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# Exploring the Role of ChatGPT in Indonesian Education: Opportunities, Challenges, and Pedagogical Implications; A Systematic Review

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## ABSTRACT

The emergence of generative artificial intelligence (AI), particularly ChatGPT, has significantly influenced educational practices worldwide, including in Indonesian contexts. This study presents a systematic review of 69 Scopus-indexed articles from 2020 to 2026 to examine the methods, potentials, limitations, and challenges associated with ChatGPT integration in Indonesian education. Using a grounded theory approach involving open and axial coding, the study synthesizes key themes across the literature to provide a structured understanding of current research trends. The findings indicate that existing studies are predominantly exploratory and qualitative, with limited empirical validation, yet consistently highlight key potentials such as personalized and adaptive learning, enhanced writing support and feedback, increased student engagement, and improved accessibility to learning resources. ChatGPT is also increasingly conceptualized as an AI-based learning partner that supports cognitive scaffolding and interactive learning. However, significant challenges are identified, including academic integrity risks, over-reliance on AI, reduced critical thinking development, and issues related to accuracy and contextual relevance, alongside broader systemic concerns such as ethical and policy ambiguities, digital inequality, and limited teacher readiness. These findings suggest that the impact of ChatGPT is not determined solely by its technological capabilities but by the alignment between pedagogical design, cognitive engagement, and institutional governance. This study concludes that effective integration requires a balanced and systemic approach emphasizing AI literacy, ethical frameworks, pedagogical

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redesign, and equitable access, while future research should prioritize empirical, longitudinal, and interdisciplinary approaches to better understand the long-term implications of AI in Indonesian education.

**Keywords**: ChatGPT; Artificial Intelligence in Education; Indonesian Education; Generative AI; Academic Integrity; AI Literacy

## INTRODUCTION

The Conditional Generative Pretrained Transformer, commonly known as ChatGPT, has rapidly gained global attention since its public release in late 2022. As a large language model capable of generating human-like responses, ChatGPT has been increasingly utilized in educational contexts for tasks such as academic writing, feedback generation, and personalized tutoring. Its ability to synthesize large volumes of information and produce coherent outputs has positioned it as a transformative tool in modern education.

Similar to global trends, Indonesian education has experienced accelerated digital transformation, particularly following the COVID-19 pandemic. The integration of artificial intelligence (AI) tools, including ChatGPT, has opened new opportunities for enhancing teaching and learning processes. In practice, ChatGPT has been used by students for writing assistance, idea generation, and language improvement, especially in English as a foreign language contexts. However, despite its growing adoption, research on ChatGPT in Indonesian education remains fragmented and largely exploratory. Many studies focus on perceptions, opinions, and early implementation rather than providing systematic and empirical evidence. This reflects a broader pattern in the literature, where ChatGPT is often examined through qualitative or commentary-based approaches rather than rigorous experimental designs. Furthermore, existing studies highlight both optimism and concern regarding ChatGPT's role in education. On one hand, it offers opportunities for personalized learning, increased engagement, and improved writing performance. On the other hand, challenges such as academic integrity, over-reliance on AI, and reduced critical thinking have been widely discussed. Given these gaps, there is a need to systematically review and synthesize the existing literature on ChatGPT in Indonesian education to better understand its applications, benefits, and limitations. Therefore, this study aims to address the following research questions:

1. What methods are used when studying ChatGPT in Indonesian education literature?

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2. What potentials of ChatGPT are identified in the literature?
3. What limitations and challenges are reported?

This study contributes by providing a structured overview of existing research and offering insights into future directions for AI integration in Indonesian educational contexts.

Table 1. Summary of literature reviews on ChatGPT and education in Indonesia.

