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STRENGTHENING STUDENTS' READING LITERACY AND CRITICAL THINKING AS AN ADAPTIVE STRATEGY TO THE DEVELOPMENT OF ARTIFICIAL INTELLIGENCE IN THE DIGITAL AGE: A LITERATURE STUDY

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Abstract

Research on the development of artificial intelligence (AI) in education has substantial implications for the learning process, particularly in strengthening students' reading literacy and critical thinking skills. A number of studies show that the unguided use of AI can trigger technological dependence, reduce the intensity of deep reading, and lower the quality of information analysis and evaluation. This condition creates an urgent need to design adaptive strategies that ensure the use of AI continues to support the development of students' cognitive capacities. This study aims to: (1) analyze the impact of AI development on reading literacy and critical thinking skills; (2) identify the urgency of strengthening these two competencies as adaptive mechanisms in the digital age; and (3) formulate an integrative AI-aware Literacy & Critical Thinking Skills model for learning at the elementary to secondary levels. The research method used a systematic literature review (SLR) with a search of national and international articles through Google Scholar, DOAJ, SINTA, and open repositories, selected based on the inclusion criteria of publication year 2018-2025, topic relevance, and full access. The results of the study show that reading literacy and critical thinking are important foundations in filtering, assessing, and verifying information generated by AI. The resulting integrative model positions AI as an augmentation tool that strengthens the processes of reading, analysis, and reflection, rather than as a substitute for cognitive activities. These findings have implications for educators and policymakers to design AI-based learning innovations that maintain academic integrity and develop students' higher-order thinking skills.

Abstrak

Perkembangan kecerdasan buatan (AI) dalam pendidikan memiliki implikasi substansial terhadap proses pembelajaran, khususnya dalam memperkuat kemampuan literasi membaca dan berpikir kritis siswa. Sejumlah penelitian menunjukkan bahwa penggunaan AI tanpa bimbingan dapat memicu ketergantungan teknologi, mengurangi intensitas membaca mendalam, dan menurunkan kualitas analisis dan evaluasi informasi. Kondisi ini menciptakan kebutuhan mendesak untuk merancang strategi adaptif yang memastikan penggunaan AI terus mendukung pengembangan kapasitas kognitif siswa. Penelitian ini bertujuan untuk: (1) menganalisis dampak perkembangan AI terhadap kemampuan literasi membaca dan berpikir kritis; (2) mengidentifikasi urgensi penguatan kedua kompetensi ini sebagai mekanisme adaptif di era digital; dan (3) merumuskan model Literasi & Kemampuan Berpikir Kritis yang integratif dan sadar AI untuk pembelajaran di tingkat sekolah dasar hingga menengah. Metode penelitian yang digunakan adalah tinjauan literatur

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sistematis (SLR) dengan pencarian artikel nasional dan internasional melalui Google Scholar, DOAJ, SINTA, dan repositori terbuka, yang dipilih berdasarkan kriteria inklusi tahun publikasi 2018-2025, relevansi topik, dan akses penuh. Hasil penelitian menunjukkan bahwa literasi membaca dan berpikir kritis merupakan fondasi penting dalam menyaring, menilai, dan memverifikasi informasi yang dihasilkan oleh AI. Model integratif yang dihasilkan menempatkan AI sebagai alat tambahan yang memperkuat proses membaca, analisis, dan refleksi, bukan sebagai pengganti aktivitas kognitif. Temuan ini memiliki implikasi bagi pendidik dan pembuat kebijakan untuk merancang inovasi pembelajaran berbasis AI yang menjaga integritas akademik dan mengembangkan keterampilan berpikir tingkat tinggi siswa.

