



Deep Learning Research in Indonesian Primary Education: A 2025 Bibliometric Mapping

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ABSTRACT

Learning in Indonesian primary schools still tends to emphasize memorization, limiting students' deep conceptual understanding and critical thinking skills. This condition underscores the need for approaches such as deep learning, which promotes conceptual interconnection and real-world application. However, no bibliometric study has specifically mapped deep learning trends in Indonesian primary education for the year 2025, creating a gap in current knowledge. This study aims to address that gap by analyzing research trends through a bibliometric method. Data were collected from Google Scholar via Publish or Perish using the keywords "deep learning" AND "elementary education" OR "primary school," limited to publications in 2025. A total of 38 journal articles that met the inclusion criteria were processed using Mendeley for metadata cleaning and VOSviewer for keyword mapping. The results show that deep learning is most frequently linked to literacy, numeracy, the Merdeka Curriculum, and the use of digital media. Network, overlay, and density visualizations indicate a shift from technology-focused discussions toward pedagogically meaningful efforts to strengthen foundational competencies. This study also recognizes limitations arising from the use of Google Scholar as the sole database, which may reduce international coverage and include non-indexed sources. Further research is recommended to explore practical classroom implementation, develop applied instructional strategies, and expand analyses across multiple years and international databases to produce more comprehensive insights for improving primary education in Indonesia

Keywords: *Deep Learning; Primary Education; Bibliometrics; Independent Curriculum.*

ABSTRAK

Pembelajaran di sekolah dasar Indonesia masih cenderung menekankan pada hafalan, yang membatasi pemahaman konseptual mendalam dan keterampilan berpikir kritis siswa. Kondisi ini menyoroti kebutuhan akan pendekatan seperti pembelajaran mendalam, yang mempromosikan hubungan konseptual dan penerapan dalam kehidupan nyata. Namun, belum ada studi bibliometrik

yang secara khusus memetakan tren pembelajaran mendalam dalam pendidikan dasar Indonesia untuk tahun 2025, menciptakan kesenjangan dalam pengetahuan saat ini. Studi ini bertujuan untuk mengatasi kesenjangan tersebut dengan menganalisis tren penelitian melalui metode bibliometrik. Data dikumpulkan dari Google Scholar melalui Publish or Perish menggunakan kata kunci "deep learning" DAN "pendidikan dasar" ATAU "sekolah dasar", dibatasi pada publikasi tahun 2025. Sebanyak 38 artikel jurnal yang memenuhi kriteria inklusi diproses menggunakan Mendeley untuk pembersihan metadata dan VOSviewer untuk pemetaan kata kunci. Hasil penelitian menunjukkan bahwa deep learning paling sering dikaitkan dengan literasi, numerasi, Kurikulum Merdeka, dan penggunaan media digital. Visualisasi jaringan, overlay, dan kepadatan menunjukkan pergeseran dari pembahasan yang berfokus pada teknologi menuju upaya pedagogis yang bermakna untuk memperkuat kompetensi dasar. Studi ini juga mengakui keterbatasan yang timbul dari penggunaan Google Scholar sebagai basis data tunggal, yang dapat mengurangi cakupan internasional dan mencakup sumber-sumber yang tidak terindeks. Penelitian lebih lanjut disarankan untuk mengeksplorasi implementasi praktis di kelas, mengembangkan strategi instruksional terapan, dan memperluas analisis melintasi tahun-tahun dan basis data internasional untuk menghasilkan wawasan yang lebih komprehensif dalam meningkatkan pendidikan dasar di Indonesia.

Kata Kunci: Deep Learning; Pendidikan Dasar; Bibliometrik; Kurikulum Merdeka.