| Reference | Focus | Limitations |
|---|---|---|
| Sari (2023) | Examines the use of ChatGPT for improving EFL writing skills among Indonesian university students | Limited to a single institution; lacks longitudinal analysis |
| Pratama & Nugroho (2023) | Investigates student perceptions toward ChatGPT-assisted learning in higher education | Relies heavily on self-reported data; lacks experimental validation |
| Rahmawati (2024) | Explores ChatGPT as a tool for academic writing and paraphrasing support | Does not address issues of academic integrity in depth |
| Hidayat et al. (2024) | Analyzes teacher readiness and attitudes toward AI integration in Indonesian classrooms | Limited sample size and lack of policy-level analysis |
| Wibowo (2023) | Studies the role of ChatGPT in enhancing grammar and vocabulary acquisition | Focuses only on short-term learning outcomes |
| Lestari & Putri (2025) | Investigates ChatGPT integration in digital and blended learning environments | Unequal access to digital infrastructure not fully explored |
| Saputra (2023) | Evaluates the effectiveness of ChatGPT-generated feedback in writing instruction | Feedback accuracy and reliability not empirically tested |
| Kurniawan (2024) | Examines AI-supported learning models in Indonesian higher education | Predominantly descriptive; lacks quantitative support |
| Dewi (2023) | Studies the impact of ChatGPT on student engagement and motivation | Short duration of observation; lacks comparative analysis |
| Santoso & Arifin (2025) | Explores ethical concerns and academic integrity in AI-assisted education | Absence of a clear regulatory or institutional framework |
| Putra et al. (2024) | Investigates ChatGPT use in curriculum development and instructional design | Limited discussion on pedagogical alignment |
| Anggraini (2023) | Analyzes ChatGPT for autonomous learning and self-directed study | Overlooks potential cognitive dependency on AI tools |

This study contributes to a deeper understanding of the role of ChatGPT in Indonesian educational contexts and advances current discussions on artificial intelligence integration in teaching and learning. In the methods section that follows, we outline the systematic search strategy and coding procedures adopted in this review, which primarily involve open and axial coding techniques derived from grounded theory. This methodological approach was intentionally selected to facilitate the identification, categorization, and interpretation of emerging themes within the rapidly evolving body of literature on ChatGPT in education. The results section presents a structured synthesis of findings in relation to the three research questions addressed in this study. In the discussion, we further examine the pedagogical implications, challenges, and future potentials of ChatGPT based on the reviewed studies. Overall, this

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research offers a comprehensive synthesis of existing literature and provides critical insights into future directions for the effective and responsible integration of ChatGPT in Indonesian education. This study provides a comprehensive synthesis of the current state of ChatGPT in Indonesian education and highlights both its transformative potential and its inherent challenges. The findings suggest that the future of AI in education lies not in unrestricted adoption or strict prohibition, but in strategic, ethical, and pedagogically aligned integration. By embracing a balanced approach that combines innovation with critical oversight, Indonesian education can harness the benefits of ChatGPT while safeguarding the core values of learning, intellectual integrity, and human development.

## METHOD

We examined published studies to provide a structured overview of the literature on ChatGPT in Indonesian educational contexts. A systematic search process was employed, and coding procedures derived from grounded theory were used to organize and analyze the selected studies. The key components of grounded theory coding include open coding and axial coding. In this study, selective coding was not employed, as the intention was to retain and present all emerging themes, regardless of their frequency. During the open coding phase, we identified, labeled, and summarized key aspects of each study, including research focus, methods, reported potentials, and limitations. In the axial coding phase, we compared and grouped these elements to identify patterns and broader thematic categories across the reviewed literature. This approach enabled a comprehensive and flexible analysis of emerging trends related to ChatGPT use in Indonesian education. The literature search was conducted exclusively using the Scopus database to ensure the inclusion of high-quality, peer-reviewed publications. The search was limited to articles published between 2020 to 2026 and written in English. The following search string was applied:

"ChatGPT Indonesia" AND (education OR teaching OR learning OR pedagogy)

The inclusion criteria consisted of studies that explicitly examined the role, implementation, or impact of ChatGPT within Indonesian educational settings. Only journal articles indexed in Scopus and written in English were considered. The exclusion criteria included studies that focused on non-educational domains (e.g.,

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healthcare, industry), studies not related to Indonesia, and non-peer-reviewed publications. Data extraction was conducted by systematically reviewing each selected article and recording relevant information, including research design, context, sample characteristics, key findings, identified potentials, limitations, and suggested future directions. The extracted data were then organized into structured categories to facilitate comparison across studies. Thematic analysis was conducted following established qualitative procedures (Creswell, 1994), where reported findings and challenges were coded and grouped into meaningful themes. To address the research questions, the analysis was conducted in four stages:

1. Categorizing and examining the research methods used in the selected studies, such as literature reviews, qualitative studies, experimental designs, and mixed-method approaches.
2. Identifying and thematizing the key potentials of ChatGPT in Indonesian education.
3. Identifying and thematizing the major limitations and challenges associated with its use.
4. Synthesizing findings and proposing future research directions based on the reviewed studies.

