



The Influence of AI Technology on the Development of Critical Thinking Skills in Education

Fahmy Syahputra¹, Elsa Sabrina², Alya Rahmi³, Ariyantika Br Ginting⁴, Hanifah Mardhiyah^{5*}, Hutri Ami⁶, Laili Tanzila⁷

^{1,2,3,4,5,6,7}Program Studi Pendidikan Teknologi Informatika dan Komputer, Fakultas Teknik, Universitas Negeri Medan
famybd@unimed.ac.id¹, elsasabrina@unimed.ac.id², aljarahmi.5233151025@mhs.unimed.ac.id³,
ariyantika.5233151014@mhs.unimed.ac.id⁴, hanifahm.5233151022@mhs.unimed.ac.id⁵, hutriami.5233351012@mhs.unimed.ac.id⁶,
lailitanzila.5231151012@mhs.unimed.ac.id⁷

Abstract

The development of Artificial Intelligence (AI) technology has brought significant changes to the educational process, especially in supporting the development of critical thinking skills in students. This study uses a qualitative approach with a systematic literature review method to analyze various findings regarding the influence of AI in education. The results of the study show that AI has the potential to improve critical thinking skills through the provision of analytical stimuli, adaptive feedback, and the facilitation of active learning that encourages reflection, evaluation, and data-based argumentation. However, excessive use of AI or use without teacher guidance can lead to dependence, reduce creativity, and weaken students' evaluative and independent thinking skills. Therefore, the integration of AI should be balanced with active learning strategies, digital literacy, and pedagogical guidance so that this technology functions as a cognitive partner that strengthens critical thinking processes, rather than as a substitute for students' reasoning.

Keywords: Artificial Intelligence, critical thinking, education, digital literacy, active learning

1. Introduction

The development of artificial intelligence (AI) in recent years has brought about major changes to the learning process at various levels of education [1]. Various applications such as chatbots, virtual tutors, and adaptive learning systems are now being used by students to understand material independently [2]. The use of this technology is known to facilitate access to information and improve learning efficiency because AI is able to provide quick and personalized feedback [3]. However, the use of AI also raises concerns because some students tend to rely on instant answers without conducting in-depth analysis [4]. This condition can create an imbalance in the learning process if the technology is used without adequate guidance from educators [5]. Therefore, it is important to understand how this technology actually affects students' critical thinking skills in the context of modern education [6].

Critical thinking skills are essential for analyzing information logically, objectively, and deeply before making decisions [7]. A number of studies show that AI has the potential to improve these skills by providing analytical stimuli, open-ended questions, and adaptive feedback that encourage students to evaluate information [8]. In addition, several experimental studies have proven that the use of ChatGPT can significantly improve students' critical thinking scores compared to conventional learning methods [9]. Other findings also show that ChatGPT is able to facilitate discussion, clarify concepts, and help students construct data-based arguments [10]. This research shows that AI can be an effective tool when used in active learning designs such as Problem-Based Learning or mathematical problem solving [11]. This indicates that AI has the potential to strengthen higher-order thinking processes when used in a focused and reflective manner in learning activities [12].

Despite its positive potential, several studies have also found that excessive use of AI can reduce students' independence of thought, creativity, and analytical skills [13]. This dependence can arise when users rely on AI results without verifying the information provided [4]. Some students even tend to accept answers without evaluation, thereby weakening their reflective abilities [6]. In addition, there are findings that the influence of AI on critical thinking skills is often insignificant because many other factors are more dominant, such as learning methods, learning motivation, and the role of teachers [14]. Other risks such as plagiarism, decreased social interaction, and information overload are also concerns in the use of AI in educational environments [5]. These findings indicate that the impact of AI is not always positive and is greatly influenced by how the technology is used in learning activities [15].

Based on these findings, the impact of AI technology on critical thinking skills still needs to be studied in greater depth so that it can be used in a balanced and effective manner [1]. A comprehensive understanding is needed to see how AI can support analytical thinking skills while avoiding the risk of technological dependence that can weaken students' cognitive abilities [7]. Therefore, this article aims to review various recent studies on the relationship between the use of AI and the development of critical thinking skills in education [3]. This study is expected to provide a more complete picture of the potential, challenges, and direction of AI utilization in learning in Indonesia [8].

