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The Impact of Using Artificial Intelligence in Learning on Students' Critical Thinking Skills: A Literature and Public Sentiment Analysis Study

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ABSTRACT

This study aims to analyze the impact of the use of artificial intelligence (AI) in learning on students' critical thinking skills. Using a literature analysis approach and public sentiment study, this study identifies trends and findings from previous studies related to the integration of AI in education and its impact on students' cognitive abilities, especially in terms of critical thinking. Public sentiment studies focus on understanding public perceptions and views on the use of AI in the context of learning and its impact on students' critical thinking skills. The results of this study are expected to provide comprehensive insight into the potential benefits and challenges faced in the use of AI in education, as well as its implications for the development of students' critical thinking skills. In addition, this study has the potential to offer recommendations regarding effective learning policies and strategies to maximize the benefits of AI in improving students' critical thinking skills.

Keywords: *Artificial Intelligence; Critical Thinking Skills; Educational Technology; Education 4.0.*

INTRODUCTION

The development of artificial intelligence (AI) technology has brought about major changes in various aspects of human life, including in the world of education. AI enables the automation of various tasks, deeper data analysis, and the development of more innovative and adaptive learning methods. The implementation of AI in education has grown rapidly in recent years, with various applications such as adaptive learning systems, educational chatbots, learning data analysis, and automated assessment systems that help improve learning effectiveness (Santos & Nordin, 2023). This technology provides great opportunities for educators and students to improve the quality of the teaching and learning process through more personalized and data-driven methods.

One of the main benefits of using AI in education is its ability to provide a more personalized and interactive learning experience. AI can adjust learning materials based on the needs and level of understanding of each student, allowing for a more effective and efficient learning process (Johnson et al., 2022). In addition, AI is also able to provide real-time feedback, which can help students understand difficult

concepts and increase their learning motivation. With this technology, students can learn at their own pace, without being limited by conventional learning methods that are often general and less attentive to individual needs.

In addition, AI also plays a role in developing students' critical thinking skills. Critical thinking skills are one of the essential competencies needed in the 21st century, where students are required to be able to analyze, evaluate, and formulate solutions to various complex problems (Facione, 2015). Various studies have shown that AI can help students develop these skills through problem-solving-based learning, data analysis, and automatic and data-based feedback (Rahman & Aziz, 2021). In an AI-supported learning environment, students can practice solving various scenarios and case studies that require critical thinking skills, and receive guidance tailored to their needs.

However, although AI has great potential to improve the quality of education, there are still several challenges and concerns that need to be considered. One of the main challenges is the potential for students to become dependent on technology, which can reduce their ability to think independently and interact socially in the learning environment. Several studies have shown that the use of AI in education can lead to reduced social interaction between students and teachers, which is an important aspect of the conventional learning process (Kim & Lee, 2020). In addition, there are also concerns about bias in AI algorithms and the protection of student data and privacy in the use of AI-based technology in schools.

Therefore, it is important to understand thoroughly how AI can be used effectively in education, as well as how existing challenges can be overcome. This study aims to analyze the impact of the use of AI in education on students' critical thinking skills, through a literature review approach and public sentiment analysis. By combining various academic studies and public perceptions of AI in education, this study is expected to provide a more comprehensive understanding of the benefits, challenges, and opportunities offered by AI in education.

METHOD

This research uses a qualitative approach with literature review and meta-analysis methods to analyse the impact of using artificial intelligence (AI) in learning on students' critical thinking skills. The qualitative approach aims to understand phenomena in depth through analysis of various literature sources without direct intervention of the research subject (Sugiyono, 2014).

The literature review method was used to identify, evaluate and synthesise previous studies relevant to this topic (Tohirin, 2012; Rakhman et al., 2021). This technique allows researchers to find patterns and trends in academic studies and provides a conceptual mapping of the relationship between AI use and students' critical thinking (Pamungkasari & Widayati, 2015).

In addition, this study applied the meta-analysis method, which is a systematic approach to combining the results of quantitative research in order to obtain more generalised conclusions (Borenstein et al., 2011). Meta-analysis aims to synthesise

previous research findings by evaluating effect sizes and relationships between variables that have been empirically tested in various studies (Cooper, 2017; Xu et al., 2017).

