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Article

Artificial Intelligence in Teacher Soft-Skill Development: A Review of Educational Initiatives in West Sumatra

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Abstract. This study examines the application of artificial intelligence (AI) in developing teachers' soft skills in West Sumatra. AI technology plays an important role in supporting the improvement of communication skills, classroom management, and critical thinking through personalized training and instant feedback. This study uses a qualitative descriptive method with a case study approach to analyze the effectiveness of AI in supporting teacher competency development. The results of the study show that although AI is able to provide positive impacts, the main challenges faced are the digital infrastructure gap and low digital literacy among teachers, especially in remote areas. However, with the support of the right policies and more inclusive training, AI has great potential to improve the quality of education in West Sumatra.

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1. Introduction

The development of soft skills among teachers is a crucial element in addressing educational challenges in the digital era. With the rapid advancement of technology, Artificial Intelligence (AI) is playing an increasingly significant role in supporting teacher competency development, particularly

in West Sumatra. This initiative aims to prepare educators to respond to the growing demands for dynamic and technology-based learning [1-5].

The use of AI in education has expanded rapidly worldwide, with diverse implementations and challenges depending on infrastructure, policy, and national objectives [6]. In the United States and Europe, AI is utilized to enhance personalized learning, refine student assessments, and provide real-time feedback to both students and educators [7]. AI tools assist in streamlining administrative processes and even support lesson planning. For instance, many teachers have begun using generative AI tools such as ChatGPT to design curricula while efficiently managing assessments and feedback. However, concerns exist regarding misinformation, bias, and overreliance on AI, highlighting the need for clear guidelines and targeted teacher training [8,9].

In countries such as China and Spain, governments have taken a more structured approach. China has developed strict regulations regarding AI use in education, ensuring that the technology is employed ethically and to foster innovation in teaching [10,11]. Spain, on the other hand, was among the first to establish AI policy task forces for education, aiming to manage the rapid changes AI brings to schools while ensuring inclusivity and equity [12,13].

Despite its benefits, AI adoption in education faces challenges. Globally, only a small proportion of schools and universities have formal AI integration strategies. Many institutions struggle with issues such as digital infrastructure, data literacy, and recruiting skilled personnel to implement AI-based tools effectively [14]. Moreover, disparities between and within countries remain a significant challenge, particularly as many schools in resource-limited regions lack access to the technology and training required to make AI a useful educational tool [15,16].

One application of AI in education is through more personalized training and mentoring. AI-based systems can analyze individual teacher needs and provide training recommendations aligned with their competencies. This enables each teacher to participate in more effective training focused on the specific skills they need to develop [17]. In West Sumatra, several initiatives have begun adopting this technology to help teachers enhance soft skills such as communication, classroom management, and critical thinking [18,19].

AI is also used to provide instant and measurable feedback on teacher performance during training. For example, AI can analyze teaching methods and offer suggestions to improve student engagement, whether in face-to-face or online instruction [20,21]. This allows teachers to address deficiencies quickly and maximize learning effectiveness [22,23].

The use of AI in teacher education in West Sumatra is not limited to formal training but also includes continuous mentoring. AI systems can serve as virtual mentors, available to provide guidance according to teachers' needs [24,25]. In practice, AI can identify specific weaknesses, such as insufficient presentation skills or limited variation in teaching methods, and offer implementable solutions.

Furthermore, AI helps teachers develop adaptive skills required in the ever-evolving digital education environment [26,27]. By providing simulations of complex classroom situations or problem-based learning scenarios, AI can train teachers to tackle challenges they might not encounter in daily teaching. This not only enhances teaching skills but also prepares educators to become more innovative in leveraging technology in the classroom [1,28].

Although AI holds significant potential for improving teachers' soft skills, several challenges must be addressed. A primary challenge is the uneven digital infrastructure across regions in West Sumatra. Additionally, not all teachers feel comfortable or are able to adapt quickly to new technologies, necessitating inclusive and supportive training approaches [29].

