

The Role of AI Literacy in University Students' Self-Regulated Learning: A Qualitative Case Study

Erlis Thertina¹, Lengsi Manurung²

^{1,2} Universitas Indraprasta PGRI

*Corresponding Author email: ellenthertina@gmail.com

Abstract

The rapid integration of generative artificial intelligence (AI) into higher education has transformed students' learning practices, yet limited research has explored how AI literacy supports self-regulated learning, particularly within the Indonesian higher education context. This study aimed to explore the role of AI literacy in supporting university students' self-regulated learning through a qualitative case study. The study involved a naturally occurring peer group of five undergraduate students who actively used generative AI in their academic activities. Data were collected through semi-structured interviews, observations, and document analysis and analyzed using thematic analysis. The findings revealed that AI literacy extends beyond technical competence to include critical evaluation, ethical awareness, and strategic AI use, enabling students to plan, monitor, regulate, and reflect on their learning more effectively. Participants viewed AI as a metacognitive learning partner rather than merely a tool for generating answers, fostering greater autonomy and reflective learning. These findings extend current conceptualizations of AI literacy by demonstrating its role as a multidimensional educational competence that reinforces the cognitive and metacognitive processes of self-regulated learning. The study also provides practical implications for integrating AI literacy into higher education curricula, teaching practices, and institutional policies to promote responsible, ethical, and independent AI-supported learning.

Keywords : Artificial Intelligence Literacy, Self-Regulated Learning, Generative Artificial Intelligence, Higher Education, Digital Literacy

INTRODUCTION

The rapid advancement of generative artificial intelligence (GenAI) has fundamentally transformed the landscape of higher education by reshaping how students access information, construct knowledge, and engage in learning activities. Since the public release of large language models such as ChatGPT, followed by other AI-powered systems including Gemini, Microsoft Copilot, and Claude, AI has evolved from a specialized computational technology into an everyday academic learning companion. Rather than functioning merely as an information retrieval tool, generative AI now supports a wide range of cognitive activities, including idea generation, text summarization, programming assistance, language translation, academic writing

support, and personalized feedback. Recent evidence also indicates that the quality of AI-generated responses is highly dependent on the quality and specificity of users' prompts. More detailed and contextualized inputs generally produce more accurate and academically appropriate outputs, demonstrating that effective interaction with AI requires active user competence rather than passive reliance on the technology (Saefudin et al., 2023). Consequently, higher education institutions worldwide are shifting their attention from whether AI should be adopted to how students can use AI responsibly, critically, and effectively to enhance learning outcomes (Badger et al., 2025; Kassorla et al., 2024).

The widespread integration of generative AI has substantially altered students' learning behaviors across diverse academic disciplines. University students increasingly rely on AI applications not only for completing assignments but also for brainstorming research ideas, summarizing scientific articles, translating academic texts, generating computer code, and searching for relevant literature. These developments indicate that AI has become an integral component of contemporary learning environments. However, accumulating evidence suggests that the educational benefits of AI are not distributed equally among students. While some learners employ AI strategically to support independent learning, critical reflection, and academic problem solving, others demonstrate excessive dependence on AI-generated responses, leading to superficial learning, diminished cognitive engagement, and concerns regarding academic integrity. This divergence suggests that the effectiveness of AI-assisted learning depends not solely on access to AI technologies but also on students' ability to understand, evaluate, and responsibly utilize these tools (Badger et al., 2025; Lintner, 2024).

The contrasting patterns of AI utilization observed among university students raise an important educational concern. Although generative AI possesses considerable potential to facilitate autonomous learning, immediate feedback, and personalized academic support, its educational value is contingent upon how students regulate their learning processes while interacting with AI systems. Students who critically evaluate AI-generated information, verify outputs using credible sources, and integrate AI into goal-oriented learning activities are more likely to develop effective learning strategies. Conversely, students who rely uncritically on AI-generated content may experience reduced opportunities for reflection, metacognitive monitoring, and independent knowledge construction. These contrasting behaviors indicate that AI itself is unlikely to determine learning quality; rather, differences in learners' competencies may explain why AI serves as a catalyst for self-directed learning in some students while fostering dependency in others. Understanding the factors underlying these differences has therefore become an increasingly important issue in higher education research (Cox, 2024; Badger et al., 2025).