Data sources were obtained from peer-reviewed accredited scientific journals and academic databases (Petticrew & Roberts, 2006). Literature selection was based on criteria of relevance, credibility, and novelty within the last five years (Machi & McEvoy, 2021). Data analysis was conducted using a thematic synthesis approach to identify patterns and research gaps in this field (Bowen, 2009).

FINDINGS AND DISCUSSION

1. Concept of artificial intelligence in learning

Artificial intelligence (AI) is an innovation that is starting to be adopted as a result of technological advancements as it has great potential to help education. AI allows for a more personalized and flexible learning experience to be tailored to the unique needs of each student. Problem-based learning, also known as PBL, is one of the learning approaches that can be reinforced with the help of artificial intelligence. This method encourages students to think critically and creatively while seeking solutions to real problems by emphasizing exploration and problem-solving.

Simply put, AI is the ability of machines to do things that would normally require human intelligence, such as identifying sounds, making decisions, and solving problems. Technologies such as machine learning, natural language processing (NLP), and big data analytics enable AI to improve the efficiency and effectiveness of the learning process.

In the world of education, AI has been applied in various forms, such as adaptive learning systems that can adjust course materials to students' learning styles and needs, virtual assistants that assist students in learning, virtual assistants that assist students in learning. By implementing adaptive learning systems that can tailor course materials to students' learning styles and needs, virtual assistants that assist students in learning, and automated evaluation tools that speed up the assessment process. Many leading universities have even incorporated AI into their curriculum to improve learning outcomes and provide students with a more personalized learning experience (Ratnasari et al., 2024).

According to research, the use of AI in education has significant positive effects. Artificial intelligence allows students to receive feedback and customize their learning in real-time. It helps teachers identify students' unique needs and provide more appropriate guidance. While AI has the potential to be used in education, there are issues to incorporating it. Ethics, data privacy, and the digital divide must be taken seriously. It is difficult to incorporate AI into education in Indonesia. The main barriers to implementing this technology in primary schools include the lack of technological infrastructure, lack of teacher instruction, and limited resources. To solve these problems, methods based on local context should be used. This approach should

consider the unique needs of students and the constraints that exist in the Indonesian educational environment (Nurul Nujum et al., 2025).

2. The positive impact of AI on students' critical thinking skills

AI can be employed as a learning medium that facilitates the learning process of students. The greatest benefit of AI is that it can provide detailed and pertinent information in a matter of seconds. For example, AI applications can provide more analytical insights of information on a particular topic, thereby enabling students to comprehend complicated concepts in a more graphical and interactive way. ideas in a more interactive and pictorial way. This helps students to understand better, which can improve their critical thinking process. According to Liu and Li (2020), AI can assist students in understanding course material by presenting relevant information and in-depth data analysis. However, uncontrolled use of AI risks hindering the development of students' ability to make independent decisions based on their own reasoning. Furthermore, Dede (2016) emphasized the important role of wise teaching in integrating AI, so that students do not just rely on technology to get answers, but are also trained to think critically and analytically in solving problems. Therefore, it is necessary to further explore the impact of AI on the development of critical thinking skills among students, as well as how the educational sphere can optimize the use of AI to serve as a tool, not a substitute, in their critical thinking process (Cholvistaria et al., 2025).

AI can be a platform that makes students' learning process more enriched. In addition, AI is also poised to free users from administrative hassles so that teachers can spend more time developing students' critical skills. For example, the application of AI in the assessment process makes the responses more specific and timely, allowing students to correct their cognitive errors in time. Harmilawati et al. (2024) believe that AI can encourage critical thinking in several ways, including opening up opportunities to learn the material, enabling group and individual learning, and enhancing problem-based learning approaches. In addition, AI-based systems can provide immediate feedback on students' answers, helping them understand where they went wrong and how to correct them. This helps improve their reflective and critical thinking skills. AI not only provides answers, but also encourages exploration of various possible solutions. This makes students accustomed to thinking creatively in completing tasks and finding new ways of solving problems. However, over-reliance on this technology can lead to many problems such as social isolation, uncertainty regarding the quality of information provided, and various ethical and privacy concerns. Therefore, to make the most of the benefits of AI while minimizing its negative impacts, there should be a planned and balanced application of the technology in the education system to provide relevant and descriptive information in a limited amount of time. For example, AI applications can provide a more critical analysis of data on a given subject, allowing students to understand complex concepts in a more visual and pictorial manner in a more interactive and pictorial manner. This allows the learner to form more understanding, and this can lead to better critical thinking processes.