However, with support from local governments and collaborative initiatives between the education and technology sectors, the potential of AI to enhance teachers' soft skills in West Sumatra can be optimized. This also opens opportunities for developing more holistic education policies, where technology integration and skill development become primary focal points.

2. Experimental Section

This study employs a combination of descriptive research and article review to depict and analyze how AI is utilized in the development of teachers' soft skills in West Sumatra. This approach was chosen to provide an empirical overview while also examining findings from relevant literature in the field.

2.1. Type of Research

This study is qualitative and descriptive in nature, employing an article review approach to examine the literature on AI applications in education, as well as a case study approach to obtain empirical data from AI-based soft-skill training in West Sumatra.

2.2. Research Subjects and Data Sources

The descriptive study was conducted with teachers in West Sumatra who had participated in AI training. Subjects were selected using purposive sampling based on the criterion of active participation in the training program for at least six months. Additionally, for the article review method, data sources included relevant literature such as journal articles, government reports, and case studies from countries that have implemented AI in teacher training.

2.3. Research Instruments

To obtain empirical data, several instruments were employed:

a. Semi-structured interviews: Used to explore teachers' experiences and perceptions regarding the impact of AI on the development of soft skills, such as communication and classroom management.
b. Participatory observation: Involved direct observation during training sessions to examine the application of AI in real-world situations.
c. Literature review: Conducted a review of articles related to AI implementation in education, particularly in the context of skill development in countries such as the United States, China, and Spain, which served as benchmarks for this study.

2.4. Data Analysis Techniques

The data were analyzed using a thematic analysis approach for empirical data from interviews and observations, and content analysis for the literature review. The process was carried out through the following steps:

a. Data from interviews and observations were coded to identify key themes related to the impact of AI on teachers' soft-skill development.
b. The literature review was analyzed to identify patterns of AI application in educational development relevant to the context of West Sumatra.
c. The results of these analyses were then integrated to provide a comprehensive conclusion regarding the potential and challenges of AI implementation in teacher education.

2.5. Data Validity

The validity of the study was maintained through data triangulation, which involved comparing data from interviews, observations, and article reviews. Additionally, peer debriefing was conducted to ensure that the findings were consistent and accurate.