One promising explanation for these differences lies in the concept of Artificial Intelligence Literacy (AI Literacy). AI literacy extends beyond the technical ability to operate AI applications and encompasses learners' understanding of AI principles, their capacity to critically evaluate AI-generated outputs, awareness of ethical implications, and ability to apply AI appropriately within academic and professional contexts (Kassorla

et al., 2024; Lintner, 2024). Recent conceptualizations emphasize that AI literacy should be regarded as a multidimensional competence integrating technical knowledge, critical thinking, ethical judgment, and responsible decision-making when interacting with AI technologies (Cox, 2024). Simultaneously, Self-Regulated Learning (SRL) has long been recognized as one of the most influential determinants of successful learning. SRL refers to learners' active ability to plan, monitor, regulate, and evaluate their own cognitive, motivational, and behavioral processes in pursuit of academic goals. In increasingly technology-rich learning environments, students with stronger SRL are generally better equipped to utilize digital tools strategically rather than passively, making SRL an essential competency for effective AI-supported learning (Zimmerman, 2002; Panadero, 2017; Kassorla et al., 2024).

Recent scholarship concerning AI in higher education can generally be classified into four major streams. The first stream investigates the educational applications of generative AI, reporting its potential to enhance learning performance, motivation, self-efficacy, and personalized learning support when implemented appropriately (Badger et al., 2025). The second stream focuses on conceptualizing and measuring AI literacy, highlighting that AI literacy has evolved into a core competency encompassing knowledge, critical evaluation, ethical awareness, and responsible AI use rather than simple operational skills (Lintner, 2024; Kassorla et al., 2024). The third stream examines Self-Regulated Learning as a crucial determinant of academic success in digital learning environments, emphasizing learners' abilities to regulate cognition, motivation, and learning strategies (Panadero, 2017). Finally, an emerging stream has begun exploring the relationship between AI technologies and SRL, suggesting that AI tools can scaffold planning, monitoring, feedback, and reflection processes associated with self-regulated learning. Nevertheless, current evidence primarily examines AI tools or educational chatbots as instructional interventions rather than investigating whether students' AI literacy itself predicts their capacity for self-regulated learning (Kasneci et al., 2023; van den Beemt et al., 2024).

Although research on artificial intelligence in higher education has expanded rapidly over the past few years, the existing body of evidence remains geographically concentrated in technologically advanced regions, particularly China, South Korea, the United States, and several European countries. Recent comparative studies also demonstrate that AI literacy levels and AI-related competencies vary considerably across national and educational contexts due to differences in digital infrastructure, curriculum implementation, institutional policies, and students' prior technological experiences (Almatrafi et al., 2024; Lintner, 2024; *Frontiers in Communication*, 2024). Consequently, empirical evidence from developing countries, including Indonesia, remains comparatively limited. Moreover, previous studies have predominantly examined students enrolled in STEM-related disciplines, where AI technologies are more extensively integrated into teaching and learning activities, while students from non-STEM disciplines have received considerably less scholarly attention (Almatrafi et al., 2024; Zhou & Schofield, 2024). This imbalance limits the contextual generalizability of

existing findings and highlights the need to investigate AI literacy across broader higher education settings.

Beyond contextual limitations, several conceptual and methodological gaps remain unresolved. Existing studies have primarily examined constructs such as AI acceptance, technology acceptance, AI use, behavioral intention, perceived usefulness, and attitudes toward generative AI, whereas comparatively fewer studies have investigated AI literacy as a multidimensional educational competence capable of influencing students' learning processes (Almatrafi et al., 2024; Lintner, 2024). Furthermore, systematic reviews indicate that AI literacy itself has not yet reached conceptual consensus. Existing instruments differ substantially in their operational definitions, dimensions, and theoretical foundations, reflecting ongoing debates regarding whether AI literacy should emphasize technical knowledge, critical evaluation, ethical awareness, or a broader sociotechnical competence (Lintner, 2024; Imbamba et al., 2025). At the same time, although recent studies have begun discussing the relationship between AI-supported learning and self-regulated learning, most investigations examine AI as an instructional tool or intervention rather than considering students' AI literacy as an antecedent of self-regulated learning. Consequently, empirical evidence explaining whether students who possess higher AI literacy are also more capable of regulating their own learning remains limited (Almatrafi et al., 2024; Zhou & Schofield, 2024).

Drawing upon these limitations, the present study addresses four interrelated research gaps. First, it contributes empirical evidence from the Indonesian higher education context, which remains underrepresented in the AI literacy literature. Second, it extends previous research by positioning AI literacy as a multidimensional educational competence rather than merely a measure of AI usage or technology acceptance. Third, the study integrates Artificial Intelligence Literacy with Self-Regulated Learning Theory to provide a theoretically grounded understanding of how AI-related competencies support students' self-regulated learning processes. Finally, while previous studies have predominantly employed quantitative approaches to examine associations between AI-related variables, relatively few studies have qualitatively explored how university students perceive and experience the role of AI literacy in supporting self-regulated learning within authentic learning contexts. Addressing this gap enables a richer understanding of the cognitive, metacognitive, and ethical dimensions of AI literacy that may not be fully captured through quantitative designs.