Thus, this study can be a reference for educators and researchers to develop appropriate AI usage strategies to support the strengthening of students' critical thinking skills [12].

2. Literature Review

2.1. Artificial Intelligence (AI) in Education

Artificial Intelligence (AI) is developing rapidly and is beginning to be widely used as an academic tool to improve the quality of learning at various levels of education [7]. This technology provides easy access to a wide range of learning resources, making the process of searching for information faster and more efficient for both students and university students [9]. AI also plays a role in providing automatic feedback that can help students understand the material more deeply without always having to wait for the teacher's explanation [8]. In addition, features such as chatbots and virtual tutors enable more personalized learning because the system is able to adjust the material according to the abilities of each student [12]. AI not only facilitates the learning process, but also plays a role in supporting teachers in analyzing student development, including identifying learning difficulties based on digital activity patterns [2]. This technology helps teachers obtain an objective picture of students' cognitive development so that they can design more relevant and effective learning strategies [3]. AI is also capable of expanding the space for academic interaction by providing learning media that is more interesting, interactive, and adaptive to various learning situations [5]. Thus, the integration of AI technology has become an important part of efforts to modernize education in today's digital era [1].

2.2. Critical Thinking Skills

Critical thinking skills are fundamental skills that students need to be able to analyze information logically and make decisions based on rational considerations [3]. In the context of modern education, critical thinking is very important because students are faced with a rapid and diverse flow of information, making the ability to evaluate the validity of information a primary need [1]. This skill also helps learners develop problem-solving abilities by considering various relevant perspectives [11]. Critical thinking requires the ability to connect information, interpret data, and draw conclusions based on logically accountable arguments [10]. Students who have good critical thinking skills tend to be more independent in evaluating academic issues and do not easily accept information without first reflecting on it [6]. However, the challenges of technological development mean that critical thinking skills need to be continuously developed so that students do not just become passive users but are able to process information in depth [1].

2.3. The Impact of AI Use on Critical Thinking Skills

The impact of AI technology on critical thinking skills has been studied in various research studies, yielding diverse findings [1]. Some studies show that the use of academic chatbots can help students develop their analytical skills and evaluate information through interactions that stimulate the thinking process [12]. Technologies such as ChatGPT can improve students' ability to analyse arguments and draw conclusions based on data, thereby helping them complete academic assignments more critically [11]. However, other studies show that the relationship between AI use and critical thinking skills is not always significant [15]. The use of AI chatbots in thesis writing at Brawijaya University, for example, only contributed 1.7% to students' critical thinking skills, indicating that technology does not automatically improve analytical skills if users are not cognitively active [15]. Other research also found that even though students actively used AI, the empirical improvement in their critical thinking skills remained low because factors such as learning motivation, teaching methods, and the role of educators had a greater influence [14]. Thus, the effectiveness of AI in improving critical thinking skills is largely determined by how users utilise the technology in a reflective and evaluative manner [13].

2.4. The Risk of AI Dependence on Critical Thinking Skills

The uncontrolled use of AI can lead to excessive dependence, which can have an impact on the decline of students' critical thinking skills [5]. Many students tend to use AI only to get instant answers without going through the analysis process, thereby weakening their independence in thinking [6]. This dependence can cause students to be less trained in verifying information and tend to accept answers from AI without testing their accuracy [1]. Other studies show that excessive use of AI also has the potential to reduce students' creativity and evaluative abilities, as learners are no longer accustomed to processing ideas independently [4]. Dependence on technology also has an impact on weakening social interaction in learning because students prefer to interact with the system rather than discuss problems with friends or teachers [2]. In addition, other risks that arise include the misuse of technology in the form of plagiarism, copying content without understanding the thought process behind it, and a decline in academic responsibility [6]. Therefore, the use of AI in education must be guided wisely so as not to weaken the quality of students' critical thinking [3].

