The Impact of AI on the Future of Education in Indonesia

Moh Fauziddin[1], Twinda Rizki Adha[2✉], Nurul Arifiyanti[3], Fenny Indriyani[4], Lussy Midani Rizki[5], Verra Wulandary[6], Vankelu Sai Venkateswarlu Reddy[7]

(1,2) Universitas Pahlawan Tuanku Tambusai, Indonesia

(3) Universitas Negeri Yogyakarta, Indonesia

(4) Universitas Islam Riau, Indonesia

(5) Universitas Pendidikan Indonesia, Indonesia

(6) Hiroshima University, Japan

(7) Vel Tech Rangarajan Dr. Sagunthala R&D Institute of Science and Technology, India

✉ **Corresponding author**

(twindaradha@gmail.com)

Abstract

Artificial Intelligence (AI) has the potential to revolutionize education in Indonesia by improving its quality and accessibility. The current study employed a Systematics Literature Review (SLR) method to analyze the impact of AI implementation in education. The findings revealed that AI can support adaptive learning, provide accurate assessments, and personalize the students' learning experiences. However, limited infrastructure, data privacy concerns, and the digital divide remain significant challenges. Effective utilization of AI requires teacher training and clear ethical policies to protect student privacy. By integrating AI technology, the education system of Indonesia can foster a more innovative and responsive learning environment, equipping students to face the challenges of the digital era. The current study also recommended that collaboration among the government, educational institutions, and private sectors is needed to maximize the potential of AI in education.

Keywords: *Adaptive education, Artificial Intelligence, digital literacy, educational ethics, technology.*

INTRODUCTION

Education plays an important role in driving technological progress, particularly in addressing the challenges of the digital era. Among the most significant technological breakthroughs is Artificial Intelligence (AI). AI, a branch of computer science, focuses on creating systems that mimic human cognitive functions. It encompasses a range of technologies, from machine learning to natural language processing, and involves the science and engineering of building machines capable of performing tasks typically requiring human intelligence. Within the educational context, AI is potentially able to revolutionize teaching and learning by broadening access to high-quality educational resources for both students and teachers (Panjwani, 2024).

AI profoundly impacts education by creating opportunities for students to engage in more personalized and meaningful learning (Ejjami, 2024). AI-personalized learning facilitates enabling students to study according to their unique needs, interests, and abilities. AI-driven systems, such as virtual tutors and adaptive platforms, deliver tailored content aligned with students' levels of comprehension. This ensures that challenging students receive additional support while the other typically developed students receive the new challenges (Essa et al., 2023). Such adaptability promotes the delivery of quality education, which not only imparts knowledge and skills but also equips students to adapt to the rapid changes of society.

Moreover, AI can develop the students' critical thinking and creativity (Celik et al., 2024). Students can engage in interactive simulations, virtual experiments, and complex problem-solving tasks by utilizing AI-based technology. AI also plays a pivotal role in enhancing accessibility for students with special needs (Neeharika & Riyazuddin, 2023). Tools such as AI-powered text readers, automated translators, and visual aids enable students with learning barriers to fully participate in educational processes, creating an inclusive and equitable learning environment. Furthermore, AI encouraged independent learning by providing immediate feedback and tailored recommendations, facilitating active exploration and deeper understanding (Park & Doo, 2024). These advancements enhanced learning effectiveness and instilled confidence and self-reliance in students, helping them achieve their educational goals. AI substantially transformed the educational process by delivering real-time feedback, facilitating personalized learning experiences, and promoting innovative teaching methodologies (Fauziddin & Ningrum, 2024).

A notable example of successful AI implementation in education is Coursera, a platform that utilizes AI algorithms to analyze user data and recommend courses aligned with learners' interests and needs. Coursera reported that over 77 million users are registered on its platform, with AI integration increasing course completion rates by up to 20% (Sugandini et al., 2022). This finding demonstrated AI's significant contribution to improving learning experiences globally. In Europe, initiatives such as "AI4Schools" aim to incorporate AI into school curricula, emphasizing 21st-century skills development. These initiatives involve collaboration between educational institutions, governments, and technology companies to create responsive and innovative learning environments tailored to students' needs. Early results indicate improved student engagement and learning outcomes, underscoring AI's potential for education.