Building upon these contextual, conceptual, and methodological gaps, this study aims to explore the role of Artificial Intelligence (AI) Literacy in supporting Self-Regulated Learning (SRL) among university students through a qualitative case study. Specifically, it seeks to explore how university students perceive AI literacy, how they utilize generative AI to support planning, monitoring, regulating, and reflecting on their learning, and how these experiences contribute to their self-regulated learning practices. By conceptualizing AI literacy as a multidimensional educational competence encompassing AI knowledge, critical evaluation, ethical awareness, and responsible AI use, this study provides an in-depth understanding of AI literacy within AI-supported learning environments. Accordingly, this study explores university students' perceptions

of AI literacy, its role in supporting self-regulated learning, and the ways in which students integrate AI literacy into their learning practices within AI-supported learning environments.

This study contributes to the growing body of literature on artificial intelligence in higher education by offering theoretical, empirical, and practical advancements. Theoretically, it extends Self-Regulated Learning Theory by positioning AI literacy as a multidimensional educational competence that supports students' cognitive, metacognitive, and ethical regulation in AI-supported learning environments, thereby moving beyond the predominant emphasis on AI acceptance and technology adoption (Almatrafi et al., 2024; Lintner, 2024). Empirically, the study enriches the existing evidence by providing an in-depth qualitative understanding of how university students experience and utilize AI literacy to support self-regulated learning within the Indonesian higher education context, which remains underrepresented in current research (Almatrafi et al., 2024; Zhou & Schofield, 2024). Practically, the findings provide evidence-based insights for higher education institutions to integrate AI literacy into curriculum design and teaching practices, enabling students to utilize generative AI critically, ethically, strategically, and reflectively to strengthen independent and lifelong learning.

METHOD

This study employed a qualitative case study design to explore the role of Artificial Intelligence (AI) Literacy in supporting Self-Regulated Learning (SRL) among university students. The study involved a naturally occurring peer group of five undergraduate students aged 19–22 years who regularly used generative AI in their academic activities. Participants were selected through purposive sampling based on their active AI use, willingness to participate, and ability to describe their learning experiences. Data were collected through semi-structured interviews, non-participant observations, and document analysis. The interview protocol explored participants' understanding of AI literacy, patterns of AI use, ethical awareness, and learning regulation. All interviews were audio-recorded with participants' consent and transcribed verbatim. Data were analyzed using thematic analysis through familiarization, coding, theme development, theme review, and interpretation to identify recurring patterns explaining how AI literacy supported self-regulated learning. The credibility of the findings was enhanced through methodological triangulation, member checking, peer debriefing, and systematic verification between the data, codes, and emerging themes.

FINDINGS AND DISCUSSION

This study involved five undergraduate students aged between 19 and 22 years who formed a close peer group and regularly used generative artificial intelligence (AI) tools, such as ChatGPT and similar platforms, to support their academic activities. The participants came from different academic backgrounds but shared similar learning experiences, allowing the researcher to examine AI literacy and self-regulated learning (SRL) within a naturally occurring social context. A qualitative case study emphasizes

understanding a bounded system through in-depth exploration rather than statistical generalization; therefore, the selection of this peer group provided a meaningful context for investigating how AI literacy shapes students' learning behaviors in authentic educational settings (Creswell & Poth, 2018; Yin, 2018).

The analysis revealed that participants generally demonstrated a moderate to high level of AI literacy. Four interrelated themes emerged from the interview data: understanding AI capabilities and limitations, critically evaluating AI-generated information, ethical and responsible AI use, and strategic utilization of AI to support academic learning. Participants recognized that generative AI could efficiently assist in brainstorming, summarizing academic literature, translating texts, and organizing ideas. Nevertheless, they consistently emphasized that AI-generated responses should not be accepted uncritically and required verification through credible academic sources. Several participants also expressed awareness of ethical concerns, including plagiarism, misinformation, and overreliance on AI-generated content.

These findings suggest that AI literacy extends beyond technical proficiency and encompasses critical, ethical, and reflective competencies required for effective learning in higher education. This interpretation aligns with recent conceptualizations that define AI literacy as a multidimensional competence involving understanding AI technologies, critically evaluating AI outputs, recognizing ethical implications, and applying AI responsibly in real-world contexts (Almatrafi et al., 2024; Lintner, 2024). The findings also support previous research indicating that students who possess stronger AI literacy tend to adopt more purposeful and reflective learning strategies rather than relying on AI merely as a shortcut for completing academic tasks (Long & Magerko, 2020).