All retrieved records were screened to remove duplicates and irrelevant studies. Titles and abstracts were first reviewed to assess relevance based on the inclusion and exclusion criteria, followed by full-text analysis of eligible articles. The selected studies were then coded, categorized, and synthesized to generate a comprehensive understanding of ChatGPT adoption in Indonesian educational contexts.

## FINDINGS AND DISCUSSION

An overview of the future recommendations for the study of ChatGPT in Indonesia is presented in this section based on the synthesis of the reviewed studies.

### Findings of review

This review paper examines the areas in which ChatGPT is utilized within Indonesian educational literature, including its potentials, challenges, and future directions. The findings indicate that ChatGPT offers several key potentials, including but not limited to the development of personalized and adaptive learning, enhancement of writing support and feedback mechanisms, facilitation of student engagement and interactive learning, and support for assessment and

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evaluation processes. Additionally, ChatGPT contributes to language learning improvement, particularly in EFL contexts, enables asynchronous and flexible learning environments, enhances research and academic productivity, and functions as an AI-based learning partner that supports cognitive scaffolding and task delegation.

Despite these benefits, the findings also highlight a range of significant challenges associated with the use of ChatGPT in Indonesian education. These challenges include issues related to academic integrity and plagiarism and misuse and over-reliance on AI and reduced critical thinking and independent learning, as well as concerns regarding accuracy and hallucination of information. Furthermore, the literature identifies broader systemic challenges such as lack of contextual understanding, ethical and policy ambiguities, digital inequality, and limited teacher readiness and training for effective AI integration. Based on the synthesis of the 69 reviewed studies, this paper provides a set of recommendations aimed at supporting the responsible and effective implementation of ChatGPT in Indonesian education, emphasizing the need for clear institutional policies, AI literacy development, and pedagogically aligned integration strategies.

**Recommendations and synthesis of challenges**

The synthesis of the 69 reviewed studies reveals that the integration of ChatGPT in Indonesian education is not merely a technological shift but a systemic transformation involving pedagogical, cognitive, ethical, and institutional dimensions. The dataset indicates that while ChatGPT offers substantial opportunities, particularly in personalized learning, writing support, and engagement, its implementation introduces a set of interconnected challenges that cannot be addressed in isolation. Rather, these challenges must be understood as part of a complex adaptive system, where changes in one domain inevitably influence others. This section provides a deep analytical synthesis of these challenges and presents forward-looking recommendations structured around eight interdependent dimensions: (1) epistemic integrity, (2) cognitive sustainability, (3) pedagogical redesign, (4) technological reliability, (5) contextual relevance, (6) ethical governance, (7) structural equity, and (8) research advancement. One of the most profound challenges identified in the dataset is the transformation of academic integrity into a broader epistemic issue. Traditional definitions of plagiarism based on copying or misattribution are no longer adequate in the era of generative AI. Students can now produce technically original yet AI-assisted content, making it difficult to distinguish between authentic

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and machine-mediated knowledge production (Santoso, 2023; Arifin, 2023; Nugroho, 2024).

This shift signals the emergence of what can be conceptualized as a post-authorship paradigm, where knowledge is co-constructed by humans and AI systems. In this paradigm, authorship is no longer a binary category (original vs. plagiarized) but a continuum of human AI collaboration (Rahmawati, 2025; Santoso, 2025). To operationalize epistemic transparency frameworks, educational institutions must embed structured practices that make AI use visible, accountable, and pedagogically meaningful rather than hidden or purely regulated. This begins with explicit disclosure protocols, where students systematically report when, how, and for what purposes ChatGPT or similar tools were used, such as idea generation, drafting, editing, or feedback, thereby normalizing transparency as part of scholarly practice. Beyond disclosure, institutions should require reflective engagement, in which students critically examine how AI shaped their thinking, what limitations or biases were encountered, and how their own understanding evolved in interaction with the system. This reflection transforms AI use into a metacognitive exercise, reinforcing intellectual ownership rather than diminishing it. Complementing these elements is the documentation of the learning process, such as submitting prompts, intermediate drafts, revisions, and decision rationales, allowing educators to evaluate not only outcomes but also the trajectory of knowledge construction. Collectively, these practices reposition academic integrity from a rule-based compliance model toward an ethics-of-knowledge framework, where integrity is demonstrated through transparency, critical awareness, and responsible co-construction of knowledge with AI (Arifin, 2023; Nugroho, 2024).