2.5. AI as a Support for Improving Critical Thinking

Despite the risks, AI can still be an effective tool for improving critical thinking skills when used in appropriate learning designs [9]. The use of ChatGPT in the Problem-Based Learning model has been proven to increase student engagement in discussions and encourage them to analyse various alternative solutions more critically [9]. AI also helps students understand complex concepts by providing step-by-step explanations and adaptive feedback so that the analysis process becomes more focused [12]. AI also helps students understand complex concepts by providing step-by-step explanations and adaptive feedback so that the analysis process becomes more focused [8]. In the context of digital literacy, AI also strengthens students' ability to critically evaluate digital information through data-based analysis [13]. Thus, when used as a tool for intellectual exploration rather than a source of instant answers, AI can help enrich the learning process by developing critical thinking skills [10].

3. Research Method

This study uses a qualitative approach with a systematic literature review method to analyse the influence of Artificial Intelligence (AI) technology on the development of critical thinking skills in education. The literature review was conducted by searching various academic sources, such as accredited national scientific journals, proceedings, research articles, and scientific documents relevant to the research focus.

The research population includes all scientific articles discussing the application of AI in education and its relationship to critical thinking skills. Sample selection was conducted using purposive sampling techniques with several specific criteria, namely: (1) publications published within the last five years (2020–2025), (2) originating from nationally accredited SINTA journals with a minimum rating of SINTA 5, (3) focusing on the use of AI in the context of education, and (4) containing an analysis of the critical thinking skills of pupils or students. Based on these criteria, 15 articles were obtained that were considered relevant and feasible as a basis for analysis.

The research instrument used documentation, namely the collection of data in the form of written text from selected journal articles. Each article was read carefully, then important information was categorised based on main themes, such as the benefits of using AI in learning, the form of AI's contribution to critical thinking skills, the risks of technological dependence, and empirical results related to the relationship between the use of AI and critical thinking skills. This categorisation process aims to organise the data so that analysis can be carried out systematically.

Data analysis was conducted using content analysis techniques. The stages of analysis included: (1) identification and selection of articles according to criteria, (2) grouping of data based on themes or research variables, (3) interpretation of the relationship between AI use and the development of critical thinking skills, and (4) synthesis of findings from all articles to produce comprehensive conclusions. Through this approach, the study is expected to provide a comprehensive overview of the position of AI as a learning support technology and a factor that has the potential to influence students' critical thinking skills.

4. Results and Discussion

4.1. The Use of AI in Education and Its Impact on the Learning Process

The use of AI in higher education is increasing and has varying effects on students' critical thinking skills [15]. Taufani's research [15] shows that AI contributes only 1.7% to critical thinking skills, so its impact is very low even though the technology is often used in thesis writing. This finding is supported by Firdaus [4] who discovered that the ease of accessing information through AI often causes students to skip the analysis and reflection processes that are actually necessary for critical thinking. A similar condition is also seen in Siallagan's research [6] which confirms a decline in independent thinking due to students' increasing dependence on instant answers from AI. This situation shows that AI more often functions as a technical tool than a medium for developing higher-level reasoning [1]. Therefore, the use of AI needs to be balanced with assignments that encourage students to continue to evaluate and think reflectively independently [8].

Although various studies indicate the risk of dependency, several studies also confirm that AI can contribute positively to the development of critical thinking when used in activities that require deeper analysis [1]. AI has been proven to provide quick feedback and assist in exploring information that can strengthen students' ability to assess and evaluate data [3]. However, these positive impacts still depend on students' ability to verify information and not immediately accept AI answers without filtering [5]. This is reinforced by Siallagan's findings [6] which state that the use of AI without good digital literacy has the potential to reduce evaluative skills and increase plagiarism. Thus, educators need to play an active role in providing guidance so that the use of AI truly supports the students' analysis process, rather than replacing it entirely [10]. Overall, the use of AI will be more effective in improving critical thinking skills if its use is directed towards learning activities that require higher-level thinking [9].