INTRODUCTION

In 21st-century education, the concept of deep learning has become an important approach that is widely discussed (Maehler et al., 2025; Verma & Yuvaraj, 2025; Wulandari et al., 2025). It should be emphasized that deep learning in a pedagogical context is not artificial intelligence technology, but rather a learning strategy that emphasizes deep understanding, interconnections between concepts, and the application of knowledge in real-life situations (Damai Ari Kontesa et al., 2023; Hasanah & Pujiati, 2025). Unlike surface learning, which focuses more on memorization, deep learning encourages students to think critically, analyze, and relate knowledge to experience (Güngör et al., 2025; Wu et al., 2025). Thus, this approach is relevant to addressing today's educational challenges, which require students not only to master knowledge, but also to be able to use it meaningfully.

Basic education plays a strategic role as the foundation for developing students' academic abilities and character (Engle et al., 2025; Narváez et al., 2025). At this stage, students begin to be equipped with basic literacy, numeracy, and critical thinking skills, which are important for the next level of education (Mota et al., 2024). The application of deep learning in primary education is believed to strengthen literacy and numeracy achievements while fostering problem-solving skills that are essential in the 21st century (Martínez-León et al., 2024; Prahani et al., 2024). Therefore, research topics related to deep learning in elementary education continue to develop and attract the attention of many parties.

However, literacy and numeracy remain major challenges in many countries, including Indonesia. International reports such as the Programme for International Student Assessment (PISA) show that the literacy and numeracy skills of Indonesian elementary school students are still below the global average (Chen et al., 2024). This situation encourages researchers and education practitioners to seek more effective learning strategies (Cristofolini et al., 2024; Lorenzo-Lledó et al., 2024). In this context, deep learning presents itself as an alternative that is not only focused on memorization, but also encourages students to explore, understand concepts in depth, and apply them in solving real-world problems.

Previous studies have shown that the application of deep learning in science, mathematics, and literacy education can improve students' conceptual understanding, learning motivation, and critical thinking skills (Silveira et al., 2024; Velasco et al., 2024). However, the results of these studies are still separate with varying focuses, such as curriculum, learning strategies, or specific subjects. There have not been many studies that provide a comprehensive overview of the development of deep learning research at the elementary education level.

This condition indicates a research gap, namely the lack of studies that comprehensively map deep learning research trends in basic education. Most existing studies are limited to case studies in specific classrooms or specific subject topics, so they do not provide a big picture of the direction of research development over time. Therefore, a bibliometric analysis is needed to trace the development of publications, dominant themes, and interconnections between topics in deep learning research in primary education, especially in 2025 as a representation of current trends.

Based on the above description, this study aims to analyze trends in deep learning research in primary education in 2025 through a bibliometric approach. This analysis is expected to provide an overview of the research development map, prominent theme clusters, and relationships between key concepts. The benefits of this research not only contribute academically to enriching the literature, but also practically as a basis for policy formulation, curriculum development, and learning strategies relevant to literacy, numeracy, and 21st-century competencies in elementary schools.

METHODS

Type and Design

This study uses bibliometric methods to describe research trends on deep learning in elementary education in 2025. Bibliometric analysis was chosen because it can show the number of publications, the most frequently used keywords, and the connections between topics, thereby providing a comprehensive picture of the direction of research development in this field.

Data and Data Sources

The research data was taken from the Google Scholar database in Indonesia. The search was conducted using the keywords "deep learning" AND "elementary education" OR "primary school" limited to publications in 2025. The types of documents used were journal articles, conference proceedings, and reviews, while editorials and non-scientific manuscripts were not included.

Data collection technique

Data was obtained using Publish or Perish software to retrieve publication data and calculate citation metrics. The data was then processed using Mendeley to remove duplicates, align keywords, and organize metadata before being exported again.

Data analysis

The export results from Mendeley were downloaded in RIS format, then the data was analyzed using VOSviewer to construct a map of keyword relationships (co-occurrence). On

the map, the size of the circle represents the frequency of word occurrence, the lines indicate the level of connection between words, and the colors illustrate research topic clusters.

RESULTS AND DISCUSSION

RESEARCH RESULTS

Search results using Publish or Perish yielded 38 research articles in Indonesia throughout 2025 that were relevant to the topic of deep learning in the context of primary education. These articles were then further selected based on their titles, abstracts, and keywords to ensure their suitability for the research context. This number shows that studies on deep learning in primary education are beginning to receive serious attention in Indonesia, although the number of publications is still relatively limited when compared to other technology-based education topics.