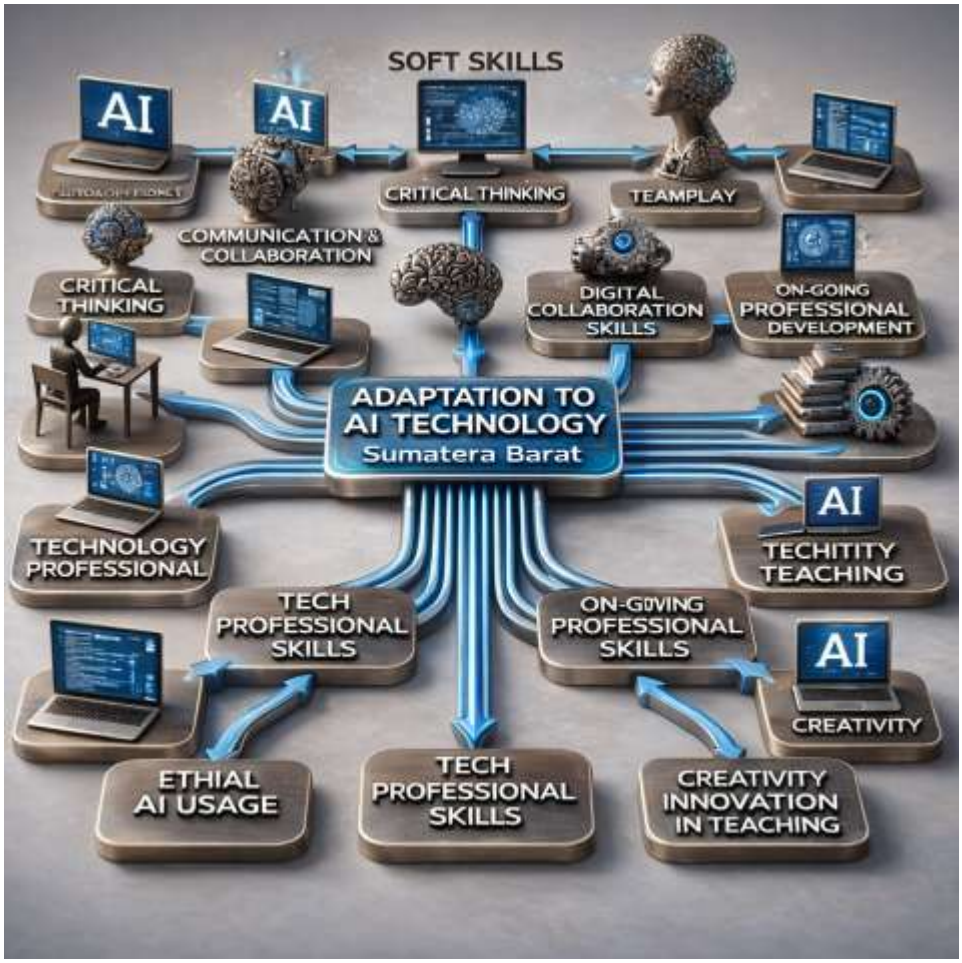

Figure 1. Flowchart

3. Results and Discussion

Table 1. Comparison of AI Skills Development

Type of Skills	Global Implementation (%)	Leading Regions in Implementation	Challenges
Cognitive Skills	30	North America, Europe	Excessive reliance on AI tools can hinder the development of practical skills.
Digital and AI Literacy	25	Asia, Europe	Ethical concerns and lack of infrastructure in underdeveloped regions.
Problem Solving & Critical Thinking	20	North America, Asia	Developing real-world problem-solving skills through AI requires greater integration.

Table 2. Global Implementation of AI Skills

Type of Skills	Global Implementation (%)	Leading Regions in Implementation
Cognitive Skills	30	North America (40%), Europe (30%)
Digital and AI Literacy	25	Asia (35%), Europe (30%)
Problem Solving & Critical Thinking	20	North America (30%), Asia (40%)
Administrative and Pedagogical Skills	25	Global (North America, Europe, Asia)

Table 3. Comparison of AI Skills Development in Southeast Asia

Type of Skills	Implementation Percentage in Southeast Asia (%)	Primary Focus	Challenges
Cognitive Skills	35	Adaptive learning, automated assessment tools	Limited digital infrastructure in certain countries
Digital and AI Literacy	30	Teaching digital literacy and AI programming in the curriculum	Digital gaps and lack of trained educators
Problem Solving & Critical Thinking	25	Problem-based learning through AI-based simulations	Integration into the learning system remains limited
Administrative and Pedagogical Skills	30	Automation of administrative tasks and teaching using AI	Limited access to AI technology in rural areas

Table 4. Comparison of AI Implementation in Southeast Asia by Region

Type of Skills	Implementation Percentage in Southeast Asia Region (%)	Leading Countries	Regional Leadership Percentage (%)
Cognitive Skills	35	Singapore, Malaysia	Singapura (40%), Malaysia (30%)
Digital and AI Literacy	30	Indonesia, Vietnam	Indonesia (35%), Vietnam (25%)
Problem Solving & Critical Thinking	25	Thailand, Philippines	Thailand (30%), Philippines (25%)
Administrative and Pedagogical Skills	30	Singapore, Malaysia, Indonesia	Singapore (35%), Malaysia (30%), Indonesia (20%)

Table 5. Comparison of AI Skills Development on Major Islands in Indonesia

Type of Skills	Implementation Percentage (%)	Main Focus	Challenge
Cognitive Skills	35	Adaptive learning in high schools and universities	Uneven access to internet infrastructure in remote areas
Digital Literacy and AI	30	Teaching digital literacy, introducing basic AI in the curriculum	Lack of educators trained in AI
Problem Solving and Critical Thinking	20	Problem-based learning at university	Limitations of AI use in elementary and secondary schools
Administrative and Pedagogical Skills	25	Automation of administrative tasks in educational institutions	Limitations of AI technology in remote schools