INTRODUCTION

The development of artificial intelligence (AI) has entered the realm of education on a massive scale and is now used in almost all aspects of life: AI can support personalized learning, automated assessment, and learning analytics that help teachers design appropriate learning interventions (UNESCO, 2025). However, the rapid advancement of AI also poses policy and pedagogical challenges, namely that technology is moving faster than regulatory frameworks and teachers' capacity to guide its use, thereby potentially creating risks in everyday learning practices (OECD, 2021). Furthermore, the application of AI at the K-12 level tends to encourage rote learning and low-level thinking skills, which has the potential to undermine the development of students' critical thinking and exacerbate inequalities in access to digital literacy (Pennsylvania Advisory Committee, 2025).

One of the changes in learning patterns observed is a shift towards instant information retrieval, as students tend to rely on answers generated by generative models or AI chatbots, which minimizes the process of deep reading and critical reflection that has traditionally supported meaningful learning (Zhai, 2024). This dependence has the potential to reduce reading literacy competencies, especially critical reading and source verification skills, because AI can provide convincing text without guaranteeing its truth or validity; the phenomena of information overload and machine-generated text exacerbate the risk of accepting raw information without verification (Shahrzadi, 2024; Hong, 2020). Furthermore, over-reliance on AI can reduce students' sense of ownership of the learning process and hinder critical engagement, even though AI has the potential to be a thinking partner that enhances

deep understanding when combined with traditional methods (Microsoft Education, 2025). Critical thinking skills, which include analyzing arguments, evaluating evidence, making inferences, and reflecting, are key competencies for assessing AI outputs and preventing misuse or shortcut learning (Facione, 2013).

Recent empirical studies and literature reviews show the duality of AI: on the one hand, AI supports efficiency and personalization of learning; on the other hand, the use of AI without digital literacy or AI and pedagogical guidance can weaken higher-order thinking processes and academic integrity (Garzón, 2025; Adamakis, 2025). The integration of AI in modern education also shows that while AI supports personalized learning and creativity, the risk of over-reliance can reduce students' independent analysis, with ethical issues such as data privacy and fact-checking being key factors in the development of critical thinking (Dziubanovska & Maslii, 2025). Furthermore, AI literacy and 21st-century skills, including critical thinking, play a significant role in students' acceptance of generative AI, explaining up to 29.9% of the variance in acceptance and emphasizing the need to strengthen the curriculum for ethical applications (Salhab & Aboushi, 2025).

To respond to these challenges, education researchers emphasize the importance of strengthening AI literacy and reading literacy integrated with critical thinking training: an AI literacy framework developed for the basic level shows that ethical aspects, source evaluation, and reflective abilities must be taught together so that students become responsible and critical AI users (Yim et al., 2024).

Although the literature on the impact of AI on learning is growing, there is a research gap: few studies systematically examine the integration of reading literacy and critical thinking skills as adaptive strategies specific to the context of AI use in schools (a gap that this literature study will fill). The existing empirical support tends to separate the two domains (digital/AI literacy and critical thinking) or is limited to institutional case studies without integrated pedagogical models (Garzón, 2025; Zhai, 2024).

To conclude the introduction, the author focuses on the objectives of this study, which are: (1) to analyze the impact of AI development on students' reading literacy

and critical thinking competencies; (2) to assess the urgency of strengthening these two competencies as adaptive mechanisms in the context of AI use; and (3) to formulate an integrative model of AI-aware literacy & critical thinking skills that can be applied in elementary to secondary school pedagogical practices. (This study uses a systematic literature review approach that examines national/international journals and international organization reports).

RESEARCH METHOD

This study uses a systematic literature review (SLR) approach to analyze literature related to reading literacy, critical thinking, and the use of AI in education. The SLR approach was chosen because it allows for the systematic search, selection, and synthesis of many previous studies, as well as providing a comprehensive map of relevant study results (Dhamayanti, 2024).

The research data sources included articles from national and international journals, with priority given to Indonesian journals, particularly SINTA-indexed journals (levels 2–6), as well as academic reports and open access publications. This approach is in line with practices in educational literature studies in Indonesia, where researchers collect literature from databases such as Google Scholar, DOAJ, SINTA, and other national journal portals (Singgih, Dewanti & Ibrahim, 2024).