3. Negative impact of AI on students' critical thinking skills

While artificial intelligence (AI) offers various benefits in education, its misuse can also lead to a number of negative impacts that need to be taken seriously. One of the main challenges is the increasing dependence of students on technology, which can be the reason for the weakening of independent and critical thinking skills, as well as the weakening of independence in thinking and decision-making, as students tend to rely on AI to obtain instant answers without going through an in-depth analysis process (Selwyn, 2019). In addition, excessive reliance can also reduce students' ability to reflect and critically evaluate information, which ultimately risks reducing creativity and innovation in solving academic problems (Faisal, n.d., 2024).

The quality of information provided by AI is not always guaranteed to be accurate, because basically AI has limitations in certain respects including in sorting out valid and credible information even though it is based on very sophisticated algorithms. For users who do not have good digital literacy skills, it will be very risky to accept and use misleading information without further verification. This will greatly impact the quality of their academic understanding and indirectly contribute to the spread of invalid information in the academic environment.

Another negative impact is the reduction of social interaction among students due to the reliance on AI-based technology. There will be no more discussions between individuals or teams, as the use of AI has indirectly reduced the opportunity to collaborate directly. In fact, social interaction plays an important role in the development of communication skills, cooperation, and emotional intelligence (Bandura, 1977). This lack of interpersonal interaction may impact the social skills that are indispensable in future professional environments.

Considering these risks and challenges, it is important for schools to design a balanced strategy for the implementation and utilization of AI for students. The utilization of AI should also be supported by efforts to strengthen digital literacy and develop strict privacy policies, as well as encourage more active social interactions so that students can still optimally develop critical thinking and interpersonal skills (Amalia et al., 2024).

4. Analysis of public sentiment towards the use of artificial intelligence

Recent years have seen a significant advancement in the use and development of artificial intelligence (AI) in Indonesian education, which has created new opportunities to improve the quality of education in Indonesia, innovate the learning process, and overcome a number of challenges faced by the country's educational system. As AI technology matures and information technology becomes more widely available, the education sector is able to incorporate AI into a variety of areas, from teaching to school administration, which has led to improvements in education that are better, more efficient, and responsive to the needs of students, teachers, and educational institutions.

Though there are certain drawbacks, the advancement and application of AI in education undoubtedly contributes to the change of Indonesian education. The ChatGPT app is one of the most widely used AI tools for assisting with teaching and learning activities these days. Both teaching staff and students frequently utilize this AI program to locate the information they require. However, if this AI application is used as a quick approach to answers, it will negatively affect how kids' enthusiasm in learning develops. Because kids are accustomed to receiving answers right away without having to learn and think beforehand, this will result in lazy learning (Saepudin et al., 2024).

The process of gathering, comprehending, and evaluating the thoughts, feelings, and responses that people or groups have about a specific subject or thing is known as sentiment analysis. Since AI has a big impact on many facets of human existence, such as economics, employment, ethics, and socioculture, it is imperative to understand how people feel about it. Sentiment analysis techniques enable us to monitor and examine how society at large or particular groups perceive, accept, and assess AI.

Better sentiment outcomes are obtained from the public's reaction to AI techniques. AI is viewed by many as a technology with enormous potential to enhance human existence. This includes AI's capacity to boost productivity, solve challenging issues, and even spur creativity across a range of sectors. However, there are worries that AI could replace human control and have detrimental effects on privacy and employment. The use of AI in decision-making that could have an impact on human life without proper restrictions has also sparked ethical questions. Because there are already so many advantages, society can accept artificial intelligence instruments (Oktavia & Isnain, 2024).