Table 6. Comparison of AI Implementation on Large Islands in Indonesia

Island	Types of Skills	Percentage of AI Implementation (%)	Main Focus	Challenge
Jawa	Cognitive Skills	40	Adaptive learning and AI literacy in schools and universities	Infrastructure is relatively good, but challenges outside big cities
Sumatra	Digital Literacy and AI	30	Digital literacy and basic AI skills development	Access to technological infrastructure is uneven in remote areas
Kalimantan	Administrative and Pedagogical Skills	20	Automation of administrative tasks in municipal educational institutions	Limited digital infrastructure in remote areas
Sulawesi	Problem Solving and Critical Thinking	25	Development of critical thinking skills in high school	Digital infrastructure and technology are not evenly distributed
Papua	Digital Literacy and AI	15	Teaching digital literacy and basic technology in several schools	Limited internet and technology access in remote areas
Bali & Nusa Tenggara	Cognitive Skills	35	The use of AI technology in adaptive learning	Challenges in teacher training and deployment of AI

				technology outside large cities

Table 7. Comparison of AI Expertise Development in the Provinces of Sumatra Island

Province	Types of Skills	Percentage of AI Implementation (%)	Main Focus	Challenge
Sumatera Utara	Digital Literacy and AI	35	Teaching digital literacy in secondary schools and universities	Limitations of teacher training in AI technology
Sumatera Barat	Cognitive Skills	30	The use of AI in adaptive learning in high schools	Uneven digital infrastructure in remote areas
Riau	Administrative and Pedagogical Skills	25	Automation of administrative tasks in educational institutions	Internet access in some remote areas is still limited
Kepulauan Riau	Problem Solving and Critical Thinking	20	Developing critical thinking skills through AI learning	Internet infrastructure is inadequate in some areas
Jambi	Digital Literacy and AI	25	Teaching digital literacy in secondary schools	Limited number of teachers who master AI technology
Bengkulu	Cognitive Skills	20	Using AI to improve learning methods in schools	Infrastructure and access to technology are not yet evenly distributed.
Lampung	Digital Literacy and AI	30	Basic introduction to AI in elementary and secondary schools	AI training for teachers and the technology access gap
Aceh	Problem Solving and Critical Thinking	25	Development of critical thinking skills at university	Limited access to technology and lack of training for educators
Sumatera Selatan	Administrative and Pedagogical Skills	30	Automation of administrative tasks and learning evaluation	Limited technological infrastructure in rural areas

Table 8. Comparison of AI Expertise Development in Cities in West Sumatra

City	Types of Skills	Percentage of AI Implementation (%)	Main Focus	Challenge
Padang	Cognitive Skills	40	Adaptive learning and AI literacy in high schools and universities	Good infrastructure, but still limited to small schools on the outskirts
Bukittinggi	Digital Literacy and AI	30	Digital literacy and basic introduction to AI in secondary schools	Teacher training is still limited, especially at the elementary school level.
Payakumbuh	Problem Solving and Critical Thinking	25	AI-based critical thinking skills development in high schools	Digital infrastructure in remote schools is still inadequate
Solok	Administrative and Pedagogical Skills	20	Automation of administrative tasks in educational institutions	Limited access to AI technology in some remote schools
Pariaman	Digital Literacy and AI	25	Introduction to digital literacy and basic AI in secondary schools	Lack of teaching staff who master AI technology
Sawahlunto	Cognitive Skills	20	Applying AI to improve learning methods	Technological infrastructure is not yet fully distributed in remote areas.
Padang Panjang	Digital Literacy and AI	30	Teaching digital literacy and basic technology in schools	Internet access in some areas is still limited
Painan (Kab. Pesisir Selatan)	Cognitive Skills	20	AI-based cognitive skills development in schools	Digital infrastructure is not yet optimal, especially in border areas

The research findings presented in Tables 1 through 10 comprehensively illustrate the development of AI-based skills in education, both globally and in West Sumatra. Each table provides insights into the types of skills developed, the challenges encountered, and regional differences in AI implementation.