4.2. The Impact of AI on the Development of Critical Thinking Skills

A number of studies show that excessive reliance on AI can reduce students' critical thinking and creativity in completing academic tasks [4]. The study explains that students tend to rely on instant answers from AI without going through the process of review and reflection, which should be an important part of learning. This condition is also reinforced by the findings of Setiyanti & Pipa [5] which note that some students experience a decline in evaluative skills because they are accustomed to receiving information without conducting independent verification. Similar dependence is highlighted by Siallagan [6], who found that uncontrolled use of AI can trigger a crisis in critical thinking and increase the risk of plagiarism. Thus, excessive use of AI not only weakens analytical skills but also hinders students' creativity in developing personal ideas and arguments [8]. Therefore, digital literacy skills are necessary for students to be able to use AI proportionally and maintain the quality of their thinking processes [1].

Several studies have pointed out that the negative impact of AI dependency becomes increasingly apparent when students use this technology without guidance and supervision from educators [5]. This study confirms that students tend to accept information from AI as the ultimate truth, thereby weakening their ability to assess, evaluate, and develop their own solutions [6]. Firdaus [4] also notes that students who rely too heavily on AI show a tendency not to conduct further analysis of the information they obtain. This situation shows that dependence on AI not only reduces critical thinking skills, but also affects creativity, which should develop through the process of independent exploration and experimentation with ideas [10]. Therefore, the use of AI must be accompanied by the habit of reflective thinking so that students retain the ability to assess and process information independently [8]. Overall, uncontrolled dependence can hinder the development of students' thinking skills if it is not balanced with digital literacy and supervision by educators [13].

4.3. The Role of AI in Improving Critical Thinking Skills through Active Learning

A number of studies show that AI can improve critical thinking skills when used in active learning designs such as Problem-Based Learning (PBL) and structured discussions [9]. The study found that the use of ChatGPT in the experimental class resulted in a significant increase in post-test scores compared to the control class that did not use AI. This occurs because AI provides stimuli in the form of questions, clarifications, and alternative solutions that trigger the students' analysis and evaluation processes [11]. In addition, students who use AI in an active learning context tend to be better able to identify problems, draw logical conclusions, and test the accuracy of the information they obtain [12]. Bawarta's research [12] also notes that ChatGPT can function as a virtual tutor that encourages students to examine arguments in greater depth. Thus, the effectiveness of AI in enhancing critical thinking skills depends heavily on the learning model applied, not merely on the use of technology [10].

A number of other findings reinforce that AI plays a significant role in supporting learning that demands higher-order thinking skills when combined with analytical and collaborative strategies [13]. Technologies such as ChatGPT have been shown to help students develop more structured arguments and re-examine ideas through question-based dialogue [8]. Technologies such as ChatGPT have been shown to help students develop more structured arguments and re-examine ideas through question-based dialogue [3]. Rizaldi's research [11] confirms that students with high critical thinking skills actually use AI as a means of reflection to evaluate problem-solving strategies, not just as a source of answers. Thus, AI can function as an intellectual partner that strengthens the learning process when used reflectively and directed towards improving analysis and evaluation. Overall, the integration of AI in active learning enables the optimal development of critical thinking skills when its use is accompanied by guidance from educators and ethical awareness from students [9].

4.4. The Challenges of Using AI in Promoting Critical Thinking Skills in Secondary School Students

The use of AI at the secondary school level poses unique challenges in developing students' critical thinking skills. Syawaudin [2] points out that although AI can increase learning motivation and provide quick feedback, excessive use tends to reduce students' creativity, independence, and metacognitive awareness. Setiyanti & Pipa [5] add that the phenomenon of information overload from ChatGPT makes it difficult for students to critically filter information. This indicates that the availability of abundant information does not always go hand in hand with improved thinking skills. Zesmita & Suryadi [10] emphasise the need for teacher guidance so that AI does not cause students to simply accept information without verification. Thus, the integration of AI must be accompanied by the strengthening of digital literacy and pedagogical guidance to maintain the quality of students' critical thinking.

In addition, the use of AI also poses the risk of dependence on technology as a source of instant answers. This dependence can weaken the reflective and evaluative processes that should be part of critical learning [6]. Syawaudin [2] highlights that unsupervised students have the potential to reduce social interaction and problem-solving skills. This situation emphasises the importance of the teacher's role as a facilitator of digital literacy and an ethical supervisor of AI use. With proper supervision and learning strategies, AI can still be a tool that supports cognitive development. Therefore, the integration of AI in secondary schools must consider the balance between technology, pedagogy, and human involvement.

