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Research Article

Artificial Intelligence for Learning in Indonesia: Current Research Trends and School Implementation

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Abstract. This study aims to analyze trends and developments in research on Artificial Intelligence for learning in Indonesia. The method used is bibliometric analysis with specific keywords that resulted in 120 research documents. Data analysis was conducted using the VOSviewer application to map keyword clusters and research novelty. The analysis concludes that research on Artificial Intelligence for Learning in Indonesia is divided into four main clusters representing different thematic focuses, including digital technology utilization, cognitive skill development, academic data governance, and instructional integration with performance analysis. The first cluster emphasizes the role of technology in enhancing user engagement, while the second cluster focuses on automation and the development of twenty-first century skills. The third cluster highlights the importance of data management and administrative efficiency, whereas the fourth cluster stresses technology integration in instructional processes and learning evaluation. Furthermore, the novelty analysis indicates that yellow-colored keywords such as "Elementary School", "Local Wisdom", and

"Motivation" serve as indicators of recent research trends. These findings suggest a shift in research focus toward primary education contexts, the integration of local cultural values, and affective aspects in technology-based instruction.

Keywords: Artificial Intelligence, Education Technology, Bibliometric Analysis, Keyword Clustering, Indonesia.

Abstrak. Penelitian ini bertujuan untuk menganalisis tren dan perkembangan penelitian tentang Artificial Intelligence dalam pembelajaran di Indonesia. Metode yang digunakan adalah analisis bibliometrik dengan kata kunci tertentu yang menghasilkan 120 dokumen penelitian. Analisis data dilakukan menggunakan aplikasi VOSviewer untuk memetakan kluster kata kunci dan kebaruan penelitian. Hasil analisis menunjukkan bahwa penelitian tentang Artificial Intelligence dalam pembelajaran di Indonesia terbagi ke dalam empat kluster utama dengan fokus tematik yang berbeda, yaitu pemanfaatan teknologi digital, pengembangan keterampilan kognitif, tata kelola data akademik, serta integrasi pembelajaran dan analisis kinerja. Kluster pertama menekankan peran teknologi dalam meningkatkan keterlibatan pengguna, kluster kedua berfokus pada otomasi dan pengembangan keterampilan abad ke-21, kluster ketiga menyoroti pentingnya manajemen data dan efisiensi administrasi, sedangkan kluster keempat menekankan integrasi teknologi dalam proses pembelajaran dan evaluasi hasil belajar. Selain itu, analisis kebaruan menunjukkan bahwa kata kunci berwarna kuning seperti "Elementary School", "Local Wisdom", dan "Motivation" menjadi indikator tren penelitian terbaru. Temuan ini mengindikasikan adanya pergeseran fokus riset menuju konteks pendidikan dasar, integrasi nilai budaya lokal, serta aspek afektif dalam pembelajaran berbasis teknologi.

Kata Kunci: Kecerdasan Buatan, Teknologi Pendidikan, Analisis Bibliometrik, Pengelompokan Kata Kunci, Indonesia.

INTRODUCTION

Education is the main foundation for developing high-quality human resources (Mierluş-Mazilu & Yilmaz, 2024; Nityasanti et al., 2025). Through education, individuals gain knowledge, skills, and values needed to face global challenges (Abubakar et al., 2024; Nilimaa, 2023). Rapid changes in society require education systems to continuously adapt (Ramadhani & Retnawati, 2024; Zafrullah & Ramadhani, 2024). Innovation in learning becomes essential to improve quality and relevance (Huang et al., 2024). Therefore, the use of technology in education is receiving increasing attention.

Digital transformation has significantly changed the teaching and learning process in schools across various educational levels today (Broza et al., 2023; Nordito S. Quimbo, 2023). Various online learning platforms, educational applications, and interactive media are now widely used by teachers and students (Manchanda & Arora, 2023). Technology enables learning to become more flexible, personalized, and engaging for diverse groups of students (Nordito S. Quimbo, 2023; Patras et al., 2021). Teachers can also utilize technology to design more effective and innovative learning strategies for classrooms. This condition encourages the emergence of

innovative technology-based learning approaches in modern educational environments today.