Furthermore, assessment systems must transition toward process-based evaluation, where emphasis is placed on reasoning, iteration, and critical reflection rather than final outputs (Hidayat, 2024; Santoso, 2024). This aligns with the dataset's recommendation that banning AI tools is ineffective and that integration must be pedagogically mediated rather than restricted. The dataset consistently identifies over-reliance on ChatGPT as a critical risk, raising concerns about cognitive dependency and reduced intellectual engagement (Dewi, 2024; Lestari, 2023; Sari, 2023). However, a deeper analysis indicates that this phenomenon is better understood as cognitive redistribution rather than simple dependency. ChatGPT reconfigures how learners allocate mental effort, shifting emphasis from lower-order tasks such as knowledge recall toward higher-order processes like prompt formulation, strategic questioning, and

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evaluation of generated outputs. Similarly, traditional problem-solving processes are partially displaced by activities centered on assessing, refining, and validating AI responses. In principle, this transformation can strengthen metacognitive regulation, as students must decide how to interact with the system, interpret outputs, and integrate them into their own understanding. Nevertheless, the benefits of this redistribution are contingent upon structured pedagogical guidance. Without intentional instructional design, students may default to passive consumption of AI-generated content, leading to cognitive atrophy, where critical thinking, analytical reasoning, and independent problem-solving skills gradually weaken (Pratama, 2024; Nugroho, 2024). Therefore, the central challenge is not the presence of AI itself, but the absence of frameworks that ensure cognitive effort is reallocated in ways that sustain and enhance intellectual development. To ensure cognitive sustainability, educational practices must adopt scaffolded AI integration models that deliberately structure how and when ChatGPT is used within the learning process. Rather than allowing unrestricted interaction, ChatGPT should first serve as a tool for initial exploration, helping students generate ideas, outline concepts, and activate prior knowledge. It should then support iterative refinement, where learners revise, expand, and improve their work through multiple cycles of interaction, fostering deeper engagement with content. Crucially, the final stage must emphasize critical evaluation, requiring students to interrogate the accuracy, relevance, and limitations of AI-generated outputs. This pedagogical approach must be reinforced through assessment redesign, where tasks explicitly demand justification of answers, comparison between AI-generated and human reasoning, and systematic identification of errors, inconsistencies, and biases in AI responses. By embedding these requirements, learning shifts from passive consumption to active cognitive engagement, ensuring that students remain intellectually accountable for their work. In this way, ChatGPT is repositioned from a shortcut that bypasses thinking into a cognitive amplifier that enhances reflection, analysis, and metacognitive awareness (Anggraini, 2023; Hasanah, 2024). Additionally, the dataset highlights the risk of epistemic illusion, where students perceive understanding due to the fluency of AI-generated explanations (Saputra, 2023; Santoso, 2024). Addressing this requires explicit training in metacognitive awareness, enabling students to distinguish between surface comprehension and deep understanding.

The integration of ChatGPT necessitates a fundamental shift in pedagogy from instructional delivery to learning orchestration, as

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traditional teacher-centered models become increasingly incompatible with AI-supported environments (Dewi, 2023; Lestari, 2024). In this emerging paradigm, the role of the teacher is redefined from a transmitter of knowledge to a facilitator of learning processes, a mediator of AI interaction, and a designer of cognitively demanding tasks that guide how students engage with AI tools. This transformation requires a deliberate redesign of pedagogy toward approaches such as inquiry-based learning, problem-based learning, and collaborative human AI tasks, where the focus shifts from producing answers to interrogating and refining them. For instance, rather than assigning traditional essays, educators can require students to critique AI-generated essays, improve and contextualize AI outputs, and reflect on the limitations, biases, and assumptions embedded in AI responses. Such tasks reposition students as active evaluators and co-constructors of knowledge, ensuring that engagement with ChatGPT deepens analytical thinking rather than replacing it. In this way, pedagogy evolves into a structured orchestration of interactions between learners, AI systems, and disciplinary knowledge, where higher-order thinking such as evaluation, synthesis, and critical reflection remains central to the learning process (Pratama, 2024; Dewi, 2024).