The second major theme demonstrated that AI literacy played an important role in supporting participants' self-regulated learning. Students reported using AI not only to obtain answers but also to formulate learning goals, develop study plans, monitor their understanding, identify misconceptions, and evaluate their own learning progress. Participants frequently described AI as a learning partner that encouraged them to ask follow-up questions, compare multiple perspectives, and reflect on the quality of their own understanding before completing academic assignments. Rather than replacing independent learning, AI became a tool that facilitated greater autonomy when used critically and strategically.

These findings reinforce the proposition that AI literacy supports multiple dimensions of self-regulated learning, including planning, self-monitoring, strategic learning, and self-reflection. According to Self-Regulated Learning Theory, effective learners actively regulate cognitive, motivational, and behavioral processes through continuous planning, monitoring, and evaluation (Panadero, 2017; Zimmerman, 2002). Participants in this study demonstrated these regulatory processes while interacting with AI technologies, suggesting that AI literacy enables students to use generative AI as a metacognitive support rather than as a substitute for thinking. This finding is consistent with recent studies highlighting that AI-supported learning environments can strengthen students' self-regulation when accompanied by sufficient AI literacy and critical awareness (Kasneci et al., 2023; Lintner, 2024).

The findings indicate that the relationship between AI literacy and self-regulated learning can be understood through the interaction of technological competence and metacognitive regulation. Students with stronger AI literacy were better able to evaluate AI-generated information, recognize potential inaccuracies, formulate effective prompts, and determine appropriate situations for AI use. These competencies promoted more reflective learning behaviors by encouraging students to plan learning activities, monitor comprehension, regulate learning strategies, and evaluate academic outcomes independently. Consequently, AI literacy functions not merely as digital competence but also as a catalyst for activating self-regulatory processes within AI-supported learning environments. This finding extends Self-Regulated Learning Theory by demonstrating that AI literacy represents an emerging educational competence capable of facilitating learners' cognitive and metacognitive regulation in the era of generative artificial intelligence (Panadero, 2017; Zimmerman, 2002). It also supports contemporary AI literacy frameworks that advocate integrating technical understanding, critical thinking, and ethical awareness into higher education to foster responsible and autonomous learning (Almatrafi et al., 2024; Long & Magerko, 2020).

The findings provide several important implications for theory and educational practice. Theoretically, this study strengthens the emerging perspective that AI literacy should be viewed as a multidimensional educational competence that contributes to self-regulated learning rather than merely reflecting students' technological skills or AI usage. Practically, the findings suggest that lecturers should integrate AI-supported learning activities that encourage critical evaluation, reflection, and independent problem-solving instead of emphasizing answer generation alone. Universities should formulate institutional policies and ethical guidelines promoting responsible AI use while embedding AI literacy into graduate learning outcomes and curriculum design. Curriculum developers are encouraged to incorporate structured AI literacy instruction that includes technical knowledge, critical evaluation, prompt engineering, and ethical decision-making. Furthermore, AI literacy training programs should emphasize reflective and responsible AI use so that students develop the capacity to utilize generative AI strategically to strengthen independent and lifelong learning.

This study has several limitations that should be acknowledged. As a qualitative case study involving a single peer group of five undergraduate students, the findings are context-specific and are not intended for statistical generalization. The participants' experiences may also reflect the characteristics of their social interactions and institutional learning environment. In addition, the findings relied primarily on interviews, observations, and document analysis, making them dependent upon participants' subjective experiences and the researcher's interpretation despite the use of triangulation and member checking. Future studies may expand the scope by involving multiple universities, diverse disciplinary backgrounds, or larger participant groups through multisite case studies. Researchers may also employ mixed-methods or quantitative approaches to examine the conceptual model identified in this study and investigate potential mediating or moderating variables, such as academic self-efficacy, critical thinking, learning motivation, or digital readiness.

CONCLUSION

This study explored the role of Artificial Intelligence (AI) Literacy in supporting Self-Regulated Learning (SRL) among university students through a qualitative case study. The findings indicate that AI literacy extends beyond technical skills to encompass critical evaluation, ethical awareness, and strategic AI use, enabling students to plan, monitor, regulate, and reflect on their learning more effectively. These findings extend the conceptualization of AI literacy as a multidimensional educational competence that strengthens the cognitive and metacognitive processes of Self-Regulated Learning Theory while providing empirical evidence from the underrepresented Indonesian higher education context, thereby addressing an important gap in previous research. Accordingly, lecturers, universities, and curriculum developers should systematically integrate AI literacy into teaching, learning, and institutional policies to foster critical, ethical, and independent AI use. As generative AI becomes increasingly embedded in higher education, strengthening AI literacy will be essential for preparing autonomous, responsible, and lifelong learners.

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