From the analysis of keywords that appeared in the 38 articles, it was found that the most frequently used terms were deep learning, basic education, literacy, numeracy, and digital learning. The emergence of these keywords indicates that research in Indonesia not only highlights the technical application of deep learning, but also links it to the strengthening of literacy, numeracy, and 21st-century skills. In addition, several articles also touch on aspects of curriculum, learning innovation, and the use of digital technology, which show a close relationship between deep learning and efforts to improve the quality of basic education.

To obtain a clearer picture of the interconnections between topics in deep learning research in primary education, keyword visualization analysis was conducted using VOSviewer. This analysis enabled the mapping of relationships between terms that frequently appeared together in articles, thereby revealing how research themes were interconnected and formed clusters. The mapping results are shown in Figure 1 on Networks as follows.

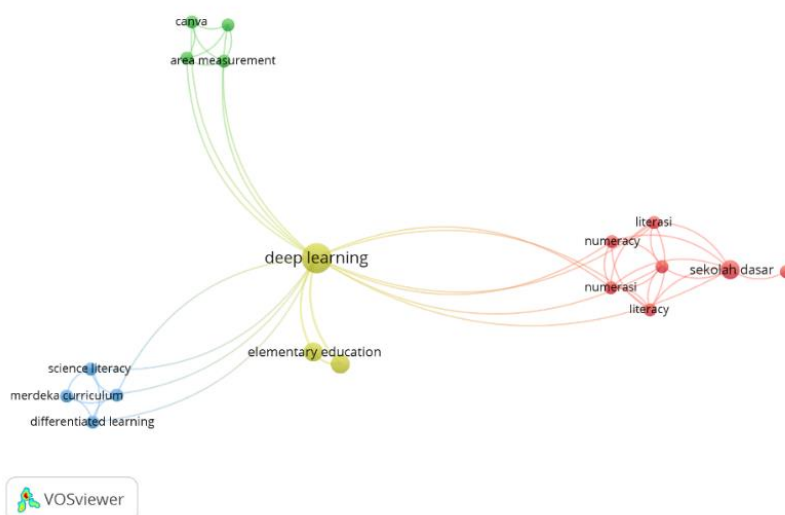


Image 1 Keyword Co-Occurrence Map from VOSviewer Analysis

The image shows a co-occurrence network. The visualization shows that the term deep learning is at the center, connecting several main clusters. The red cluster emphasizes the terms elementary school, literacy, and numeracy, indicating a research focus on improving students'

basic competencies. The blue cluster includes keywords such as “merdeka curriculum,” “differentiated learning,” and “science literacy,” which are related to curriculum innovation and learning strategies. The green cluster is associated with ‘canva’ and “area measurement,” indicating the use of digital media and its application in mathematics learning. Meanwhile, the yellow cluster contains the term “elementary education,” which shows a more general scope of research related to basic education.

Next, the analysis results are visualized with an overlay visualization shown in Figure 2 as follows.