One of the rapidly developing technologies in education today is artificial intelligence, commonly known as AI systems (Hakim & Angga, 2023; Stasolla et al., 2025; Wang et al., 2025). AI supports learning through recommendation systems, virtual tutors, and advanced analysis of student learning data (Alsolami, 2025; Karataş et al., 2024; Shin et al., 2022). This technology enables more adaptive learning experiences based on students' individual needs and learning preferences. In addition, AI can assist teachers in assessment processes and continuous monitoring of student academic progress. The use of AI is expected to increase the overall effectiveness and efficiency of educational learning systems.

Various studies have examined artificial intelligence (AI) using bibliometric analysis and systematic literature review approaches, particularly in the fields of e-commerce, business, and management (Bawack et al., 2022; Dhamija & Bag, 2020). These studies indicate that AI research mainly focuses on recommender systems, optimization, machine learning, user trust, and technology adoption. In addition, the findings highlight dominant themes such as industrial automation, operational performance, sustainable supply chains, and the Internet of Things. Most publications are concentrated in computer science, artificial intelligence, and management journals, with certain institutions emerging as major contributors. However, there is still limited research specifically addressing trends and implementation of AI in education in Indonesia.

Based on the research background and literature findings, the researcher is interested in examining trends in Artificial Intelligence in Education in Indonesia. Using the Scopus database, the researcher conducts a bibliometric analysis to systematically map publication developments. This analysis includes keyword clustering and identification of keyword novelty to explore emerging research directions.

METHOD

This analysis is a descriptive quantitative study examined using a bibliometric approach. Bibliometric analysis is a method used to investigate patterns of scientific publications based on citation data, keywords, authors, and institutions (Ariawan et al., 2024; Istiawanto et al., 2024; Izzulhaq et al., 2024; Oktarina et al., 2025; Ramadhani, Setiawan, et al., 2024; Ramadhani, Yakob, et al., 2024; Wahyuni et al., 2024). This method helps map research development in a particular field systematically. Bibliometric analysis also assists in identifying research trends and dominant themes. Therefore, this approach is considered appropriate for examining AI research directions in education (Retnawati & Hidayat, 2025).

The researcher used the keyword string "*(TITLE ("artificial intelligence") AND TITLE (school) OR TITLE (learn)) AND (EXCLUDE (EXACTKEYWORD, "Deep Learning"))*

OR EXCLUDE (EXACTKEYWORD, "Machine Learning") OR EXCLUDE (EXACTKEYWORD, "Machine-learning")) AND (LIMIT-TO (AFFILCOUNTRY, "Indonesia"))". This keyword strategy was designed to focus on general AI studies in school and learning contexts. The keywords *deep learning* and *machine learning* were excluded because they represent specific subfields of AI with distinct technical characteristics. This exclusion helps maintain relevance to educational perspectives rather than computational approaches. Based on these criteria, a total of 120 documents were obtained for analysis.

The researcher focused on keyword clustering using VOSviewer software. VOSviewer was employed to visualize networks of relationships among research keywords. Through this mapping process, dominant research theme clusters were identified. In addition, the analysis reveals interconnections among topics in AI education research. These findings serve as a foundation for identifying research trends and potential novelties for future studies.

RESULTS AND DISCUSSION

Keyword Grouping

Keyword clustering using VOSviewer aims to identify dominant research themes and visualize relationships among keywords. This process helps reveal research trends and potential gaps for future studies.

