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AI LITERACY OF PRE-SERVICE ENGLISH TEACHERS: PROFICIENCY, STRATEGIES, AND BARRIERS

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Abstract: Artificial intelligence (AI) has become increasingly significant in higher education, making multidimensional AI literacy essential for pre-service English teachers. Yet, empirical evidence in English Language Teaching (ELT) remains limited, particularly regarding students' AI literacy profiles, the autonomous strategies they use to develop such literacy, and the barriers affecting responsible AI use. This study employed an explanatory sequential mixed-methods

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design in Indonesia. Quantitative data were collected through a 30-item AI literacy questionnaire administered to 200 pre-service English teachers, followed by semi-structured interviews and focus group discussions with a purposive subsample of 25 participants. The findings indicate an uneven AI literacy profile. Although participants demonstrated strong competence in the practical use of AI tools, they showed weaker performance in higher-order dimensions, especially evaluative and ethical aspects. The qualitative data further revealed that students developed AI literacy through self-directed strategies such as prompt experimentation and output verification, but these efforts were constrained by limited institutional guidance and persistent ethical uncertainty. The study suggests that teacher education programs should incorporate structured AI literacy instruction supported by clear institutional policies to strengthen critical, reflective, and responsible AI engagement in ELT contexts.

Keywords: *speaking anxiety, EFL students, FLSAQ, teaching strategies, English language learning*

INTRODUCTION

The advancement of artificial intelligence (AI) has fundamentally reshaped the landscape of higher education. Integrating AI into the pedagogical ecosystem is no longer a matter of choice but has become a strategic imperative (Alam & Mohanty, 2023). This new reality demands that educational stakeholders be prepared to understand, utilize, and critically appraise these technologies intelligently and ethically. This global phenomenon also manifests within the Indonesian context, where students are positioned as the primary users and stakeholders most directly impacted by the shift towards AI-driven academic environments (Helmiatin et al., 2024). Consequently, AI literacy has emerged as a crucial new competency that must be cultivated, particularly among pre-service English

teachers, who are poised to become key agents of change in shaping 21st-century pedagogical practices.

The rapid rise of AI in English Language Teaching (ELT) has given rise to many complex challenges. These concerns include academic ethics, student work authenticity, and technological dependency (Dakakni & Safa, 2023). Students lacking sufficient AI literacy are prone to becoming passive users, operating without a nuanced understanding of the underlying system logic, inherent algorithmic biases, or the technology's operational boundaries (Stolpe & Hallström, 2024). It is not merely relevant, but imperative, to assess the AI literacy levels of pre-service English teachers. This ensures they are equipped to be more than mere users, evolving instead into discerning curators and critics of technology who act with a high degree of ethical and pedagogical consciousness.

The construct of AI literacy provides an essential framework for addressing the responsible integration of these technologies into pedagogy. Conceptually, AI literacy encompasses a foundational understanding of AI's operational principles, the ability to apply AI tools within specific contexts, the capacity for critical evaluation of AI-generated outputs, and an awareness of its broader social and ethical implications (Lintner, 2024; Long et al., 2023; Ng et al., 2021). Within the context of ELT, this competency manifests in the ability to utilize AI for language instruction, technology-enhanced assessment, pedagogical material development, and the design of interactive learning activities. Nevertheless, prior research indicates that while students exhibit significant enthusiasm for using AI, their deeper technical comprehension remains limited, particularly in their capacity to critically evaluate AI outputs and consider the ethical implications of its application (Laupichler et al., 2024).

Moreover, ELT requires a nuanced understanding of the complex interplay between text, culture, and interpersonal communication. These are domains that AI systems have yet to master fully. In this light, the role of AI in language education should be

conceptualized as collaborative and reflective, rather than purely substitutive (Hastomo et al., 2024). It is crucial to investigate the strategies that students autonomously employ to develop their AI literacy, such as through tool exploration, critical discourse, and the integration of AI into their academic workflows (Chiu et al., 2024). Furthermore, it is equally important to map the barriers they encounter across technical, pedagogical, and psychological domains (Stolpe & Hallström, 2024). An inquiry that jointly examines these autonomous learning strategies and prohibitive barriers is thus essential to guide the responsible integration of AI into language pedagogy

To account for these complexities, AI literacy is increasingly conceptualized from a multidimensional perspective. Beyond the cognitive domain, AI literacy is also shaped by affective factors, behavioral components, and ethical consciousness, which pertain to understanding how and within what boundaries AI should be employed (Ng et al., 2024). This multidimensional approach to AI literacy is encapsulated in the ABCE (affective, behavioural, cognitive, ethical) framework, which has informed the development of several measurement instruments, such as the AI Literacy Questionnaire (Ng et al., 2024) and the Multidimensional AI Literacy Scale (Carolus et al., 2023). Such a framework underscores that a comprehensive understanding of AI literacy cannot rely solely on technical knowledge. On the contrary, it must also encompass the attitudes, values, and learning strategies students bring to their technological engagement.