Countries in Asia, such as China and Japan, have also invested significantly in AI for education (Nevezhin, 2021). The Chinese government, for instance, has launched initiatives to develop AI-based educational systems capable of reaching remote areas and providing better educational access to underserved students(Song et al., 2022). According to China's Ministry of Education, over 40% of schools in the country have adopted AI technologies in teaching and learning processes.

Despite AI's immense potential to transform education, its implementation in Indonesia faced several challenges. One major obstacle was the technological infrastructure gap, as many remote areas lack sufficient internet access and digital devices to support AI adoption (Choczyńska, 2024). Furthermore, limited technological knowledge and skills among educators hinder progress, exacerbated by insufficient teacher training and professional development opportunities (Soeparno & Ismaniati, 2022). Public awareness and acceptance of AI in education remain low, compounded by concerns over data privacy and security (Farooqi et al., 2024). Additionally, inadequate collaboration between the government, educational institutions, and private sectors has impeded the optimal development and utilization of AI in the educational sector (Diantama, 2023).

Addressing these barriers requires collective efforts to ensure that AI's potential is fully realized, enabling the creation of an inclusive and high-quality education system in Indonesia. While the challenges of AI adoption are complex, the technology still offers significant opportunities to enhance learning quality. AI could address pressing educational issues, such as personalized learning, improved accessibility, and the development of 21st-century skills (Celik et al., 2024). However, these benefits must be weighed against potential risks, including access inequality, lack of teacher readiness, and privacy and data ethics concerns. These challenges highlight the urgent need for a deeper understanding of AI's impact on education.

Previous studies have examined the impacts of AI on education. For example, AI has been shown to enhance student engagement and learning outcomes (Ma'amor et al., 2024). However, fully personalized learning experiences enabled by AI may not always yield evident benefits. Moreover, another previous study emphasized AI's potential to improve educational processes in schools and universities (Ambarita & Nurrahmatullah, 2024). Its findings also revealed that the frequency of AI tool usage among students varies widely, depending on their field of study and academic level (Fošner, 2024). While AI tools have become integral to the educational landscape in Slovenia, critical attention is needed to address their educational, ethical, and psychological implications.

Most previous studies highlighted AI's benefits in developed countries, yet few of them explored its interaction with local challenges in developing nations like Indonesia. This study aims to delineate the positive and negative impacts of AI implementation in education through a literature review approach. By taking this approach, it aims to offer comprehensive insights into maximizing the potential of AI while concurrently anticipating potential risks within the Indonesian educational context.

METHOD

The current study employed the Systematic Literature Review (SLR) method to investigate the impact of Artificial Intelligence (AI) on education in Indonesia. The SLR method enables the authors to systematically identify, analyze, and synthesize relevant literature, providing a comprehensive understanding of the topic under study. The selection of literature was executed following a set of explicit inclusion criteria, encompassing articles that engage with the implementation or impact of artificial intelligence in education, with a pronounced emphasis on Indonesia. The selected literature comprises scholarly articles published within the last decade, specifically between 2014 and 2024, in nationally recognized and internationally reputable journals. These articles were accessed through databases such as Scopus, ScienceDirect, Google Scholar, and Garuda and were written in Indonesian or English.

Exclusion criteria included articles that were not directly related to education, did not explicitly address AI, were opinion pieces or editorials, or originated from unverifiable sources. These inclusion and exclusion criteria ensure the analyzed literature is relevant, up-to-date, and academically credible, enhancing the study's reliability.

The data analysis process followed a systematic approach comprising several stages. First, articles meeting the inclusion criteria were extracted to obtain key information, such as research objectives, methods, findings, and conclusions. Second, the collected data were thematically analyzed to identify patterns, trends, and research gaps related to the impact of AI on education. Third, the thematic analysis results were compared to uncover diverse and unique perspectives relevant to Indonesia's educational context.