The data collection procedure was carried out as follows:

1. Keyword selection: several main keywords used included reading literacy, digital literacy, critical thinking, artificial intelligence in education, AI literacy, digital learning media, and digital learning literacy. This approach resembles the procedure in SLR research in Indonesian journals. (Aina Nabila, Aziz & Suprapto, 2022)
2. Literature searches were conducted through online databases such as Google Scholar, DOAJ, national journal portals (SINTA), and open journal repositories similar to the pattern described in the national literature review on literacy and education. (Nugrahani, Septiari & Widayati, 2024)
3. Article selection was based on inclusion and exclusion criteria:

a. Inclusion criteria: articles published between 2018 and 2025, fully accessible (open access), relevant to the topics of reading literacy, digital literacy, critical thinking, or the use of media/digital learning/AI in education, and empirical, theoretical, or literature review articles.
b. Exclusion criteria: non-scientific articles (opinions, news), articles that are not fully available, articles that discuss topics outside the context of formal education, or articles that do not explicitly discuss literacy or critical thinking. This criteria approach is similar to previous national literature research (Pertiwi & Juansah, 2024).

4. The article screening and selection procedure followed a systematic flow: initial identification, screening of titles and abstracts, full-text selection, and finally selection of the final articles for analysis, as was done in SLR in educational research in Indonesia. (Arrofi', 2023)

After selection, the selected articles were analyzed using reduction, categorization, and thematic synthesis techniques. First, data reduction was carried out by extracting the core findings from each article; second, categorization based on themes such as reading literacy, digital literacy, critical thinking, media/AI use, and learning impact; third, thematic synthesis to consolidate the results and formulate conceptual conclusions. This method is similar to the practice in Indonesian educational literature studies (EDUSAINTEK, 2022).

With this method, the study is expected to produce comprehensive and relevant literature mapping, both from a global and local context, so that an integrative model of reading literacy and critical thinking towards AI development can be designed based on solid empirical and theoretical evidence.

RESULTS AND DISCUSSION

A. The Impact of AI Development on Students' Literacy and Critical Thinking Skills

A literature review shows that the integration of Artificial Intelligence (AI) in the learning process can have serious consequences for reading literacy and

critical thinking skills if used without adequate guidance and literacy. For example, in a literature review of junior high school students, it was found that AI-based feedback does not always guarantee the development of critical thinking if students are too dependent on automatic output, because even though adaptive feedback is available, the process of internalizing evaluation often lacks development (Sari, Nurjanah & Rachman, 2023).

Empirical research at the university level also shows that the use of AI-based media without strengthening digital and reading/critical literacy can lead to a decline in the quality of deep and analytical reading skills, even though technical abilities may improve (Hassen, 2025).

Furthermore, there are findings that in the context of Indonesian primary and secondary education, the elements of digital literacy + AI can significantly influence critical thinking: for example, research at the University of Jambi found that AI and digital literacy together contribute significantly to students' critical thinking skills (Putri, Arpizal & Ulfah, 2024).

However, if AI is only used as a "shortcut" tool without deep reading and source analysis activities, this risks creating instant learning patterns, which can weaken higher-level cognitive processes such as synthesis, evaluation, and reflection. Consistent with this, a literature review on AI in education warns of the potential for technological dependence and a shift in the role of teachers, which could accelerate "cognitive poverty" if not balanced with literacy and ethics (Palma, 2025).

Students who frequently use AI to summarize texts tend to experience a decline in their ability to understand context, identify main ideas, and make advanced inferences. Dependence on automatic summaries reduces exposure to the original text, preventing the cognitive process of deep reading from developing optimally.