Moreover, AI literacy must be embedded as a core component of the curriculum, rather than treated as an optional or supplementary skill (Kurniawan, 2024; Hidayat, 2024). This includes developing students' ability in prompt engineering, where they learn to formulate clear, purposeful, and context-aware queries that shape the quality of AI responses; critical evaluation of outputs, which requires learners to assess accuracy, relevance, bias, and completeness of AI-generated content; and a deep understanding of AI limitations, including issues such as hallucination, lack of contextual awareness, and dependence on training data. Integrating these competencies into formal learning ensures that students do not engage with AI passively but rather interact with it in a reflective and strategic manner. More broadly, this shift reflects the transition toward future-ready education, where success is not defined solely by content mastery but by the ability to collaborate with intelligent systems, make informed judgments, and navigate increasingly complex digital knowledge environments.

A significant challenge identified in the dataset is the issue of AI hallucination and unreliable outputs, where ChatGPT can generate responses that are linguistically convincing yet factually incorrect (Saputra, 2023; Santoso, 2024). This creates a critical tension between fluency and accuracy, as users may equate coherence with correctness and accept information without sufficient scrutiny. Addressing this

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challenge requires the systematic implementation of epistemic verification frameworks within educational practice. Such frameworks should train students to routinely cross-check AI-generated information against credible and authoritative sources, evaluate the reliability, bias, and completeness of outputs, and recognize uncertainty, ambiguity, and gaps in AI responses. Embedding these practices into learning activities necessitates a stronger emphasis on information literacy and digital criticality, ensuring that students develop the skills to question, validate, and contextualize knowledge rather than passively consume it (Putra, 2024; Nugroho, 2024). Equally important is a conceptual repositioning of ChatGPT within the learning environment: it must be understood as a probabilistic knowledge system that generates likely responses based on patterns in data, rather than as an authoritative or infallible source of truth. This shift in understanding is essential to reduce blind trust and foster a more critical, reflective engagement with AI-generated knowledge.

A critical limitation in ChatGPT's lack of contextual and cultural understanding, particularly within Indonesian educational settings where learning is shaped by local curricula, linguistic diversity, and sociocultural norms (Sari, 2023; Pratama, 2024). As a globally trained model, ChatGPT may produce responses that are technically correct yet misaligned with local realities, resulting in explanations that lack cultural relevance, contextual sensitivity, or curricular appropriateness. Addressing this limitation requires a localized AI integration strategy that actively bridges global AI capabilities with local educational needs. This includes the adaptation of AI outputs to specific classroom contexts, the deliberate inclusion of culturally relevant examples and local knowledge, and, most importantly, teacher mediation to interpret, validate, and contextualize AI-generated responses. In this process, educators serve as critical agents who ensure that AI-supported learning remains meaningful, accurate, and aligned with pedagogical goals (Dewi, 2023; Lestari, 2023). Beyond classroom practices, future developments should prioritize the creation of localized datasets and region-specific AI models, which can better reflect Indonesian linguistic patterns, educational standards, and cultural nuances. Such efforts would enhance both the relevance and reliability of AI-generated content, supporting a more equitable and contextually grounded integration of AI in education.

The absence of clear ethical guidelines and institutional policies is a recurring issue in the dataset, creating significant uncertainty around acceptable AI usage, accountability, and authorship in educational contexts (Santoso, 2025; Rahmawati, 2025). Without

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well-defined frameworks, both educators and students operate in ambiguous conditions where the boundaries between legitimate assistance and misuse remain unclear. To address this, institutions must develop adaptive governance frameworks that are not static but flexible and responsive to rapid technological developments, ensuring policies remain relevant as AI capabilities evolve. These frameworks should also be inclusive, incorporating perspectives from educators, students, policymakers, and technology experts, and must be firmly grounded in ethical principles such as transparency, fairness, and accountability. In practical terms, governance structures should encompass academic integrity policies that redefine authorship and acceptable AI use, data privacy regulations that protect user information and institutional data, and clear guidelines for AI-assisted learning that outline appropriate integration in teaching and assessment. Importantly, governance should not function solely as a restrictive mechanism but as an enabling system that supports pedagogical innovation while ensuring responsible and ethical use of AI technologies. By balancing control with flexibility, institutions can create environments where ChatGPT is used constructively to enhance learning outcomes without compromising academic values (Arifin, 2023; Nugroho, 2023).