To illustrate this process, a research flow diagram (Figure 1) was employed to depict the stages of the SLR method, from article identification and screening based on inclusion and exclusion criteria to data analysis and synthesis. This diagram ensures transparency in the methodology. By adopting this structured approach, the study aims to provide a comprehensive understanding of AI's impact on education in Indonesia, offering insights that are both in-depth and well-organized.
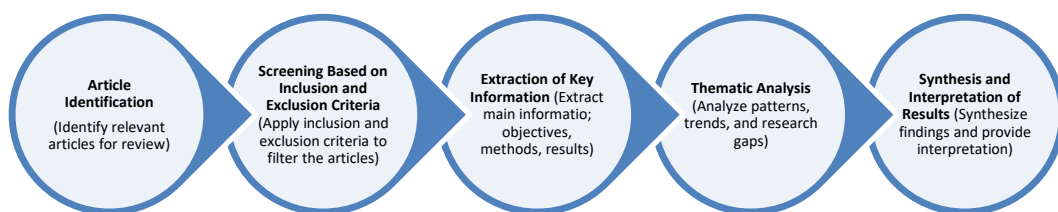

Figure 1. Systematic Literature Review (SLR) Process Flow

RESULT AND DISCUSSION

The Role of AI in Education

The integration of AI into various aspects of human life has become an undeniable phenomenon, including its growing presence in the education sector. In Indonesia, the education system continues to face numerous challenges, and AI presents significant potential to enhance the quality of education (Sappaile et al., 2024). According to a UNESCO report, approximately 60% of students in Indonesia experience difficulties in the teaching and learning process due to limited access to quality educational resources. In this context, AI can help bridge these gaps by providing more personalized and adaptive solutions for students.

One example of AI implementation in education is the adoption of AI-powered learning platforms that tailor educational content to the abilities and needs of individual learners. Applications such as Ruangguru and Zenius have integrated AI technology to deliver more targeted and effective learning recommendations. Research by Lase et al. (2024) highlights that AI-powered learning platforms can increase students' learning motivation by up to 30%, demonstrating that AI not only serves as a supporting tool but also enhances student engagement throughout the learning process.

Challenges in AI Adoption

Despite its vast potential, implementing AI in education faces several challenges. A significant obstacle lies in the readiness of both infrastructure and human resources. Data from the Ministry of Education and

Culture (2021) reveals that only about 30% of schools in Indonesia have adequate internet access to support technology-based learning initiatives. This limitation underscores the need to identify and implement strategic measures to leverage AI's potential in the Indonesian educational context fully.

The Potential of AI in Adaptive Learning

Recent advancements in AI technology have enabled its application across various sectors, including education. Adaptive learning, as a promising application, offers a personalized approach to teaching and learning by using algorithms and data analysis to tailor instructional materials to the student's individual needs. A report by Mourshed et al. (2018) suggests that AI integration in education can improve student learning outcomes by up to 30%, providing a more relevant and effective learning experience. However, this finding must be critically examined, particularly in Indonesia, where challenges such as infrastructure gaps and digital inequality persist (Farliana et al., 2024).

One of the most compelling aspects of AI in education is its ability to support adaptive learning. Adaptive learning enables the customization of educational content and teaching methods to meet the unique needs of individual students. This approach is particularly relevant in Indonesia, where students come from diverse educational backgrounds and possess varying capabilities. A previous study conducted by Trianggara et al. (2024) reveals that the implementation of AI-driven adaptive learning systems could enhance student outcomes by up to 40% compared to traditional methods. Nevertheless, this outcome requires further evaluation to assess their broader applicability, particularly in remote areas where access to AI-supportive technology may be limited.

AI systems analyze student interactions with learning materials to identify learning styles and comprehension levels, enabling tailored interventions. For instance, AI can provide supplementary materials or appropriately challenging exercises when students struggle with specific concepts, enhancing understanding and delivering a personalized learning experience. Diantama (2023) Highlighted that students who utilized AI-based adaptive learning systems could exhibit significant improvements in critical and creative thinking skills. However, these advantages must be balanced against potential risks, such as over-reliance on technology and a reduction in direct interaction between teachers and students, which could negatively impact the social aspects of learning (Berendt et al., 2020).