Table 1 shows the global distribution of skills developed through AI. Cognitive skills have the highest implementation rate (30%), followed by digital and AI literacy (25%), problem-solving and critical thinking (20%), and administrative and pedagogical skills (25%).

The interpretation of this table indicates that AI focuses primarily on developing cognitive skills, where technology is used to automate adaptive learning processes and enhance students' understanding of complex concepts. Piaget (1971), in his theory of cognitive development, stated that direct experience plays a key role in learning. In the context of AI, technology-based adaptive learning can be considered a form of relevant direct experience [30].

Digital literacy skills also represent a significant focus, particularly due to the importance of integrating digital technology into education. Wayne and Holmes et al. (2019) note that digital literacy is a key skill that must be developed in the AI era. These findings align with the use of AI in West Sumatra, which seeks to enhance teachers' digital literacy [31].

Table 2 shows that North America and Asia are leading regions in AI-based skills development. North America excels in cognitive skills (40%) and problem-solving (30%), while Asia stands out in digital and AI literacy (35%).

These results indicate that technologically advanced regions prioritize different aspects of AI implementation. North America tends to focus on developing cognitive and analytical skills, whereas Asia, particularly countries such as China and India, emphasizes improving digital literacy. Luckin & Holmes (2016) also emphasize that developed countries, like the United States, utilize AI to accelerate personalized learning [12].

In West Sumatra, cognitive skills and digital literacy are the main focus areas, although infrastructure challenges limit AI implementation in certain regions. These findings suggest that while AI has the potential to enhance educational quality, its adoption is strongly influenced by the readiness of technological infrastructure.

Table 3 shows that Singapore and Malaysia lead in developing cognitive skills (35%) and pedagogical administration skills (30%) in Southeast Asia. Indonesia excels in digital literacy development (30%), although digital infrastructure challenges remain a significant barrier.

These findings support previous research indicating that Southeast Asian countries are striving to maximize AI use in education despite technological disparities. In Indonesia, including West Sumatra, AI has begun to be used to enhance teachers' digital literacy, particularly through technology-facilitated training programs. Selwyn (2019) highlights the importance of robust infrastructure to support effective AI implementation, which remains a challenge in regions with limited technological resources [32].

Table 4 shows AI implementation percentages by region in Southeast Asia. Singapore leads in cognitive skills development (40%), while Indonesia excels in digital and AI literacy (35%). This highlights differences in focus among Southeast Asian countries, where Singapore emphasizes. AI for cognitive skills development, whereas Indonesia prioritizes improving digital literacy across various educational sectors. Demartini et al. (2024) and Glaze (2019) stress the importance of aligning AI technology with local educational needs, which aligns with the approach adopted in West Sumatra [14,33].

Table 5 illustrates AI implementation across major islands in Indonesia, with Java leading in cognitive skills development (40%) and Sumatra excelling in digital and AI literacy (30%). These findings reveal regional disparities in AI adoption. In West Sumatra, AI is primarily focused on enhancing teachers' digital literacy. However, limited infrastructure in remote areas remains a major challenge, consistent with Luckin & Holmes (2016), who note that technological constraints often hinder AI adoption in less developed regions [12].

Table 6 compares AI skills development across major Indonesian islands, with primary focus areas including cognitive skills, digital literacy, and pedagogical administration. Java leads in cognitive skills development (40%), while Sumatra emphasizes digital literacy (30%).

Infrastructure gaps outside major cities in West Sumatra hinder equitable AI implementation. Piaget (1971) stated that optimal learning experiences require a supportive environment, and in this

context, the availability of technological infrastructure is a key element that must be improved for broader AI adoption [30].