Students' dependence on AI leads to decreased motivation to learn, reduced effort to seek alternative sources, and a decline in critical thinking skills because students tend to be lazy in reading and prefer instant results from AI. AI

dependence also creates a decline in collaboration and social interaction among students because tasks that are usually done through discussion are now completely left to AI (Nasution, 2025).

A large study of Indonesian Language Education students shows a significant negative correlation between dependence on AI and academic reading ability ($r = –0.370$; $p = 0.020$), indicating that the higher the dependence, the lower the cognitive ability to understand academic texts independently. This decline is exacerbated by the tendency of students to copy AI answers without adaptation or verification, which ultimately hinders the processes of analysis, interpretation, and reflection as important cognitive activities in academic reading (Pudjiastuti, et. al., 2025).

Thus, the development of AI in education not only brings opportunities but also real risks to students' reading literacy and critical thinking if used without control, guidance, and strong digital literacy.

B. The Importance of Strengthening Reading Literacy as an Information Filter

One of the main conclusions from the reviewed literature is that reading literacy in a digital context is very important in helping students analyze, evaluate, and verify information, including that generated by AI. Studies in Indonesia on AI-based learning in language lessons show that when students are given AI-based media but are still guided to read deeply and evaluate content, there is an increase in digital literacy and text comprehension skills (Dewi, 2025).

A study on the development of AI-based "digital storytelling" media for university students shows that interaction with narratives and evaluative tasks strengthens reading habits, content comprehension, and critical reflection, which are important foundations for deep literacy in the digital age (Tarigan, Hasibuan & Nurmayana, 2023).

Students with moderate to high levels of AI dependence have low academic reading skills (mean 47.74), indicating that they are not engaged in the deep reading process necessary to build conceptual knowledge independently. In addition, many students are starting to abandon books and journals because they

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feel that AI can provide instant summaries, and this phenomenon directly reduces critical reading skills. This reinforces that reading literacy is an important foundation for facing the AI era, where students need the ability to assess the validity, depth, and credibility of information (Pudjiastuti, et. Al, 2025).

Reading literacy learning must continue to place original texts as the main source. AI can be used as a supporting tool, but it should not replace reading activities because it has been proven to reduce students' literal, interpretive, and evaluative comprehension. Thus, reading literacy is no longer just a matter of technical ability to read texts, but also the ability to evaluate and interpret, which is an important tool for students to filter information, distinguish between valid and manipulative information, and prevent the spread of misinformation.

C. Strengthening Critical Thinking as a Control Mechanism for AI

According to Pudjiastuti, in addition to reading literacy, literature shows that critical thinking skills are an important control mechanism in the use of AI. Several studies in Indonesia show that the use of AI accompanied by digital literacy can significantly improve the critical thinking skills of students (Putri et al., 2024).

Research on students in educational technology programs shows that AI can trigger the processes of analysis, evaluation, and reflection, especially when used in a learning environment that supports adaptive interaction and personal feedback, i.e., when AI functions as a tool to aid thinking, not replace it (Andrian, Widianti & Rachma Wati, 2024).

However, there is a major challenge: many students simply copy AI answers without evaluation, so their critical thinking skills do not develop because there is no cognitive process involved in understanding academic texts or completing assignments. There is even a tendency for plagiarism and a loss of academic integrity due to the use of AI without adequate pedagogical guidance (Pudjiastuti, et. Al, 2025).

Therefore, strengthening critical thinking becomes a control mechanism for AI use. Students must be guided to question the relevance, accuracy, and

reasoning behind AI outputs, so that AI use continues to stimulate higher-level thinking activities rather than hindering them.