To fully realize the potential of AI in adaptive learning, teacher training programs are essential to equip educators with the necessary skills to integrate AI into teaching practices. Sundari (2024) revealed that many Indonesian teachers lack confidence in utilizing new technologies, including AI, in their classrooms. Therefore, comprehensive and sustainable training initiatives are crucial to ensure that teachers can effectively leverage AI tools. Additionally, curriculum adaptation remains a critical challenge. Without a framework that integrates technology into the curriculum, the potential of AI to support adaptive learning may remain underutilized (Ejjami, 2024).

AI in Assessment and Feedback

Beyond supporting adaptive learning, AI holds tremendous potential in assessment and feedback systems. AI-based assessments can provide faster, and more accurate feedback compared to traditional methods. A study by Yahya et al. (2023) showed that AI-based assessment systems could reduce the time required to deliver feedback to students by up to 50%. These systems help students quickly identify their strengths and weaknesses, allowing them to make timely improvements. Furthermore, AI facilitates the analysis of assessment data, uncovering patterns and trends in student performance. By leveraging machine learning algorithms, AI systems can identify students at risk of academic difficulties and recommend targeted interventions. A study by Ummah et al. (2024) reports that schools employing AI-driven assessment systems have achieved up to a 20% increase in graduation rates, underscoring the role of AI not only as an assessment tool but also as a catalyst for improving overall learning outcomes.

Despite these advantages, challenges related to AI implementation must be addressed. A significant concern is the risk of algorithmic bias. For example, algorithms trained on non-representative or biased datasets may produce unfair assessments. Regular evaluations and audits of AI-based systems are thus essential to ensure fairness and accuracy. Additionally, issues surrounding data privacy and security are critical. AI-based assessments require the collection of sensitive student data, which must be handled in compliance with Indonesia's recently enacted Personal Data Protection Law. This legislation mandates educational institutions to implement robust measures to safeguard student data (Küzecİ, 2022).

Ethical and Privacy Concerns

AI offers numerous educational benefits; ethical and privacy challenges must not be overlooked. The use of AI in education involves collecting and analyzing sensitive student data, raising significant privacy concerns. A report by B et al. (2024) highlighted that many AI-based educational platforms lack clear privacy policies, putting student data at risk of misuse. For instance, a data breach at an AI-based learning platform in 2023 exposed the personal information of thousands of students, underscoring the urgent need for robust data security measures.

Additionally, there are concerns about potential bias in AI algorithms. If the data used to train these systems is not representative, the outputs may reflect and perpetuate existing biases, negatively impacting students, particularly those from underrepresented backgrounds. A study by R. Nurhayati et al. (2024) revealed that algorithmic bias in AI systems could exacerbate educational disparities, as seen in Indonesian schools where students from remote areas received lower grades due to urban-centric training data. Addressing these challenges requires the involvement of multiple stakeholders—including educators, parents, and students—in the development and implementation of AI systems. By incorporating diverse perspectives, these technologies can be applied equitably and ethically, ensuring their benefits are accessible to all.

CONCLUSION

Artificial Intelligence (AI) has significant potential to improve the quality and accessibility of education in Indonesia. By utilizing adaptive learning, AI can personalize educational materials to meet individual students' needs, enhancing motivation and learning outcomes. It also streamlines the assessment process by providing rapid and accurate feedback, enabling students to identify their strengths and areas for improvement. However, challenges such as inadequate infrastructure, digital divides, and limited digital literacy among educators hinder its implementation. Addressing these issues requires comprehensive teacher training, robust data privacy policies, and regular evaluations to mitigate the risk of bias in AI algorithms, ensuring equitable and accurate learning outcomes. Collaboration among the government, educational institutions, and private sectors is crucial to overcome these barriers. With strategic planning and investment, AI can foster a more inclusive and innovative education system, equipping Indonesia to meet the demands of the digital era.