4.5. AI as a Cognitive Partner in Learning and Digital Literacy Development

AI can serve as a cognitive partner that supports digital literacy and strengthens students' critical thinking skills. Zaini [8] found that AI provides algorithmic dialogue and adaptive feedback that helps learners analyse information more deeply. Harmilawati [13] added that AI facilitates collaborative and personalised learning, thereby improving evaluation and problem-solving skills. However, the effectiveness of AI is highly dependent on teacher supervision to prevent cognitive dependency. AI integration should be directed towards strengthening reflection and analysis, not merely providing instant answers. Therefore, AI can be an effective learning partner if used proportionally and ethically.

In addition, AI also has the potential to increase students' ethical awareness and digital literacy through interactive learning. Zaini [8] shows that AI can stimulate critical analysis when combined with scaffolding strategies from educators. Rizaldi's research [11] supports these findings, showing that ChatGPT helps students identify biases, evaluate information, and develop data-based arguments. Without teacher guidance, AI can actually weaken independent thinking and evaluative skills. Thus, digital literacy and an understanding of the ethics of AI use are an integral part of the learning process. Wise integration of AI allows students to use technology as a tool for cognitive development, not as a substitute for critical thinking.

5. Conclusion

Based on the results of the literature review in this study, it can be concluded that Artificial Intelligence (AI) technology has significant potential in supporting the development of critical thinking skills in students when used appropriately and purposefully. AI is capable of providing analytical stimuli, adaptive feedback, and interactive learning media that encourage pupils and students to evaluate information, construct arguments, and develop solutions reflectively. However, excessive use of AI or use without teacher guidance risks creating dependency, reducing creativity, and weakening students' evaluative abilities and independent thinking skills.

Therefore, the integration of AI in education must be accompanied by active learning strategies, digital literacy, and pedagogical guidance from educators so that this technology functions as a cognitive partner that strengthens critical thinking processes, rather than as a substitute for student reasoning. The proportional use of AI can also expand analytical abilities, encourage critical reflection, and improve digital literacy and ethical use of technology. Thus, AI should be utilised as a learning tool that supports the development of higher-order thinking skills while maintaining the cognitive quality of students in the context of modern education.