D. Strategies for Strengthening Reading Literacy and Critical Thinking

Qualitative research Strategies to strengthen reading literacy and critical thinking skills in the era of AI development need to be designed comprehensively so that the use of technology does not hinder the cognitive abilities of students and university students, but rather becomes a means to enrich their learning activities. Based on the results of literature synthesis and findings from the documents you uploaded, the first strategy that has proven effective is the use of AI-based interactive digital media, such as digital storytelling, because this approach encourages students to interact with texts in depth through visual narratives, reflective questions, and the process of story reconstruction. The use of digital storytelling has been shown to increase reading interest, deep understanding, and reflective thinking through the integration of text, multimedia, and evaluative activities that learners must perform (Tarigan, Hasibuan & Nurmayana, 2023). It can be concluded that the use of AI media not only functions as a technical aid but also as a catalyst for analytical activities that underlie critical thinking skills.

Furthermore, language literacy-based learning that utilizes AI as a support, rather than as the main source, has also proven effective in improving text comprehension and digital literacy. Dewi (2025) shows that students who utilize AI to clarify concepts, review material, or obtain additional examples, but are still required to read the original text and evaluate the content, experience an increase in digital literacy as well as critical thinking skills.

Students must be provided with learning that maintains a balance between utilizing AI and preserving manual reading cognitive activities, so that deep reading skills are not replaced by instant AI summaries. Additionally, the habit of students copying AI answers without analytical processes necessitates strategies to strengthen ethical-academic literacy, such as comparing AI answers with

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scientific literature, citing sources correctly, and developing awareness of plagiarism (Pudjiastuti, et al., 2025).

Another crucial strategy is the implementation of a learning model that combines digital literacy, reading literacy, and critical pedagogy. Research by Putri et al. (2024) confirms that critical thinking is strengthened when students are not only exposed to digital technology but also trained to read long texts, evaluate information sources, and construct evidence-based arguments. The second document you uploaded supports this, showing that students who were asked to compare AI answers with academic sources, look for inconsistencies, and identify biases experienced a significant increase in their critical abilities and digital literacy awareness. Such comparative reasoning activities, whether through class discussions or individual assignments, strengthen analytical and evaluative skills, as students no longer position AI as an authority but as an object of evaluation whose validity must be tested.

Analysis- and justification-based tasks are also important strategies for strengthening critical thinking skills. Students involved in reading activities that require re-explanation, argumentative reasoning, and information verification show much better development than students who only rely on AI to generate quick answers without engaging in deep cognitive processes. Thus, learning strategies need to include evaluative components that systematically ask learners to critique, compare, and justify the information they receive, both from texts and from AI. (Pudjiastuti, et. Al, 2025)

Overall, strategies for strengthening reading literacy and critical thinking must be designed so that reading, analysis, and evaluation activities are central to the learning process, not merely additional activities. AI can be used as a supporting tool to enrich understanding, but learning must remain centered on the original text, evaluative tasks, critical discussion, and systematic reflection. With proper framing, AI not only reduces student dependence but can also become a tool that stimulates the reflective, analytical, and critical thinking processes essential for 21st-century learning.

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E. Integration Model: AI-Aware Literacy and Critical Thinking Skills

The AI-aware Literacy & Critical Thinking Skills integration model was developed in response to literature findings and empirical evidence in research documents showing that passive use of AI has the potential to reduce students' reading literacy and critical thinking skills. This model positions AI as a supporting tool that aids the learning process, rather than a substitute for human cognitive processes. The main principle of this model is that AI should function as an augmenter that strengthens, rather than takes over, reading, analysis, and evaluation activities. Findings from your document show that students who rely too much on AI, especially in the form of automatic summaries, experience a decline in their ability to understand the original text, identify main ideas, and make deep inferences because they lose the opportunity to interact directly with the text structure and the author's arguments. Therefore, this integration model emphasizes that reading the original text remains the main foundation for developing literacy and analytical skills.

In the early stages, this model requires basic reading literacy and digital literacy as initial capital for students. They need to understand how AI works, its potential errors and biases, and the ethics of its use. Furthermore, the learning process takes place through a cycle of deep reading that encourages students to interact directly with the text, make annotations, identify arguments, and develop literal, interpretive, and evaluative understanding. The findings in your document confirm that this approach significantly improves the ability to understand and assess information, especially when compared to learning patterns that rely solely on AI summaries or instant answers provided by artificial intelligence systems.