Assessing AI literacy within the ELT context is complicated by distinct learner profiles and the limitations of current measurement tools. Pre-service English teachers often possess strong critical and ethical skills but weaker technical comprehension (Deng & Zhang, 2023), with proficiency also influenced by demographic factors and prior experience. This situation creates a serious problem because many future teachers may not be ready to use AI tools effectively in the classroom (Zulianti et al., 2024). They may face difficulties in evaluating AI-generated content, using the tools responsibly, and

guiding students in their use. Compounding this challenge, existing assessment instruments are frequently fragmented, failing to capture the full spectrum of AI literacy constructs identified in systematic reviews (Almatrafi et al., 2024). Therefore, the present study addresses this gap by implementing a comprehensive AI literacy assessment tailored for this population. A specific and complete tool is urgently needed to measure AI literacy in the ELT field. Without this, it is difficult to identify the needs of teacher training programs. Therefore, the present study addresses this gap by implementing a comprehensive AI literacy assessment tailored for this population.

While AI literacy research is expanding, a significant gap exists in the ELT context, as most assessment instruments are tailored for general, STEM, or medical fields (Cardon et al., 2023; Carolus et al., 2023; Jin, Martinez-Maldonado, et al., 2025; Lee et al., 2021; Long et al., 2023; Ng et al., 2024; Zhang & Zhang, 2024). Consequently, there is a dearth of inquiry into how pre-service English teachers autonomously develop their competencies and navigate AI's unique pedagogical and ethical complexities in a humanities discipline. This lack of attention has led to limited understanding of their abilities, making it hard to design effective interventions. It is necessary to conduct this study now to ensure that English teacher preparation is relevant, complete, and responsive to the growing use of AI in education. To address this gap within the Indonesian context, the present study provides a holistic investigation guided by the following research questions:

1. What is the proficiency level of AI literacy among pre-service English teachers?
2. What strategies do they employ to develop this competency?
3. What factors impede the effective utilization of AI in their language learning?

METHOD

Research Design

This study employed a mixed-methods approach, utilizing an explanatory sequential design that integrated quantitative and qualitative phases in succession (Creswell & Clark, 2023). This design was selected to comprehensively understand English education students' AI literacy by exploring numerical data, which was then elaborated upon through in-depth qualitative analysis. The initial phase utilized a quantitative method, with the primary instrument being a multiple-choice test adapted from the GLAT (The generative AI literacy assessment test) (Jin et al., 2025) and modified for the Indonesian context, comprising 30 items across four primary dimensions (Know & Understand, Use & Apply, Evaluate & Create, and Ethics). This phase addressed Research Question 1 on students' proficiency levels. The second phase employed a qualitative approach, utilizing semi-structured interviews (Carolus et al., 2023; Zhang & Zhang, 2024), and was supplemented by Focus Group Discussions (FGDs). This qualitative phase addressed Research Questions 2 and 3, which explored students' strategies and barriers in using AI.

Participants and Sampling

The initial quantitative phase of the study involved 200 undergraduate participants (178 female, 22 male) from English Language Education programs. To ensure geographical and institutional representation, the sample was selected via convenience sampling from five universities across Indonesia (Lampung, Central Java, West Kalimantan, South Sulawesi, and Bali). These five institutions were selected based on regional diversity, public-private representation, and the availability of English education programs with active undergraduate enrollment. This selection aimed to capture variation in student backgrounds, institutional resources, and digital infrastructure across different provinces. A comprehensive breakdown of the participants' demographic characteristics is provided in Table 1.

Table 1.
Participants demographic information

Variable	Category	Participants (n)	Percentage (%)	Age Range
Gender	Female	178	89	19–21
	Male	22	11	19–21
Academic Year	2nd Year	63	31.5	Mostly 19
	3rd Year	91	45.5	Mostly 20
	4th Year	46	23	Mostly 21
Institutional Region	Lampung	43	21.5	19–21
	Central Java	48	24	19–21
	West Kalimantan	36	18	19–21
	South Sulawesi	39	19.5	19–21
	Bali	34	17	19–21

The subsequent qualitative phase involved semi-structured interviews with a purposive subsample of 25 participants drawn from the initial cohort. Participants were selected using a maximum variation sampling strategy based on their AI literacy scores from the test results. This method included individuals with high, moderate, and low proficiency across the four AI literacy dimensions. The selection process also considered regional distribution, gender, academic year, and prior experience with AI tools. To be eligible, participants had to (1) be actively enrolled as students, (2) have used at least one AI-based language learning tool, (3) provide informed consent, and (4) express willingness to participate in the interview.