Tables 7 and 8 show that provinces and cities in West Sumatra, such as Padang, Bukittinggi, and Payakumbuh, have begun implementing AI in education, particularly in developing cognitive skills and digital literacy. Padang leads in cognitive skills development (40%), while Bukittinggi focuses on digital literacy (30%).

These findings suggest that cities in West Sumatra with better infrastructure tend to advance more rapidly in AI implementation. Nonetheless, rural and remote areas, such as Pesisir Selatan, continue to face technology access challenges. Tanjung et al. (2024) emphasize that such infrastructure disparities create inequities in access to quality education, which is also reflected in AI implementation in West Sumatra [34].

Based on the findings from these tables, it is evident that AI has substantial potential to enhance teachers' skills, particularly in cognitive and digital literacy areas. However, infrastructure challenges and technology adaptation remain major obstacles. The authors argue that to realize AI's full potential in education in West Sumatra, local governments need to focus on improving digital infrastructure and providing more inclusive teacher training, especially in remote areas.

Alordiah (2023) and Ambarwati et al. (2022) assert that educational technology adaptation should be tailored to local needs and supported by adequate policies. AI implementation not only enhances teachers' soft skills but also opens opportunities for developing a more inclusive and equitable education system across West Sumatra [4,5].

The results from these tables provide a clear overview of AI's impact on skills development in the education sector, particularly in West Sumatra. With appropriate policy support and infrastructure improvements, AI can serve as an effective tool to enhance educational quality, especially in developing teachers' cognitive and digital literacy skills.

4. Conclusion

This study demonstrates that the implementation of artificial intelligence (AI) holds significant potential for enhancing teachers' soft skills, particularly in communication, classroom management, and critical thinking. In West Sumatra, AI initiatives have shown positive effects by personalizing training and providing teachers with immediate and measurable feedback.

However, the main challenges are the disparities in digital infrastructure across regions and the low level of digital literacy among teachers, especially in remote areas. Nevertheless, with appropriate policy support and more inclusive training, the potential of AI to improve educational quality in West Sumatra can be fully realized.

Globally, this study confirms that AI plays a crucial role in education across various countries, with an emphasis on developing adaptive skills and personalized learning. For regions like West Sumatra, further development is required to ensure that AI integration is equitable and has a significant impact on all teachers, particularly in preparing them to meet the challenges of education in the digital era.

The integration of this technology also presents opportunities for establishing more inclusive educational policies, which not only focus on technology but also strengthen teachers' capacity to leverage AI in enhancing their teaching effectiveness.

References

[1] Aggarwal, D., Sharma, D., & Saxena, A. B. (2023). Adoption of Artificial Intelligence (AI) For Development of Smart Education as the Future of a Sustainable Education System. *Journal of Artificial Intelligence, Machine Learning and Neural Network*, *36*, 23–28. https://doi.org/10.55529/jaimlnn.36.23.28

[2] Aggarwal, K. K., & Agrawal, S. (2024). Artificial intelligence and its role in financial market. *Global Financial Analytics and Business Forecasting*, 67–82.

[3] Akgun, S., & Greenhow, C. (2022). Artificial intelligence in education: Addressing ethical challenges in K-12 settings. *Springer*, *2*(3), 431–440. https://doi.org/10.1007/s43681-021-00096-7

[4] Alordiah, C. O. (2023). Proliferation of Artificial Intelligence Tools: Adaptation Strategies in the Higher Education Sector. *Propellers Journal of Education*, *2*(1), 53–65.