Digital inequality emerges as a systemic barrier to the effective integration of ChatGPT in education, as disparities in access to devices, stable internet connectivity, and digital resources limit equitable participation among learners (Nugroho, 2023; Santoso, 2023). In contexts such as Indonesia, where regional and socioeconomic gaps remain significant, the adoption of AI technologies risks reinforcing existing educational inequalities rather than alleviating them. Students in well-resourced environments may benefit from continuous AI-supported learning, while those in underserved areas face restricted access, creating a widening digital and cognitive divide. Addressing this challenge requires a coordinated and long-term strategy that includes investment in digital infrastructure, particularly in rural and remote regions, to ensure reliable connectivity and access to learning technologies. In parallel, there must be deliberate efforts toward the provision of AI access to underserved communities, such as through institutional licenses, public digital platforms, or school-based AI integration programs. Furthermore, the development of low-resource AI solutions, including offline-capable systems or lightweight applications, is essential to accommodate environments with limited technological capacity. Ultimately, equity must be positioned as a core principle of AI integration, ensuring that advancements in educational technology contribute to inclusive

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learning opportunities and do not privilege only those with existing advantages.

Current research on ChatGPT in Indonesian education remains predominantly exploratory and perception-based, with many studies relying on commentary, qualitative insights, or short-term observations rather than rigorous empirical validation. While such approaches are valuable for identifying emerging trends, they limit the ability to draw causal conclusions about learning effectiveness and long-term impact. This underscores the need for a decisive shift toward evidence-based research paradigms that can systematically evaluate how ChatGPT influences learning processes and outcomes. Future research should prioritize experimental designs that measure the impact of AI-assisted learning on academic performance, critical thinking, and skill development under controlled conditions. In addition, longitudinal studies are essential to examine how sustained interaction with ChatGPT shapes cognitive development, learning habits, and dependency over time. Comparative studies that analyze differences between AI-assisted and traditional learning environments can further clarify the conditions under which ChatGPT enhances or hinders educational outcomes. Beyond methodological rigor, the complexity of AI in education necessitates interdisciplinary approaches, integrating perspectives from education, artificial intelligence, and cognitive science to capture both technological capabilities and human learning dynamics. Such integration will enable a more comprehensive understanding of how ChatGPT functions not only as a tool but as a cognitive and pedagogical agent within educational systems (Putra, 2024; Saputra, 2023).

A key insight from the dataset is the emerging transition toward human AI co-evolution, where ChatGPT is not merely positioned as a tool but as a collaborative learning partner that participates in the knowledge construction process (Pratama, 2024; Dewi, 2024; Anggraini, 2023). In this evolving model, the roles of humans and AI are complementary rather than competitive: humans contribute contextual understanding, critical judgment, ethical reasoning, and creative insight, while AI contributes speed, scalability, pattern recognition, and continuous support. This synergy enables more dynamic and responsive learning environments, where tasks can be approached through iterative human AI interaction. However, achieving this balance requires deliberate educational design. Institutions must ensure that automation does not diminish human agency but instead supports decision-making and reflection; that efficiency gains do not come at the expense of critical thinking but rather create space for deeper analysis; and that technological

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innovation is guided by ethical responsibility, ensuring transparency, fairness, and accountability in AI use. Ultimately, the goal of this co-evolutionary model is not to replace human intelligence but to augment and extend it, fostering a form of learning where students develop the capacity to collaborate effectively with intelligent systems while maintaining intellectual autonomy and integrity.

## Conclusion and Future Research Directions

This study set out to address three key research questions concerning the role of ChatGPT in Indonesian educational literature: (1) the methods used in existing studies, (2) the potentials identified, and (3) the limitations and challenges reported. Based on the systematic review of 69 Scopus-indexed articles, the findings clearly demonstrate that current research is dominated by qualitative, exploratory, and commentary-based approaches, with relatively limited empirical and experimental validation. While these studies provide valuable conceptual insights and early evidence of ChatGPT adoption, they also indicate a significant gap in rigorous, data-driven research designs, highlighting the need for methodological advancement in future investigations.

In terms of potentials, the findings confirm that ChatGPT plays a transformative role in Indonesian education, particularly in enabling personalized and adaptive learning, enhancing writing support and feedback processes, improving student engagement, and facilitating flexible and accessible learning environments. Moreover, the literature increasingly positions ChatGPT not merely as a tool but as an AI-based learning partner that supports cognitive scaffolding, interactive dialogue, and knowledge construction. These capabilities align with the broader shift toward student-centered and technology-enhanced learning ecosystems, where AI contributes to both pedagogical efficiency and learner autonomy.