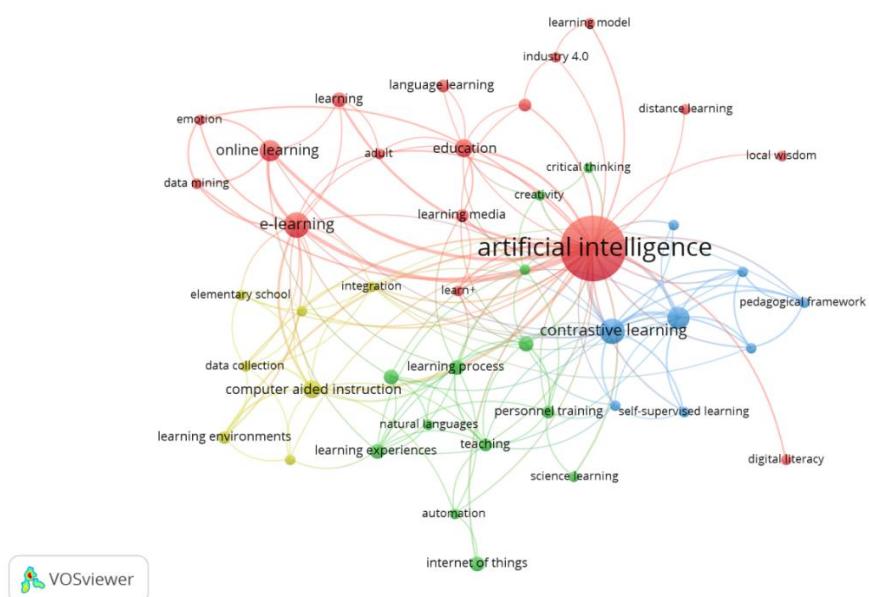


Figure 1. Keyword Clustering about Artificial Intelligence for Learning in Indonesia

Researchers obtained 45 keywords, which were divided into four clusters based on the analysis results. Each cluster represents a different research theme based on the characteristics of the keywords that emerged. Next, the researchers named the clusters based on the results of the keyword grouping.

Table 1. Keyword Grouping about Artificial Intelligence for Learning in Indonesia

Color Group	Keywords (Cluster)	Group Name
Red	Adult, Artificial Intelligence, Data Mining, Digital Literacy, Distance Learning, E-Learning, Emotion, Industry 4.0, Language Learning, Learning Media, Learning Model, Local Wisdom, Online Learning, Technology	Digital Technology and User Engagement
Green	Automation, Creativity, Critical Thinking, Curricula, Internet of Things, Learning Experiences, Learning Process, Motivation, Natural Languages, Personnel Training, Science Learning, Supervised Learning, Teaching	Automation and Cognitive Skill Development
Blue	Administrative Efficiency, Constructive Learning, Data Privacy, Federated Learning, Online Questionnaire, Pedagogical Framework, Self-Supervised Learning, Student	Data Governance and Academic Management
Yellow	Blended Learning, Computer Aided Instruction, Data Collection, Elementary School, Integration, Learning Environments, Learning Outcomes	Instructional Integration and Performance Analysis

Digital Technology and User Engagement

The cluster entitled "Digital Technology and User Engagement" discusses the use of digital technology to enhance user engagement in learning activities. This cluster focuses on e-learning, distance learning, and technology-based instructional media. Topics such as digital literacy and data mining highlight the importance of information management skills. The presence of Industry 4.0 reflects the impact of digital transformation on educational practices. Overall, this cluster emphasizes interactive and adaptive technology-supported environments.

This cluster also highlights emotional aspects and local wisdom in technology-based instruction. The integration of local culture is seen as a strategy to increase contextual relevance. Technology use is not limited to cognitive aspects but also addresses affective dimensions. This indicates a more holistic approach to instructional design. Therefore, the cluster represents contextual and innovative digital practices.

Automation and Cognitive Skill Development

The cluster with the title "Automation and Cognitive Skill Development" discusses the development of cognitive skills through automation and smart technologies. Creativity and critical thinking are central themes in this cluster. Curriculum design and motivation are also examined as supporting factors. The Internet of Things contributes to creating interactive learning experiences. This cluster emphasizes innovation in teaching strategies.

This cluster also explores personnel training and science-related instructional approaches. The use of supervised systems reflects the application of computational methods. Motivation is considered a key factor in enhancing student engagement. Innovative teaching strategies are essential for success. Thus, this cluster highlights the importance of twenty-first century competencies.

Data Governance and Academic Management

The cluster entitled "Data Governance and Academic Management" discusses data management and administrative efficiency in academic institutions. Key topics include data privacy and federated systems. Online questionnaires demonstrate the use of digital tools for data collection. Pedagogical frameworks are also discussed to support instructional processes. This cluster emphasizes the importance of secure data governance.

This cluster also highlights the role of students in technology-based systems. Self-supervised approaches reflect innovation in instructional strategies. Administrative efficiency is a major goal of digital implementation. Data security remains a critical issue. Therefore, this cluster emphasizes modern academic management systems.

Instructional Integration and Performance Analysis

The cluster entitled "Instructional Integration and Performance Analysis" discusses technology integration within instructional processes. The main focus includes blended models and computer-aided instruction. Data collection is used to evaluate student outcomes. Elementary schools serve as the primary implementation context. This cluster highlights the importance of supportive environments.