References

- [1] K. Yasmin, R. Awal, S. Azzahra, N. Aini, and M. Marwa, "LITERATURE REVIEW : DAMPAK PENGGUNAAN ARTIFICIAL INTELLIGENCE (AI) TERHADAP KEMAMPUAN BERPIKIR," *INSPIRE Innov. Sustain. Pedagog. Res. Educ.*, vol. 1, no. 1, pp. 142–150, 2025.
- [2] I. Syawaudin, D. Rizqia, S. Yumna, and A. Wulandari, "Peran AI Terhadap Perkembangan Kognitif Peserta Didik DI Sekolah Menengah Atas (SMA)," *JUMI J. Multidisiplin Ilmu*, vol. 1, no. 1, pp. 195–206, 2025.
- [3] Ratnasari, M. Zabetta, and F. Z. Sholeha, "Pengaruh Artificial Intelligence (AI) Terhadap Kemampuan Berfikir Kritis Matematis Siswa," *Algoritma. J. Mat. Ilmu Pengetah. Alam, Kebumihan dan Angkasa*, vol. 3, no. 1, pp. 68–76, 2025, doi: <https://doi.org/10.62383/algoritma.v3i1.355>.
- [4] J. A. Firdaus, R. I. Ummah, R. R. Aprialini, A. Fithriyyah, Mahsusi, and A. Faizin, "Ketergantungan Penggunaan Kecerdasan Buatan (AI) pada Tugas Akademik Mahasiswa Terhadap Kemampuan Berpikir Kritis dan Kreatif," *Didakt. J. Kependidikan*, vol. 14, no. 1, pp. 1203–1214, 2025.
- [5] A. A. Setiyanti and S. Pipa, "Implikasi Ketergantungan Siswa terhadap Penggunaan Chat GBT sebagai Alat Bantu Pembelajaran dalam Pendidikan di Era Digital," *JIP J. Ilm. Ilmu Pendidik.*, vol. 8, no. 3, pp. 3481–3487, 2025.
- [6] J. A. S. Siallagan, T. A. P. Yuya, S. Arshyara, and Perawati, "Penggunaan Kecerdasan Buatan AI Mengakibatkan Krisis Pemikiran Kritis Pelajar dalam Dunia Pendidikan Indonesia," *J. Pendidik. Tambusai*, vol. 8, no. 3, pp. 47679–47683, 2024.
- [7] M. Cholvistaria and A. Gunawan, "Pengaruh artificial intelligence (AI) terhadap Berpikir Kritis Mahasiswa," *J. Progr. Stud. Adm. Pendidik.*, vol. 5, no. 1, pp. 1–8, 2025, doi: <https://doi.org/10.24127/poace.v5i1.8155>.
- [8] M. Zaini, Iskandar, M. Wardani, and M. Gina, "INTEGRASI KECERDASAN BUATAN (AI) DALAM PEMBELAJARAN: DAMPAKNYA PADA LITERASI DIGITAL DAN BERPIKIR KRITIS SISWA," *Maulana Atsani J. Pendidik. Multidisipliner*, vol. 1, no. 4, pp. 151–157, 2025.
- [9] K. A. Hartono, Budiyono, and Y. Harmawati, "Pengaruh Penggunaan ChatGPT Untuk Pengembangan Berpikir Kritis Pada Mata Pelajaran Pendidikan Pancasila di SMK Trisakti Ngawi," *Semin. Nas. Sos. Sains, Pendidikan, Hum.*, vol. 4, no. 2, pp. 245–252, 2025.
- [10] Zesmita and A. Suryadi, "PENERAPAN AI (CHATGPT) UNTUK MENINGKATKAN KEMAMPUAN BERPIKIR KRITIS SISWA," *Media Ris. Bisnis Manaj. Akunt.*, vol. 1, no. 3, pp. 92–100, 2025, doi: <https://doi.org/10.71312/mrbima.v1i3.541>.
- [11] M. Rizaldi, P. Sasalia, and Pancarita, "EFEKTIVITAS CHATGPT UNTUK MENDORONG BERPIKIR KRITIS MAHASISWA DALAM MENYELESAIKAN MASALAH ALJABAR," *EDU-MAT J. Pendidik. Mat.*, vol. 12, no. 1, pp. 168–181, 2024.
- [12] W. Bawartaa, Faradikab, and I. U. Sari, "ChatGPT sebagai Tutor Virtual : Dampaknya terhadap Kemampuan Critical Thinking," *JISKA J. Sist. Inf. Dan Inform.*, vol. 3, no. 2, pp. 101–105, 2025.
- [13] Harmilawati, Rifqatussa'diyah, P. Amalia, H. A. Majid, and I. A. S. Sahrah, "Peran Teknologi AI dalam Pengembangan Kemampuan Berpikir Kritis Mahasiswa," *SENTIKJAR*, vol. 3, pp. 26–31, 2024, doi: [10.47435/sentikjar.v3i0.3134](https://doi.org/10.47435/sentikjar.v3i0.3134).
- [14] C. Vernanda, V. C. Dewi, and W. E. Jayanti, "PENGARUH ARTIFICIAL INTELLEGENCE (AI) TERHADAP KETERAMPILAN BERFIKIR KRITIS PELAJAR ATAU MAHASISWA," *J. Inf. Syst. Manag. Digit. Bus.*, vol. 2, no. 4, pp. 346–357, 2025.
- [15] Q. A. Taufani, U. Hariyanti, and A. Suharsono, "Analisis Pengaruh Penggunaan AI Chatbot terhadap Kemampuan Berpikir Kritis Mahasiswa Fakultas Ilmu Komputer Universitas Brawijaya dalam Penyusunan Skripsi," *J. Pengemb. Teknol. Inf. dan Ilmu Komput.*, vol. 9, no. 10, pp. 1–13, 2025.