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Enhancing the Effectiveness of Technology-Based Learning with AI Training for Teachers: A Literature Review

Andrie Riomalen Yordan Rissi[1*], Balthasar Insantuan[2], Marlina Evelyn[3], Erlita Ariyanti Widiyastuti[4], Mariyanti Nenohai[5], Bernadetha Nadeak[6]
Universitas Kristen Indonesia
Corresponding Author: Andrie Riomalen Yordan Rissi
riomalenandrie@gmail.com

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A B S T R A C T
This study aims to explore and analyze the role of artificial intelligence (AI) training in enhancing the effectiveness of technology-based learning for teachers. Using a literature review method, the results show that AI training can improve teachers' digital skills, personalize learning, and foster innovation and development of teaching methods that meet students' needs and technological advancements. The challenges faced include limited infrastructure and budget, lack of pedagogical understanding of AI, resistance to change, and data privacy issues. To address these challenges, increased investment in technology, comprehensive training for teachers, inclusive change approaches, and strict data security policies are needed. Consequently, teachers can design appropriate learning strategies, as well as implement and assess technology-based learning effectively.

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INTRODUCTION

Technology has become an integral part of human life and has permeated various aspects, including education. The use of technology in education is inseparable from the rapid development of science and technology. Artificial intelligence (AI) has now become one of the main trends. AI has also entered the world of education, showing great potential in enhancing the effectiveness of the learning process.

According to a survey published by the American Psychological Association, 7 out of 10 teenagers use generative AI tools to help with homework (apa.org, 2025). This indicates active engagement of children with AI technology in the educational context. Today's teenagers tend to use AI to complete their homework.

Training is a means to improve skills and is conducted outside the formal education system over a relatively short period (Ubay, 2021). Through training, teachers can adapt and enhance their skills, particularly in using artificial intelligence or AI. This training is expected to contribute positively and improve the quality of teaching in this digital era (Sitompu et al., 2023). With proper training, teachers can understand and apply technology, especially artificial intelligence (AI), in the learning process, thereby increasing teaching effectiveness (Patty & Lekatompessy, 2024).

Training can also help teachers develop their digital skills, enable personalized learning according to each student's needs, and encourage innovation in teaching methods (Soegiarto et al., 2023). Additionally, AI training prepares teachers to face digital world challenges, such as limited infrastructure and lack of pedagogical understanding of AI applications (Cakraningtyas, 2025).

Previous research conducted by Rahayu and Alhadi (2023) shows that training utilizing Artificial Intelligence (AI) for effective presentations and communication helps teachers develop their ability to use AI in learning activities. This highlights the importance of training to equip teachers with adequate knowledge and skills, enabling them to integrate AI into various aspects of teaching, from lesson planning to learning outcome evaluation, and create a more effective and adaptive learning environment.

LITERATURE REVIEW

The Global AI Faculty Survey (2025) by the Digital Education Council, which collected 1,681 responses from faculty at 52 institutions in 28 countries, offers diverse perspectives on AI in education. This survey revealed that 61% of faculty have used AI in teaching, primarily for creating teaching materials (75%) and administrative tasks (58%). Although the survey shows that 61% of faculty have used AI in teaching, significant concerns remain regarding students' ability to evaluate AI outputs and the potential over-reliance on this technology. A total of 83% of faculty are worried about students' critical thinking skills in assessing AI-generated results, while 82% are concerned that students may become too dependent on AI for their academic tasks. Additionally, only 6% of faculty are satisfied with the AI literacy resources provided by their institutions. This indicates a significant gap in the training and support needed to effectively utilize AI in teaching. From the survey data, 86% of faculty see themselves using AI in

the future, highlighting the need to update student assessment methods and improve AI literacy among teachers.

The development of artificial intelligence (AI) requires teachers to enhance their AI literacy. What teachers need to improve their ability to enhance technology-based learning is training. Training is a structured and systematic learning process conducted over a short period aimed at increasing teachers' knowledge and skills (Nadeak, 2021). AI training for teachers is crucial to ensure they can master this technology and use it to improve teaching quality.

METHODOLOGY

This study aims to explore and analyze the role of artificial intelligence (AI) training in enhancing the effectiveness of technology-based learning for teachers. The research employs a literature review method. This approach involves collecting and analyzing information from various relevant sources (Febrianto and Siroj, 2024). A literature review is a written summary of various sources that describe previous and current information on the research topic (Juliangkary, 2022). Through the literature review method, this article will examine various studies and relevant literature to understand how AI training can help teachers develop their digital skills, enable personalized learning according to each student's needs, and encourage innovation in teaching methods.