This cluster also emphasizes the analysis of student performance outcomes. Technology integration aims to improve instructional effectiveness. Conducive environments support successful implementation. Data-based evaluation assists decision making. Thus, this cluster promotes evidence-based instructional practices.

Keyword Novelty

Keyword novelty analysis using VOSviewer aims to identify emerging research topics. Furthermore, this analysis helps identify research trends and potential future research gaps.

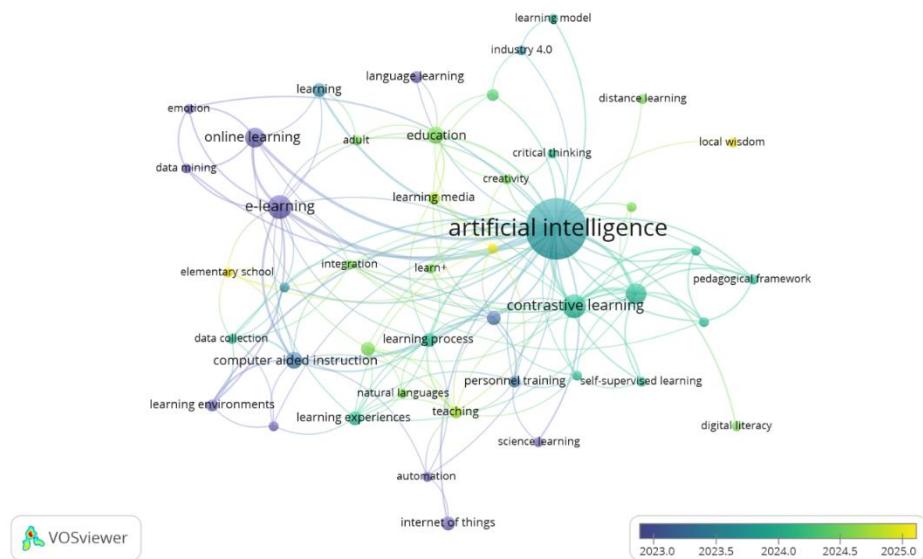


Figure 2. Keyword Novelty

Yellow keywords indicate research topics that have emerged in recent years. Yellow in VOSviewer represents novelty or current research trends. These keywords indicate a shift in research focus within the field being studied. Researchers use yellow keywords as a basis for determining research novelty. This is crucial to ensuring the research makes a cutting-edge scientific contribution. Thus, this analysis helps identify the direction of recent research developments.

The keyword "Elementary School" is included in the yellow group, indicating a research focus on elementary education. This topic reflects researchers' increasing attention to the application of technology to early childhood students. Research at the elementary school level is considered strategic in developing competencies from the outset. This also demonstrates efforts to integrate learning innovations into the fundamental stages of education. The emergence of this keyword demonstrates the need to develop learning models that are appropriate to the characteristics of elementary school students. Therefore, Elementary School serves as an indicator of novelty in the research.

Furthermore, the keywords "Local Wisdom" and "Motivation" are also included in the yellow group. This indicates a research trend that integrates local wisdom values into technology-based learning. Researchers are increasingly recognizing the importance of cultural context in enhancing learning effectiveness. Meanwhile, motivational aspects are a primary concern for increasing student engagement. The emergence of these keywords signals a shift in research that focuses not only on technology but also on affective and contextual factors. Thus, Local Wisdom and Motivation are novel elements in this study.

CONCLUSION

The analysis concludes that research on Artificial Intelligence for Learning in Indonesia is divided into four main clusters representing different thematic focuses, including digital technology utilization, cognitive skill development, academic data governance, and instructional integration with performance analysis. The first cluster emphasizes the role of technology in enhancing user engagement, while the second cluster focuses on automation and the development of twenty-first century skills. The third cluster highlights the importance of data management and administrative efficiency, whereas the fourth cluster stresses technology integration in instructional processes and learning evaluation. Furthermore, the novelty analysis indicates that yellow-colored keywords such as "Elementary School", "Local Wisdom", and "Motivation" serve as indicators of recent research trends. These findings suggest a shift in research focus toward primary education contexts, the integration of local cultural values, and affective aspects in technology-based instruction.

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