Ethical Considerations

Ethical approval for this research was obtained from the Research Ethics Committee of the Institute for Research and Community Service (LPPM) at STKIP PGRI Bandar Lampung. Ethical procedures included: (1) the provision of an electronic informed consent form outlining the study's objectives, benefits, and confidentiality protocols; (2) data anonymization; (3) the participants' right to withdraw at any time without penalty; and (4) secure, encrypted data storage.

Instrument

This study employed an explanatory sequential mixed-methods approach to data collection. The primary quantitative instrument was an online 30-item multiple-choice AI literacy test designed to assess pre-service English teachers' AI literacy proficiency and to address the first research question. Adapted from the scale developed by Jin et al. (2025) and modified for the Indonesian ELT context, the instrument consisted of 30 items with five response options (a, b, c, d, and e) for each question. The framework was selected because it conceptualizes AI literacy through four key domains: Know and Understand, Use and Apply, Evaluate and Create, and Ethics. These domains encompass essential knowledge and skills relevant to English language teaching. Specifically, pre-service teachers are expected to demonstrate an understanding of fundamental AI concepts, apply AI tools in learning activities, critically evaluate the accuracy and quality of AI-generated content, and recognize ethical implications of AI use. The framework supports the purpose of this study by offering a structured and practical basis for measuring AI literacy in a language education setting. The complete version of the instrument is provided in the Appendix.

Items were scored dichotomously (correct = 1, incorrect = 0) and summed within each dimension. To facilitate interpretation across dimensions with different numbers of items, raw domain scores were linearly transformed to a 1–5 scale using: $\text{Scaled score} = 1 + 4(\text{Raw}/k)$, where k is the number of items in the domain. Students' overall AI literacy score was computed as the average of the four transformed domain scores. Proficiency levels were categorized as Low (1.00–2.50), Moderate (2.51–3.50), and High (3.51–5.00). The reported means and SDs in Table 3 refer to these transformed scores.

Prior to the main administration, the instrument underwent an independent field test (validation pilot) with pre-service English teachers recruited from universities outside the main study sample ($N = 220$) to evaluate construct validity and reliability. To reduce overfitting, the sample was randomly split into two subsamples:

Subsample A (n = 110) for Exploratory Factor Analysis (EFA) and Subsample B (n = 110) for Confirmatory Factor Analysis (CFA). Because the items were scored dichotomously (0/1), EFA was conducted on a tetrachoric correlation matrix using ULS extraction with an oblique rotation. Factor loadings ranged from 0.46 to 0.78, exceeding the recommended minimum of 0.40 (Ferguson & Takane, 1989). CFA on Subsample B used WLSMV and indicated acceptable model fit ($\chi^2/df = 2.18$, RMSEA = 0.058, CFI = 0.928, TLI = 0.915, SRMR = 0.071), supporting the hypothesized four-domain structure. Reliability for dichotomous items was estimated using KR-20, yielding coefficients of 0.75 (Know & Understand), 0.80 (Use & Apply), 0.73 (Evaluate & Create), and 0.78 (Ethics). The finalized instrument was then administered to the main study sample (N = 200) to address the research questions on proficiency levels, strategies, and barriers. Triangulation in the qualitative phase was achieved through interviews and FGDs. Two coders conducted independent analyses. Member checking was used to confirm thematic accuracy.

The second and third research questions were addressed through semi-structured interviews and FGDs. The interviews were guided by ten open-ended questions aligned with two analytic foci: (1) indicators of AI-learning and (2) indicators of barriers to effective AI use (Carolus et al., 2023; Zhang & Zhang, 2024). FGDs were conducted to triangulate interview results and elicit shared norms through peer interaction. Activities included discussion prompts on AI-supported ELT tasks, comparison of experiences, debate on ethical boundaries, and identification of institutional support needs.

Data Collection

The study employed a sequential data collection strategy. Initially, quantitative data on AI literacy proficiency were gathered through an online test administered via Google Forms. The test was disseminated to pre-service English teachers through WhatsApp, with distribution facilitated by heads of study programs and faculty members at the participating institutions. The data collection process

for the test was conducted over three weeks in March 2025. Subsequently, qualitative data were collected from a purposively selected subsample of 25 participants through semi-structured interviews and FGDs conducted over five weeks (early April to mid-May 2025). These participants were selected through maximum variation purposive sampling based on their AI literacy scores, gender, region, and academic year to ensure heterogeneous representation, with their demographic distribution summarized in Table 2.