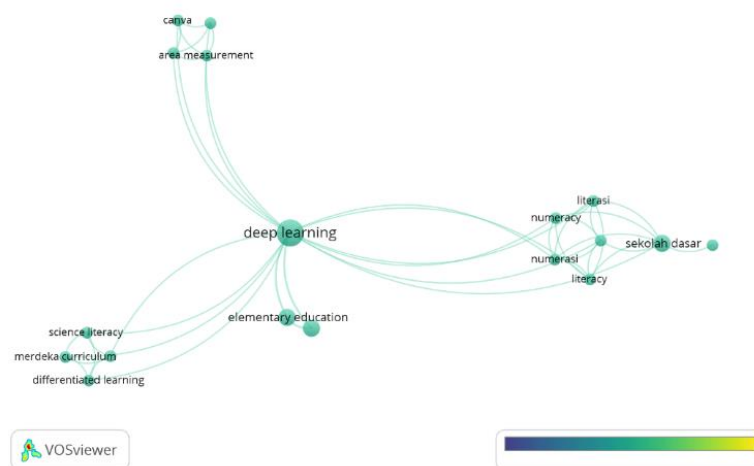


Image 2 overlay visualization

Unlike previous network maps that emphasized the relationships between keywords, overlay visualization provides an overview of the development of these keywords over time. The colors on the map indicate the year or period when the keywords were used more frequently. In Figure 2, it can be seen that the term deep learning remains at the center with strong connections to various other keywords, but with a different color distribution. Keywords such as literacy, numeracy, and elementary school appear in relatively newer colors, indicating that research related to the integration of deep learning with basic student competencies is a growing trend in recent years. Meanwhile, terms such as independent curriculum and differentiated learning appear slightly earlier, reflecting researchers' attention to education policies and learning strategies that support personalized learning.

In addition, keywords such as Canva and area measurement indicate that the research focuses on the use of digital media and practical applications in mathematics learning. The newer colors associated with these words indicate that these topics have become popular in recent years, in line with the increasing use of technology in the classroom. Thus, this overlay visualization confirms that research on deep learning in primary education is not only developing in terms of curriculum concepts, but is also increasingly moving towards real-world applications in the classroom, especially in literacy, numeracy, and digital media integration.

Next, Figure 3 will display a density visualization showing the density or intensity of research on a particular topic. The brighter or yellower an area is, the more frequently the keyword appears in the publications analyzed. Conversely, blue areas indicate keywords that appear relatively infrequently. Figure 3 will be displayed as follows.

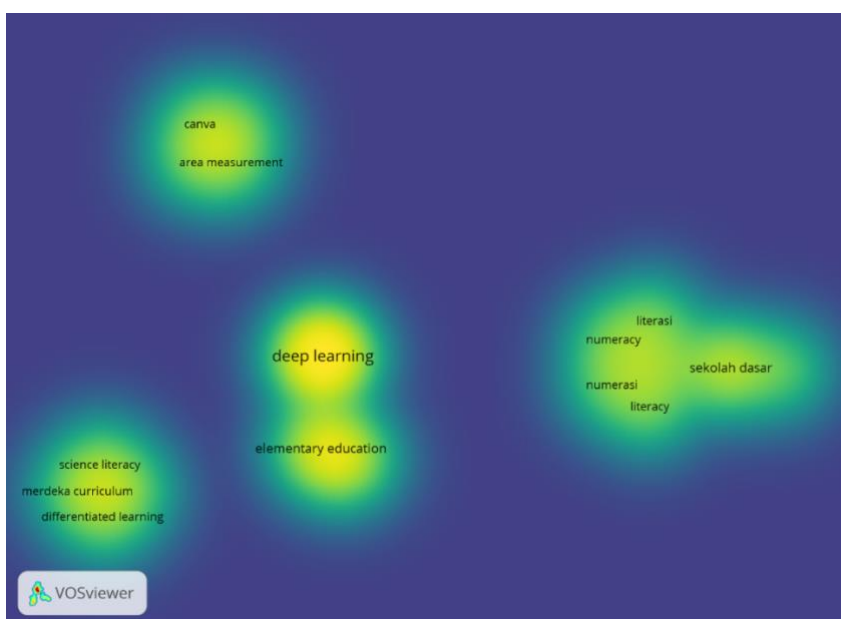


Image 3 density visualization

It can be seen that the term deep learning occupies the central position with the brightest yellow color, indicating that this topic is the main focus and most widely studied in the context of basic education. Directly related keywords, such as elementary education and primary school, also show fairly bright colors, indicating the large number of studies linking deep learning to the field of basic education.

In addition, keyword groups such as literacy and numeracy also appear prominent, indicating that students' basic competencies are an important focus in the application of deep learning. Meanwhile, other terms such as independent curriculum, science literacy, and differentiated learning appear to be in the moderate intensity area, which means that these topics are beginning to receive attention but not as much as literacy, numeracy, and the direct integration of deep learning.