5. Factors that influence the effectiveness of artificial intelligence to improve critical thinking processes

With the use of generative AI, users may ask, infer, and respond to questions quickly. This convenience has the dual benefits of speeding up information acquisition and creating a positive feedback loop for consumers who instantly trust the information they get. In actuality, generative AI does not always provide 100% accurate information, and it even suggests that users double-check their data.

Our minds construct knowledge relationships through the dialectical process of questioning and answering. The Greek words "kritikos," which means consideration, and "kriterior," which means standard or standard measure, are the origins of the English word "critical." Thus, the term "critical" has the etymological sense of "consideration based on a standard or standard measure." Critical thinking is an active process and a methodical, structured mode of thinking that seeks to fully comprehend information before using that understanding to establish a belief in the information's veracity. In summary, critical thinking is the capacity to examine issues and concepts in order to identify answers based on one's own knowledge and logic (Veronika Trinovianti, 2023).

The development of critical thinking abilities is significantly aided by artificial intelligence (AI). One of the main conclusions is that AI makes it simple to access a large and quick variety of learning materials, which aids in increasing their comprehension and knowledge of a variety of subjects. AI can make recommendations for learning resources based on data analysis, making learning more efficient and pertinent. Additionally, AI promotes collaborative learning by offering a platform that makes it easier for people to work together.

But the study also found significant drawbacks to implementing AI in the classroom. First, relying too much on technology can make it difficult to think critically and independently without AI's assistance. Second, AI-generated information is not necessarily trustworthy or accurate, which, if improperly handled, might be deceptive. Thirdly, excessive usage of AI may hinder social contact, which is critical for the growth of people's emotional and social intelligence. Lastly, there are privacy issues with AI-managed data that need to be treated seriously.

According to Carr (2010), an excessive reliance on technology might impede the development of critical thinking abilities and diminish one's capacity for autonomous thought. Furthermore, the quality of information produced by AI is not always certain, which highlights how crucial it is to have excellent digital literacy in order to evaluate the reliability of information. Overuse of AI can potentially affect people's social and emotional skills by decreasing social engagement. Lastly, there are issues with data privacy, which calls for transparent and unambiguous privacy policies to safeguard consumers.

If applied sensibly and responsibly, artificial intelligence (AI) offers enormous potential to enhance people's critical thinking abilities. Maximizing AI's advantages while addressing potential drawbacks like technological dependence, social isolation, and ethical issues is crucial. The greatest advantages of AI in contemporary education will be guaranteed by a well-balanced combination of this technology with conventional teaching techniques (Amalia et al., 2024).

CONCLUSION

This study highlights the complexity of the impact of artificial intelligence (AI) in learning on students' critical thinking skills. Through literature analysis and public sentiment studies, it was found that while there is potential for positive benefits, there are also challenges that need to be addressed. To ensure effective AI integration, careful planning, adequate teacher training, and curriculum development that supports students' critical thinking skills are needed. Further research is needed to explore the factors that influence the effectiveness of AI use in learning, as well as to develop more targeted strategies to improve students' critical thinking skills in the digital age.

The implications of AI integration extend beyond the classroom, affecting education policy, the role of teachers, and the future of learning itself. Ensuring equitable access to technology, resources, and training is critical to avoid further deepening existing educational disparities. This evolving landscape demands a shift in

the role of teachers, requiring professional development to equip educators to use AI tools effectively, adapt their teaching approaches, and foster critical thinking in a technology-rich environment. In addition, AI's potential to drive innovation and prepare students for future careers in technology must be balanced with the development of a variety of skills, including critical thinking, creativity, and problem solving.

In conclusion, while the use of AI in education has great potential, its success depends largely on wise and well-planned implementation, which takes into account both the benefits and challenges involved. By addressing these impacts, we can ensure that the integration of AI in education is both beneficial and equitable, and supports the development of students' critical thinking skills and prepares them for future challenges and opportunities.

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