RESEARCH RESULT AND DISCUSSION

The rapid development of technology, including in the field of education, requires teachers to adapt to these advancements. However, the digital divide remains a significant challenge. This gap includes differences in access to technology between urban and rural areas, as well as among different socio-economic groups. Educational technology can significantly facilitate learning and knowledge enhancement, but unequal access hinders this potential. Additionally, there is a disparity in technology use among teachers, including the use of AI in education (Zulfa and Hendry, 2021). Training is expected to improve teachers' technology literacy and AI usage to enhance the effectiveness of technology-based learning (Nento, 2023).

Benefits of AI Training for Teachers

AI training for teachers offers significant benefits in improving the quality of teaching and learning. Here are some of the benefits:

a. Enhancement of Digital Skills

AI training for teachers aims to equip them with knowledge about programming concepts and AI that can be applied in classroom learning. This training includes understanding programming terms and logical thinking (Subowo, 2022). With these skills, teachers can improve their ability to understand and apply programming and AI in education. Additionally, teachers can learn how to integrate AI technology with the subjects they teach and identify the use of AI to enhance classroom management and personalized learning, such as through student data analysis or adaptive learning platforms (Huda, 2024).

AI technology in education provides advanced pedagogical tools, enabling personalized teaching and offering learning support to assist teachers. With AI, teachers can increase efficiency in managing classrooms, identifying gaps, and simplifying administrative tasks (Nguyen, 2023). The use of AI in education not only helps with routine tasks but also provides deep insights into students' needs and progress, allowing teachers to adjust strategies more effectively.

Artificial intelligence (AI) plays a crucial role in supporting educational improvement and transformation (Hartati, 2021). Through AI training, teachers can enhance their digital skills. This training enables teachers to understand and apply AI technology in the learning process, from lesson planning to learning outcome evaluation. With better digital skills, teachers can create more interactive and adaptive learning environments (Segiarto, 2023).

The use of AI in education can improve the quality of human resource management and help teachers identify students' weaknesses more quickly (Gusli, 2023). With AI, teachers can more effectively understand students' needs and adjust teaching methods, creating a more personal and optimal learning experience for each student.

b. Personalized Learning

In the context of personalized learning, AI can be utilized to recognize individual student learning needs and provide materials according to their level of understanding, learning style, and interests (Kisno, 2023). With AI assistance, teachers can tailor content and teaching methods based on students' needs and abilities, making the learning process more effective and relevant as students receive materials that truly match their needs.

AI training can also help teachers understand how to use this technology to create enjoyable learning experiences. Teachers can more easily grasp how AI works, the applications that can be used in learning, and strategies to integrate this technology into daily teaching activities (Huda, 2024). Thus, teaching becomes more effective and responsive to each student's needs.

AI also has the capability to automate student evaluation processes, such as measuring progress, providing feedback, and recommending next steps (Asbara, 2024). By analyzing individual student data, AI can tailor materials, activities, and feedback, helping teachers focus on students who need more attention (Taruklimbong, 2023). This helps teachers manage their time and resources more efficiently, allowing them to give more attention to students requiring additional focus.

AI also promotes the development of personalized learning systems in education by providing learning experiences tailored to students' needs (Atzori, 2021). AI helps teachers save time in preparing teaching materials, allowing them to focus on other pedagogical aspects (Mursalin, 2024). This enables teachers to manage their time and resources more effectively and give more attention to important aspects of the learning process.

The use of AI also provides individual support to students and helps teachers design and develop learning materials, such as customized content,

educational videos, or interactive simulations. With AI, teachers can create easily understandable teaching materials with more engaging presentations, making the learning process more enjoyable. AI training can enhance the quality of classroom learning (Mursalin, 2024). It can increase student engagement and motivation, as they feel the material presented is more aligned with their interests and needs. Thus, AI can improve the overall learning experience in a dynamic and adaptive environment.

c. Innovation in Teaching Methods

AI training for teachers aims to enhance soft skills in the teaching and learning process. This training can include creating engaging media-based and video-based learning materials with AI assistance. Thus, teachers can adopt more innovative and creative teaching methods (Asbara, 2024). This allows teachers to create learning environments that meet students' needs.

AI enables teachers to collect and analyze student data, learning styles, performance, and lifestyle patterns, allowing for the adjustment of learning programs to achieve optimal results (Taruklimbong, 2023). Additionally, AI training can help teachers design their own Student Worksheets (LKPD), using AI features and technologies learned to create enjoyable learning environments (Mursalin, 2024). Innovation in teaching methods can be optimized through the use of simulations, educational games, and data analysis to identify areas that need improvement in the learning process. Through training, teachers can understand the potential of AI and develop more effective and engaging teaching strategies. Learning can include interactive media projects with Scratch, Quizizz, Teachable Machine, and enrichment materials using AI applications available on various sites beneficial to students (Subowo, 2022). With proper AI training, teachers can create more adaptive and responsive learning environments according to students' needs.