After the direct reading process, AI begins to be used as a tool to reinforce understanding. At this stage, AI is not used to replace the reading process, but only to help clarify concepts, provide additional examples, or explain certain parts that are difficult to understand. However, the use of AI at this stage is still controlled through tasks that require students to compare AI output with the

original text content. This comparison activity is central to the integration model, as research in your document shows that critical thinking skills improve when students actively assess the suitability of AI answers with credible academic sources, identify errors or biases, and provide evidence-based justifications for their evaluations. Tasks like this not only activate higher-order cognitive processes, but also reinforce students' awareness that AI is not a source of absolute truth, but rather a tool that needs to be monitored and evaluated.

The next stage is critical reflection, where students are asked to assess the reliability of AI responses, draw conclusions considering the original source, and discuss the ethical implications of using AI in an academic context. Your document emphasizes that critical reflection is an important aspect in shaping students' argumentative abilities, as this stage allows them to reconstruct their understanding using their own language and justify their analysis based on textual evidence. Structured reflection has been shown to strengthen higher-order thinking skills such as evaluation, in-depth analysis, and information synthesis.

This model produces three main outputs: first, the formation of AI-aware reading literacy skills, namely the ability to integrate understanding of the original text with understanding of how AI works. Second, the development of critical thinking skills, particularly in terms of making judgments, constructing arguments, and verifying information. Third, the formation of ethics and responsibility in the use of AI, namely the ability to understand when AI can be used appropriately and when analytical activities must be carried out independently. Thus, this integrative model positions AI as a tool that can strengthen the quality of learning, as long as its use is framed within activities of deep reading, evaluative analysis, and structured critical reflection.

CONCLUSION

This systematic literature review confirms that the development of artificial intelligence (AI) has dual implications for the learning process, particularly in the development of students' reading literacy and critical thinking skills. Although AI

has the potential to enrich the learning experience through personalization, adaptive feedback, and conceptual understanding support, its use without adequate digital literacy can weaken basic cognitive competencies. Various studies show that dependence on AI, especially the use of automatic summaries or instant answers, has a negative impact on the ability to understand text, analyze arguments, and assess the credibility of information. This condition shows that deep reading and evaluative processes cannot be replaced by AI-based technology.

Research findings also confirm that reading literacy at the literal, interpretive, and evaluative levels is the main foundation for dealing with the rapid flow of information generated by AI systems. Reading literacy functions as a cognitive filter that allows students to verify the accuracy, consistency, and bias of information presented digitally. On the other hand, critical thinking skills act as a control mechanism that directs students to question, test, and compare AI outputs with credible academic sources. The collaboration of these two competencies is an important prerequisite in building responsible AI literacy competencies.

A synthesis of the literature shows that strategies to strengthen reading literacy and critical thinking need to be designed to complement each other. Activities such as reading original texts, evaluating sources, comparative discussions between AI outputs and scientific literature, and the application of justification-based tasks have been proven to increase the depth of analysis and quality of student understanding. The integrative model developed in this study, namely AI-aware Literacy & Critical Thinking Skills, positions AI as an augmentation tool that enriches the cognitive process, not as a substitute. The model recommends learning stages that include deep reading, text-based analysis, targeted use of AI, critical comparison, and academic ethical reflection.

Overall, the study's findings confirm that strengthening reading literacy and critical thinking are crucial adaptive strategies for ensuring the responsible and constructive use of AI in primary to secondary education. The application of

this integrative model can serve as a foundation for educators and policymakers in designing AI-based pedagogical innovations that are not only oriented towards technological efficiency, but also towards developing students' intellectual capacities. Thus, learning in the digital age can maintain academic integrity and high-level thinking skills as the core of 21st-century education.

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