Keywords such as “canva” and “area measurement” appear with considerable intensity in separate clusters. This indicates that there is research focusing on the use of specific applications or media to support deep learning-based learning, although the scale is still limited.

Thus, this density visualization confirms that deep learning, literacy, numeracy, and basic education are dominant themes, while other topics such as independent curriculum, science literacy, and the use of digital media are still developing as supporting topics with potential for further study.

DISCUSSION

The results of this study show that deep learning research in Indonesian elementary education throughout 2025 is developing, although still limited in quantity (38 articles). The keyword networks reveal three dominant clusters—literacy, numeracy, and the Merdeka Curriculum—which together illustrate a shift in pedagogical orientation. Rather than treating technology integration as an end point, studies increasingly position deep learning as a means to strengthen foundational competencies, address learning gaps, and respond to national policy demands. This indicates that deep learning is beginning to function not only as a theoretical concept but as a pedagogical framework that redefines how teachers design learning experiences in elementary schools.

The implications of this study indicate that the application of deep learning in primary education is not merely an academic trend, but can also serve as a basis for decision-making in education policy in Indonesia. Findings regarding the relationship between deep learning and literacy, numeracy, and independent curriculum provide direction that future research should be focused on developing more applicable learning strategies that are tailored to the needs of primary school students. For education practitioners, these results emphasize the importance of integrating deep learning approaches into learning designs, both to improve literacy and numeracy and to support differentiated learning (Yuliana, 2025; Zafirah et al., 2025). Meanwhile, for policymakers, this research trend can be used as a reference in formulating programs to strengthen students' basic competencies in line with the digital transformation of education (Sappaile, 2025). Thus, this study not only contributes academically by mapping trends, but also has practical value in supporting the improvement of basic education quality in Indonesia (Gunawan et al., 2023).

Existing literature reinforces these directions. Nghiem et al., (2024) and Saha et al., (2024) demonstrate that deep learning consistently enhances literacy and numeracy through project-based and inquiry approaches. Tuyet et al., (2024) highlights its role in cultivating higher-order thinking, while. Patiño et al., (2024) links deep learning to differentiated instruction within the Merdeka Curriculum. Meanwhile, digital media integration (Yustitia et al., 2025) suggests that technological tools function most effectively when embedded within deep learning principles rather than used as isolated innovations. These findings confirm that the interconnection of literacy, numeracy, and curriculum reform is not coincidental, but reflects a deeper pedagogical transformation toward meaningful, concept-driven learning.

Despite its contributions, this study has several limitations. The focus on 2025 publications and the Indonesian context restricts generalizability, and the quantitative nature of bibliometric analysis does not capture the quality or depth of instructional practices discussed in the articles. Nevertheless, the thematic patterns identified provide strong indications that deep learning holds potential for addressing persistent challenges in foundational learning and for supporting curriculum implementation at the elementary level.

Future research should extend beyond trend mapping by examining how deep learning is enacted in real classrooms, how teachers interpret its principles, and which forms of scaffolding most effectively support young learners. Comparative and longitudinal studies would also deepen understanding of how deep learning evolves as part of Indonesia's educational transformation. Thus, this study provides not only a mapping of trends but also a basis for strengthening pedagogical practices rooted in deep conceptual engagement.

CONCLUSION

This study identifies 38 publications on deep learning in Indonesian primary education throughout 2025. Bibliometric analysis using Publish or Perish, Mendeley, and VOSviewer shows that research is predominantly centered on literacy, numeracy, and alignment with the Merdeka Curriculum, indicating that deep learning is increasingly viewed as a key approach for strengthening foundational competencies. The identified thematic clusters also reflect a shift from general technology use toward more contextual and pedagogically driven applications in elementary education. Although limited to 2025 publications and the Indonesian context, this study opens opportunities for broader longitudinal and comparative analyses. Future research should explore the qualitative implementation of deep learning and

its subject-specific impacts. Overall, the findings suggest that deep learning has substantial future significance for Indonesian education, positioning it as a promising framework for advancing curriculum development, instructional innovation, and the strengthening of students' core competencies.

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