[5] Ambarwati, D., Wibowo, U. B., Arsyiadanti, H., & Susanti, S. (2022). Studi Literatur: Peran Inovasi Pendidikan pada Pembelajaran Berbasis Teknologi Digital. *Jurnal Inovasi Teknologi Pendidikan*, *8*(2), 173–184. https://doi.org/10.21831/jitp.v8i2.43560

[6] Arakpogun, E. O., Elsahn, Z., Olan, F., & Elsahn, F. (2021). Artificial Intelligence in Africa: Challenges and Opportunities. *Studies in Computational Intelligence*, *935*, 375–388. https://doi.org/10.1007/978-3-030-62796-6_22

[7] Murtaza, M., Ahmed, Y., Shamsi, J. A., Sherwani, F., & Usman, M. (2022). AI-Based Personalized E-Learning Systems: Issues, Challenges, and Solutions. *IEEE Access*, *10*(August), 81323–81342. https://doi.org/10.1109/ACCESS.2022.3193938

[8] Demartini, C. G., Sciascia, L., Bosso, A., & Manuri, F. (2024). Artificial Intelligence Bringing Improvements to Adaptive Learning in Education: A Case Study. *Sustainability (Switzerland)*, *16*(3). https://doi.org/10.3390/su16031347

[9] Van Der Vorst, T., & Jelicic, N. (2019). Artificial Intelligence in Education Can AI bring the full potential of personalized learning to education? *30th European Conference of the International Telecommunications Society (ITS): "Towards a Connected and Automated Society", Helsinki, Finland, 16th-19th June, 2019*, 1–21. https://www.econstor.eu/bitstream/10419/205222/1/van-der-Vorst-Jelicic.pdf

[10] Roberts, H., Cowls, J., Morley, J., Taddeo, M., Wang, V., & Floridi, L. (2021). The Chinese approach to artificial intelligence: an analysis of policy, ethics, and regulation. *AI and Society*, *36*(1), 59–77. https://doi.org/10.1007/s00146-020-00992-2

[11] Saveliev, A., & Zhurenkov, D. (2021). Artificial intelligence and social responsibility: the case of the artificial intelligence strategies in the United States, Russia, and China. *Kybernetes*, *50*(3), 656–675. https://doi.org/10.1108/K-01-2020-0060

[12] Joshi, S., Rambola, R. K., & Churi, P. (2021). Evaluating artificial intelligence in education for next generation. *Journal of Physics: Conference Series*, *1714*(1). https://doi.org/10.1088/1742-6596/1714/1/012039

[13] Holmes, Wayne;, Bialik, M., & Fadel, C. (2019). Artificial Intelligence in Education: Promises and Implications for Teaching and learning. *Center for Curriculum Redesign*.

[14] González-Calatayud, V., Prendes-Espinosa, P., & Roig-Vila, R. (2021). Artificial intelligence for student assessment: A systematic review. *Applied Sciences (Switzerland)*, *11*(12). https://doi.org/10.3390/app11125467

[15] Ngwa, W., Olver, I., & Schmeler, K. M. (2020). The Use of Health-Related Technology to Reduce the Gap Between Developed and Undeveloped Regions Around the Globe. *American Society of Clinical Oncology Educational Book*, *40*, 227–236. https://doi.org/10.1200/edbk_288613

[16] Sharma, P., Madan, J., Mann, S., Mantri, A., & Sharma, R. (2020). Studies on the outcome and

relevance of research in artificial intelligence domain in South Asian subcontinent. *Procedia Computer Science*, *172*(2019), 616–622. https://doi.org/10.1016/j.procs.2020.05.079

[17] Chen, L., Chen, P., & Lin, Z. (2020). Artificial Intelligence in Education: A Review. *IEEE Access*, *8*, 75264–75278. https://doi.org/10.1109/ACCESS.2020.2988510

[18] Holmes, Wayne. (2023). Asian and European Teachers' Perspectives on AI and Education:A Report Based on InsightsShared by Secondary School Teachers. In *Asia-Europe Foundation (ASEF): Singapore.* . https://asef.org/publications/asian-and-european-teachers-perspectives-on-ai-and-education/

[19] Luckin, R., & Holmes, W. (2016). Intelligence Unleashed: An argument for AI in Education. In *UCL Knowledge Lab: London, UK.* . https://www.pearson.com/content/dam/corporate/global/pearson-dot-com/files/innovation/Intelligence-Unleashed-Publication.pdf