AI can also help answer students' basic questions about learning materials, allowing teachers to focus on more complex teaching aspects (Taruklimbong, 2023). Thus, AI training can also encourage innovation and development of more effective and engaging teaching methods. AI training offers many benefits in innovating and developing teaching methods. Teachers can create more interactive and engaging materials and adopt more creative teaching methods. Additionally, AI can adjust learning programs to achieve optimal results. Thus, AI training helps teachers become more responsive to students' needs.

Challenges in AI Training

Training artificial intelligence (AI) for teachers faces various challenges, including the following:

a. Infrastructure and Budget Constraints

The biggest challenge in implementing AI training for teachers is the limitation of infrastructure. This is very evident in the context of education in Indonesia, especially in 3T areas (frontier, outermost, and disadvantaged regions) where educational facilities are often inadequate. These limitations include minimal access to transportation, internet facilities, and unstable electricity (Anggraini et al., 2025). The implementation of AI training faces

significant challenges because teachers need hardware such as computers, laptops, tablets, and stable internet connections, as well as user-friendly software that meets learning needs, including AI applications that support the teaching process, online learning platforms, and AI-based educational materials to provide relevant additional resources and support the learning process in the classroom (Patty, 2024). However, in remote areas, access to these devices and online resources is often limited, hindering the effective implementation of AI training.

Difficulties in implementing AI training are also caused by budget constraints. Limited budgets result in inadequate infrastructure in many schools. Schools in remote areas have limited resources, making it difficult to provide the necessary hardware and software for AI training (Asbara et al., 2024). Additionally, budget constraints also hinder the ability of schools to conduct comprehensive and sustainable training for teachers.

Infrastructure limitations can hinder the adoption of new technologies in education. Limited internet access and lack of hardware can reduce the effectiveness of training and the use of AI in learning. Furthermore, limited budgets often become the main obstacle in providing the necessary resources for effective AI training (Patty, 2024). Overcoming infrastructure and budget challenges is key to ensuring that AI training for teachers runs more effectively, so that teachers can utilize AI technology to create learning experiences that meet students' needs, and are more adaptive and effective.

b. Lack of Pedagogical Understanding of AI

Improving teachers' competence in mastering technology must be balanced with a deep understanding of pedagogical principles. This is important because some teachers do not have adequate skills to optimally utilize technology, especially teachers from previous generations who often find it difficult to adapt to rapid technological developments (Mursalin et al., 2024).

The lack of pedagogical understanding of AI is also a significant challenge in training. Many teachers find it difficult to understand how AI can be applied in the educational context. AI developers often lack an understanding of educational science and teachers' pedagogical needs, so the AI applications developed are not always aligned with teaching practices. Comprehensive and continuous training is needed so that teachers can understand and integrate AI into various aspects of teaching, from lesson planning to evaluating learning outcomes.

The lack of understanding and knowledge about AI among teachers and educational staff hinders their ability to maximize teaching materials in learning (Hanafiah, 2023). The initial lack of understanding of technology makes it difficult for novice participants to use graphic design platforms like Canva and artificial intelligence (AI) technology, so they need more time to understand the material. To overcome this challenge, the training team implements intensive mentoring methods that allow participants to receive more personal guidance (Mursalin et al., 2024).

Thus, improving teachers' competence in mastering technology, especially AI, must be balanced with a deep pedagogical understanding. Thorough and continuous training is essential so that teachers can effectively utilize this technology.

c. Resistance to Change

This situation occurs when teachers still feel comfortable using traditional teaching methods such as lectures, note-taking, and direct evaluation, resulting in one-way interaction. Consequently, teachers tend to rarely or never use learning media to support the learning process (Gusli, 2023). Sometimes, teachers feel comfortable and reluctant to change or innovate with classroom learning activities.

The inability to adapt to more modern and interactive teaching methods causes students to be less exposed to the latest technology, which should be an integral part of their education. Teachers who still use traditional approaches such as lectures and note-taking, without utilizing technology-based learning media, contribute to a lack of creativity and innovation in the learning process. As a result, students do not get a dynamic and relevant learning experience with current technological developments (Hanafiah, 2023).

