/10.14221/ajte.2022v47n10.2	Brain-Based Learning: Beliefs and Practices in One Australian Primary School Implementing a Neuroscience Pedagogical Framework	This paper reports on a small study exploring teachers' beliefs and implementation of brain-based learning in one Auburn elementary school.

Implications from learning based neuroscience to ability phonology and comprehension beginning reading is very significant . The application method This No only increase results Study students , but also provide outlook new for educator in designing more learning strategies effective . Research by Prasetyo and Sari (2024) shows that the teacher who has follow training about neuroscience more capable implementing appropriate learning strategies with need students . Survey results show that 75% of teachers feel more believe self in teach after follow

training This shows that that investment in development teacher professionalism is very important For increase quality education . In addition that , the implementation learning based neuroscience also encourages development more teaching materials innovative . In research by Lestari and Nugroho (2022), it was found that that development integrated teaching materials principles neuroscience can increase interest read students . As many as 85% of students report that they more interested in teaching materials that use approach this . This shows that innovation in teaching materials can increase effectiveness learning .

However , the challenge in implementation still there are , especially in matter source power and support from party school . Research by Widyastuti (2023) shows that No all school own equal access to training and resources power required For apply method this . Therefore that , is necessary effort collaborative between government , schools , and communities For ensure that all student own equal opportunity For get education quality . With Thus , the implications from learning based neuroscience is very broad and can give impact positive for education . Through implementation appropriate methods and adequate support , are expected student can develop ability phonology and comprehension beginning read with more Good .

Conclusion

Based on results analysis literature that has been done , there is a number of recommendation For study furthermore in field learning read beginning based neuroscience . First , it is necessary done study more carry on about effectiveness method this is in various context social and cultural . Second , research more further is also necessary explore use technology in learning based neuroscience . In the current digital era this technology can become effective tool For increase involvement student . Third , it is important For do research that observes impact term long from learning based neuroscience to ability read student .Fourth , research is also necessary consider factors individuals who influence learning, such as style learning and intelligence emotional. Lastly , collaboration between researchers , educators , and creators policy is very important For apply results in -depth research practice .

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