REFERENCES

Ambarita, N., & Nurrahmatullah, M. F. (2024). Impacts of Artificial Intelligence on Student Learning: A Systematic Literature Review. *Jurnal VARIDIKA*, 13–30. https://doi.org/10.23917/varidika.v36i1.4730

Berendt, B., Littlejohn, A., & Blakemore, M. (2020). AI in education: learner choice and fundamental rights. *Learning, Media and Technology*, *45*(3), 312–324. https://doi.org/10.1080/17439884.2020.1786399

Celik, I., Gedrimiene, E., Siklander, S., & Muukkonen, H. (2024). The affordances of artificial intelligence-based tools for supporting 21st-century skills: *Australasian Journal of Educational Technology*. https://doi.org/10.14742/ajet.9069

Choczyńska, A. (2024). Intersectional digital inequality in Indonesia. *Insights into Regional Development*, *6*(3), 11–22. https://doi.org/10.70132/a2853658265

Diantama, S. (2023). Pemanfaatan Artificial Intelegent (AI) Dalam Dunia Pendidikan. *DEWANTECH Jurnal Teknologi Pendidikan*, *1*(1), 8–14. https://doi.org/10.61434/dewantech.v1i1.8

Ejjami, R. (2024). The Future of Learning: AI-Based Curriculum Development. *International Journal For Multidisciplinary Research*, *6*(4). https://doi.org/10.36948/ijfmr.2024.v06i04.24441

Essa, S. G., Celik, T., & Human-Hendricks, N. E. (2023). Personalized Adaptive Learning Technologies Based on Machine Learning Techniques to Identify Learning Styles: A Systematic Literature Review. *IEEE Access*, *11*, 48392–48409. https://doi.org/10.1109/ACCESS.2023.3276439

Farliana, N., Murniawaty, I., & Hardianto, H. (2024). Sustainability of the Digital Economy in Indonesia: Opportunities, Challenges and Future Development. *Review of Business and Economics Studies*, *11*(4), 21–28. https://doi.org/10.26794/2308-944X-2023-11-4-21-28

Farooqi, M. T. K., Amanat, I., & Awan, S. M. (2024). Ethical Considerations and Challenges in the Integration of Artificial Intelligence in Education: A Systematic Review. *Journal of Excellence in Management Sciences*, *3*(4), 35–50. https://doi.org/10.69565/jems.v3i4.314

Fauziddin, M., & Ningrum, M. A. (2024). Symantic Literature Review : Manfaat Artificial Intelligence (AI)

pada Pendidikan Anak Usia Dini di Indonesia. *Jurnal Obsesi : Jurnal Pendidikan Anak Usia Dini*, *8*(6), 1475–1488. https://doi.org/10.31004/obsesi.v8i6.6236

Fošner, A. (2024). University Students' Attitudes and Perceptions towards AI Tools: Implications for Sustainable Educational Practices. *Sustainability*, *16*(19), 8668. https://doi.org/10.3390/su16198668

Küzecİ, E. (2022). Personal Data Protection Law. In *Introduction to Turkish Business Law*. Introduction to Turkish Business Law.

Lase, D., Waruwu, E., Zebua, H. P., & Ndraha, A. B. (2024). Peran inovasi dalam pembangunan ekonomi dan pendidikan menuju visi Indonesia Maju 2045. *Tuhenori: Jurnal Ilmiah Multidisiplin*, *2*(2), 114–129. https://doi.org/10.62138/tuhenori.v2i2.18

Ma'amor, H., Achim, N., Ahmad, N. L., Roszaman, N. S., Kamarul Anuar, N. N., Khairul Azwa, N. C. A., Abd Rahman, S. N., & Aqilah Hamjah, N. A. (2024). The Effect of Artificial Intelligence (AI) on Students' Learning. *Information Management and Business Review*, *16*(3S(I)a), 856–867. https://doi.org/10.22610/imbr.v16i3S(I)a.4178

Mourshed, M., Krawitz, M., & Dorn, E. (2018). How to improve student educational outcomes? In *McKinsey and Company*. MCKinsey & Company. https://www.mckinsey.com/industries/social-sector/ourinsights/how-to-improve-student-educational-outcomes-new-insights-from-dataanalytics