Although technology and AI have developed rapidly, many educational institutions are still stuck in old teaching methods that are less effective and do not utilize the potential of modern technology (Gusli, 2023). As a result, the teaching and learning process in the classroom becomes less dynamic and interactive. Therefore, greater efforts are needed to provide training and mentoring to teachers so that they can master and integrate AI into their teaching.

This challenge shows that AI training for teachers is very necessary. Teachers need to be encouraged to step out of their comfort zone of traditional teaching methods and start adopting new technologies that can enhance interaction and learning effectiveness. Training is essential so that teachers can understand and integrate AI into various aspects of teaching, from lesson planning to evaluating learning outcomes. Thus, teachers can be more creative and innovative in delivering material and can maximize the use of technology-based learning media in the classroom.

d. Privacy

The main challenges in AI development include several critical aspects such as data security, algorithmic bias, and social impact. Data security is a major concern because AI often requires access to large amounts of personal and sensitive data, which must be protected from leaks and misuse. Protecting this data is crucial to maintaining individual privacy and preventing potential misuse of information that could harm users (Yusuf, 2024). Algorithmic bias is also a significant issue in AI development. Poorly designed algorithms can reinforce existing injustices and discrimination in society. This can negatively impact various aspects of life, including decision-making in health, education, and employment (Wardani, 2024).

Challenges such as regulation, security, and ethics must be addressed to ensure that this technology provides optimal benefits. Therefore, it is important

for educational institutions to provide comprehensive training to teachers so that they can integrate AI into their teaching in a safe and ethical manner (Huang, 2023).

Impact of AI Training on Teaching Quality

AI training has a significant impact on teaching quality. One of the main impacts is the ability of teachers to provide more personalized and effective learning. Through deep data analysis, AI helps teachers understand the individual needs of students, allowing them to tailor teaching methods to students' learning styles and abilities. This enables more targeted learning and improves student learning outcomes (Singh, 2025).

AI can offer innovative teaching tools, such as smart tutors and adaptive learning applications, which can provide real-time feedback and support the learning process more effectively (Celik, 2022). Here are some studies that show the impact of AI training on teaching quality:

a) Research conducted by Anwar (2024) on AI Introduction Training to Improve Teacher Competence in Digital Transformation. This study shows that teachers gain learning experiences in utilizing AI technology for engaging and interactive learning processes for students.
b) Research by Patty & Lekatompessy (2024) on AI technology training in learning for teachers at SD Negeri Tiakur shows that through this training, teachers update their understanding of AI so that they can create learning that meets students' needs.
c) Research by Subowo, Dhiyaulhaq, & Khasanah (2022) on AI training for educators and teachers at SD Muhammadiyah (Online Thematic Academy Kominfo RI) shows that training participants successfully created projects in the form of interactive learning media using Scratch, Quizizz, Teachable Machine, and enriched materials with AI applications available on various sites. The results of this training are very beneficial for student learning.
d) Canva and AI Education Training for Prospective Professional Teachers in Preparing Online Student Worksheets (LKPD) conducted by Mursalin, Muhammad Ali, Mursyidah, Muhammad Rizka, and Desi Armita (2024). This shows that with AI training, prospective teachers can quickly create LKPD using AI and Canva.

Based on the above studies, it can be seen that AI training can help teachers simplify their work, making it easier for them to identify students' needs, develop appropriate strategies, and innovate in designing, implementing, and evaluating teaching and learning activities.

CONCLUSIONS AND RECOMMENDATIONS

Comprehensive AI training for teachers can drastically improve teaching quality. This training can enhance teachers' digital skills, personalize learning, and foster innovation and development of learning that meets students' needs. The challenges faced include infrastructure and budget constraints, lack of pedagogical understanding of AI, resistance to change, and data privacy issues. If these challenges are successfully addressed, the training can help teachers

design appropriate learning strategies, as well as implement and assess them in line with students' abilities and changing times.

ADVANCED RESEARCH

Comprehensive AI training for educators holds transformative potential to elevate teaching quality by equipping teachers with the necessary digital competencies to navigate and integrate emerging technologies effectively. Such training facilitates the personalization of learning experiences, enabling educators to tailor instruction to individual student needs, thereby promoting equity and engagement. Moreover, it cultivates a culture of innovation and continuous pedagogical development, aligning educational practices with the evolving demands of the 21st-century learner. However, the successful implementation of AI training is contingent upon overcoming significant barriers, including inadequate infrastructure, limited financial resources, insufficient pedagogical frameworks for AI integration, resistance to systemic change, and pressing data privacy concerns. Addressing these challenges through strategic planning, policy support, and capacity-building initiatives will empower educators to design, implement, and evaluate adaptive learning strategies that are not only technologically sound but also pedagogically robust and ethically grounded.

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