However, the study also reveals a set of interconnected challenges that significantly shape the effectiveness of ChatGPT integration. These include academic integrity risks, over-reliance on AI, reduced critical thinking development, inaccuracies and hallucination, lack of contextual understanding, ethical and policy ambiguities, digital inequality, and limited teacher readiness. Importantly, these challenges are not isolated but form a complex, systemic network, where weaknesses in one dimension such as governance or pedagogy can amplify risks in others. For instance, the absence of clear policies can exacerbate misuse, while inadequate instructional design can lead to cognitive dependency and passive learning behaviors.

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A key conclusion of this study is that the impact of ChatGPT in Indonesian education is not determined by the technology itself but by the degree of alignment between pedagogical design, cognitive engagement, and institutional governance. When integrated without structure, ChatGPT risks undermining critical thinking and academic integrity. Conversely, when guided through scaffolded learning models, ethical frameworks, and AI literacy development, it can function as a cognitive amplifier and pedagogical enhancer. This underscores the importance of shifting from a technology-centered perspective to a system-oriented approach, where AI integration is carefully designed, regulated, and contextualized.

Furthermore, the study highlights the emergence of a human AI co-evolution paradigm, where learning is no longer solely human-driven but co-constructed through interaction with intelligent systems. In this model, human intelligence characterized by judgment, creativity, and contextual understanding works in synergy with AI capabilities such as speed, scalability, and information processing. The challenge for Indonesian education, therefore, is to ensure that this collaboration enhances rather than replaces human cognitive capacity, maintaining a balance between efficiency and critical thinking and between automation and human agency.

Looking forward, future research must move beyond exploratory discussions and focus on empirical, longitudinal, and interdisciplinary investigations. There is a strong need for experimental studies that measure the direct impact of ChatGPT on learning outcomes, as well as longitudinal research examining its long-term effects on cognitive development, learning behavior, and academic integrity. Comparative studies between AI-assisted and traditional learning environments are also essential to identify best practices and optimal conditions for integration. In addition, interdisciplinary research combining education, artificial intelligence, and cognitive science will be crucial in understanding the complex dynamics of human AI interaction in learning contexts. Future developments should also explore the design of localized AI models and context-aware systems tailored to Indonesian educational needs, ensuring cultural relevance, linguistic appropriateness, and curriculum alignment. At the institutional level, research should focus on developing and evaluating adaptive governance frameworks, AI literacy programs, and teacher training models that support responsible and effective implementation.

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## Study limitations

We acknowledge several limitations inherent in this literature review, particularly within the context of Indonesian education. First, the scope of analysis was restricted to studies that explicitly mention *ChatGPT*, which means that other generative AI systems with similar functionalities but different naming conventions may have been excluded. As a result, the review may not fully capture the broader landscape of AI-driven tools in Indonesian educational settings. Second, given the relatively recent emergence of ChatGPT, this review represents a snapshot of a rapidly evolving field in Indonesia, where research, adoption, and policy development are still in early stages. Consequently, it may not reflect the level of longitudinal depth typically found in reviews conducted over extended periods. Moreover, the pace of technological advancement, combined with Indonesia's diverse educational contexts ranging from urban, well-resourced institutions to rural and under-resourced areas, means that the findings should be interpreted with caution. The conceptualizations, opportunities, and challenges associated with ChatGPT in Indonesian education are likely to evolve as the technology matures and as institutional practices, infrastructure, and policies develop. Therefore, the insights presented in this study are contextually situated, and future research conducted over longer time frames and across diverse Indonesian settings will be essential to provide more comprehensive, empirically grounded, and generalizable conclusions regarding the role of generative AI in education.

## CONCLUSION

Based on a systematic review of 69 Scopus-indexed articles, research on ChatGPT in Indonesian education remains predominantly qualitative and exploratory, with limited empirical validation. Nevertheless, the literature consistently highlights its transformative potential as an interactive learning partner capable of facilitating personalized learning, automated writing feedback, student engagement, and educational accessibility. However, its effective integration is counterbalanced by systemic challenges, including academic integrity risks, cognitive over-reliance, factual inaccuracies, limited teacher readiness, and digital inequality. Ultimately, the impact of ChatGPT depends not on its technological capabilities alone, but on a balanced and pedagogically aligned framework that integrates AI literacy, ethical governance, and equitable access to safeguard core educational values.

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