Neeharika, C. H., & Riyazuddin, Y. M. (2023). Artificial Intelligence in Children with Special Need Education. *2023 International Conference on Intelligent Data Communication Technologies and Internet of Things (IDCIoT)*, 519–523. https://doi.org/10.1109/IDCIoT56793.2023.10053420

Nevezhin, V. (2021). Application of Artifi cial Intelligence Systems in Education in China and Japan. *Profession-Oriented School*, *9*(1), 41–49. https://doi.org/10.12737/1998-0744-2021-9-1-41-49

Panjwani, M. M. (2024). Impact of AI in teaching and learning of CS in low-resourced schools. *International Journal of Science and Research Archive*, *12*(2), 1933–1939. https://doi.org/10.30574/ijsra.2024.12.2.1451

Park, Y., & Doo, M. Y. (2024). Role of AI in Blended Learning: A Systematic Literature Review. *The International Review of Research in Open and Distributed Learning*, *25*(1), 164–196. https://doi.org/10.19173/irrodl.v25i1.7566

R. Nurhayati, Nur, T., P, S., Adillah, N., Agustina, & Urva, M. (2024). Dinamika Pembelajaran Pendidikan Agama Islam Berbasis Artificial Intelligence (AI). *Prosiding Seminar Nasional Fakultas Tarbiyah Dan Ilmu Keguruan IAIM Sinjai*, *3*, 1–7. https://doi.org/10.47435/sentikjar.v3i0.3131

Sappaile, B. I., Nuridayanti, N., Judijanto, L., & Rukimin, R. (2024). Analisis Pengaruh Pembelajaran Adaptif Berbasis Kecerdasan Buatan terhadap Pencapaian Akademik Siswa Sekolah Menengah Atas di Era Digital. *Jurnal Pendidikan West Science*, *2*(01), 25–31. https://doi.org/10.58812/jpdws.v2i01.937

Soeparno, P. L., & Ismaniati, C. (2022). Mathematics Pre-Service Teachers' Digital Literacy And Their Readiness Towards 21st Century Learning: A Mixed Method Study. *BAREKENG: Jurnal Ilmu Matematika Dan Terapan*, *16*(2), 643–650. https://doi.org/10.30598/barekengvol16iss2pp643-650

Song, J., Zhang, L., Yu, J., Peng, Y., Ma, A., & Lu, Y. (2022). Paving the Way for Novices: How to Teach AI for K-12 Education in China. *Proceedings of the AAAI Conference on Artificial Intelligence*, *36*(11), 12852–12857. https://doi.org/10.1609/aaai.v36i11.21565

Sugandini, D., Istanto, Y., Garaika, G., & Arundati, R. (2022). *Model Kesuksesan E-Learning Pada Perguruan Tinggi Negeri*. Zahir Publishing.

Sundari, E. (2024). Transformasi Pembelajaran Di Era Digital: Mengintegrasikan Teknologi Dalam Pendidikan Modern. *Sindoro: Cendekia Pendidikan*, *4*(5). https://ejournal.warunayama.org/index.php/sindorocendikiapendidikan/article/view/3325

Trianggara, D. A., Sapri, S., Supardi, R., Sari, D. M., & … (2024). Pemanfaatan Kecerdasan Buatan (AI) Dalam Pendidikan. *Jurnal Gotong Royong*, *1*(1).

Ummah, I., Husnan, H., Udin, N., Syafi'i, A. H., Nurjannah, N., & Izomi, M. S. (2024). Strategi Pembelajaran Berbasis AI dalam Menunjang Prestasi Akademik Siswa. *Teknologi Dan Assesmen Untuk Menunjang Merdeka Belajar*, *4*. https://journal.ummat.ac.id/index.php/fkip/issue/view/824

Yahya, M., Wahyudi, W., & Hidayat, A. (2023). Implementasi Artificial Intelligence (AI) di Bidang Pendidikan Kejuruan Pada Era Revolusi Industri 4.0. *Seminar Nasional Dies Natalis 62*, *1*, 190–199. https://doi.org/10.59562/semnasdies.v1i1.794