[20] Dimitriadou, E., & Lanitis, A. (2023). A critical evaluation, challenges, and future perspectives of using artificial intelligence and emerging technologies in smart classrooms. *Smart Learning Environments*, *10*(1). https://doi.org/10.1186/s40561-023-00231-3

[21] Kim, Y., Soyata, T., & Behnagh, R. F. (2018). Towards Emotionally Aware AI Smart Classroom: Current Issues and Directions for Engineering and Education. *IEEE Access*, *6*, 5308–5331. https://doi.org/10.1109/ACCESS.2018.2791861

[22] Knight, S., Dickson-Deane, C., Heggart, K., Kitto, K., Kozanoğlu, D. C., Maher, D., Naraya, B., & Zarrabi, F. (2023). Generative AI in the Australian education system: An open data set of stakeholder recommendations and emerging analysis from a public inquiry. *Australasian Journal of Educational Technology*, *39*(5), 101–124. https://doi.org/10.14742/ajet.8922

[23] Kolog, E. A., Odoi Devine, S. N., Egala, S. B., Amponsah, R., Budu, J., & Farinloye, T. (2022). *Rethinking the Implementation of Artificial Intelligence for a Sustainable Education in Africa: Challenges and Solutions*. *29*, 27–46. https://doi.org/10.1108/s1877-636120220000029003

[24] Wang, T., Lund, B. D., Marengo, A., Pagano, A., Mannuru, N. R., Teel, Z. A., & Pange, J. (2023). Exploring the Potential Impact of Artificial Intelligence (AI) on International Students in Higher Education: Generative AI, Chatbots, Analytics, and International Student Success. *Applied Sciences (Switzerland)*, *13*(11). https://doi.org/10.3390/app13116716

[25] Fauzy Maarij Mutaqin, Idah Jubaedah, Herry Koestianto, & Dede Indra Setiabudi. (2023). Efektif Artificial Intelligence (Ai) Dalam Belajar Dan Mengajar. *Jurnal Pendidikan : SEROJA*, *2*.

[26] Selwyn, N. (2019). *Should Robots Replace Teachers?: AI and the Future of Education*. Polity Press.

[27] Stewart, J., Lu, J., Gahungu, N., Goudie, A., Fegan, P. G., Bennamoun, M., Sprivulis, P., & Dwivedi, G. (2023). Western Australian medical students' attitudes towards artificial intelligence in healthcare. *PLoS ONE*, *18*(8 August), 1–14. https://doi.org/10.1371/journal.pone.0290642

[28] Tuomi, I. (2018). *The Impact of Artificial Intelligence on Learning, Teaching, and Education. Policies for the future*. https://doi.org/10.2760/12297

[29] Williams, P. T. (2023). Education Evolution: Pedagogical Techniques for the Modern World. *International Journal of Research and Review Techniques*, *2*(2), 7–13. https://ijrrt.com/index.php/ijrrt/article/view/17

[30] Piaget, J. (1971). *The Theory of Stages in Cognitive Development*. McGraw-Hill.

[31] Mouta, A., Pinto-Llorente, A. M., & Torrecilla-Sánchez, E. M. (2023). Uncovering Blind Spots in Education Ethics: Insights from a Systematic Literature Review on Artificial Intelligence in Education. In *International Journal of Artificial Intelligence in Education* (Issue 0123456789). Springer New York. https://doi.org/10.1007/s40593-023-00384-9

[32] Steels, L., & De Mantaras, R. L. (2018). The Barcelona declaration for the proper development and usage of artificial intelligence in Europe. *AI Communications*, *31*(6), 485–494. https://doi.org/10.3233/AIC-180607

[33] Glaze, A. R. (2019). *Teachers' Conceptions of Mathematics and Intelligent Tutoring System Use*.

[34] Tanjung, A. Q., Suciptaningsih, O. A., & Asikin, N. (2024). Urgensi Etika Dalam Literasi Digital Di Era Globalisasi. *WASIS : Jurnal Ilmiah Pendidikan*, *5*(1), 32–41. https://doi.org/10.24176/wasis.v5i1.11566