Table 2.
Demographic profile of qualitative participants

Variable	Category	n	%
Gender	Female	22	88
	Male	3	12
Academic year	2nd year	8	32
	3rd year	11	44
	4th year	6	24
Region	Lampung	6	24
	Central Java	6	24
	West Kalimantan	4	16
	South Sulawesi	5	20
	Bali	4	16
AI literacy group (based on test scores)	High	9	36
	Moderate	8	32
	Low	8	32

To ensure feasibility, the interviews were scheduled on a rolling basis and lasted approximately 30–45 minutes each. The FGDs were organized into four sessions (6–7 participants per group) and each session lasted approximately 60–75 minutes, allowing for in-depth interaction while maintaining manageable group sizes. All qualitative sessions were conducted remotely via Zoom. With participants' explicit consent, these sessions were video-recorded to ensure fidelity and accuracy in transcription, a process further aided by the platform's live transcription feature. Any supplementary materials were gathered and stored in a secure, encrypted Google Drive with tiered access controls.

Data Analysis

Data analysis was performed sequentially, with distinct approaches for each data type. Quantitative data were processed using the Statistical Package for the Social Sciences (SPSS) version 26, employing descriptive statistical techniques. Qualitative analysis was conducted using the six-phase thematic analysis model (Braun et al., 2015) and facilitated by NVivo 12 Plus software. The phases included: (1) data familiarization, (2) initial code generation, (3) theme searching, (4) theme review, (5) theme definition and naming, and (6) report production. Triangulation was achieved through several methods: (1) methodological triangulation, by comparing test and interview findings; (2) source triangulation; and (3) investigator triangulation, involving two independent analysts.

FINDINGS

This section presents the findings based on the three research questions. It reports pre-service English teachers' AI literacy across four dimensions, followed by the strategies they used to develop it and the barriers that limited its effective use in English language learning.

The proficiency level of AI literacy among pre-service English teachers

To address the first research question concerning AI literacy proficiency levels, quantitative data were gathered from 200 participants using a multiple-choice test adapted from the GLAT (Jin et al., 2025). This instrument was designed to assess four primary dimensions: (1) Know & Understand, (2) Use & Apply, (3) Evaluate & Create, and (4) Ethics. The descriptive statistical analysis revealed a heterogeneous profile of AI literacy across the participant cohort, as summarized in Table 3.

Table 3.

Students' AI Literacy Proficiency Levels

No	AI Literacy Dimension	Mean	SD	Criteria
1.	Know & Understand	2.85	1.15	Moderate
2.	Use & Apply	3.90	0.95	High
3.	Evaluate & Create	2.35	1.25	Low
4.	Ethics	2.50	1.20	Low
5.	Overall Mean	2.90	1.18	Moderate

Note. Domain scores were converted to a 1–5 scale from raw test scores.

Table 3 presents the descriptive statistics for students' AI literacy across four dimensions. Overall, students demonstrated moderate AI literacy ($M = 2.90$, $SD = 1.18$). The highest mean was found in the 'Use & Apply' dimension ($M = 3.90$), indicating that students were confident using AI tools for practical language learning tasks. In contrast, the lowest mean appeared in the 'Evaluate & Create' dimension ($M = 2.35$), suggesting limited ability to assess AI-generated content or use it for creative tasks. Similarly, the 'Ethics' dimension showed a low mean ($M = 2.50$), reflecting a lack of awareness of responsible AI use in language education. The 'Know & Understand' domain scored moderately ($M = 2.85$), aligning with proficiency. These results imply that while students are comfortable using AI, they may lack the critical and ethical knowledge to apply it meaningfully in English language teaching.

Students' strategies for enhancing AI literacy

Qualitative data from interviews and FGDs with 25 participants were analyzed to address the second research question and identify students' strategies to develop their AI literacy. The analysis reveals that participants are not passive consumers of technology. On the contrary, they actively engage in self-directed learning to enhance their competencies. Four principal strategies for this autonomous skill development were identified through thematic analysis in Figure 1.

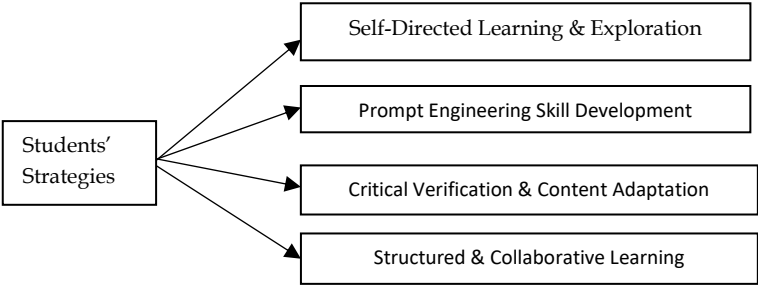


Figure 1. *The strategy of EFL pre-service teachers to advance AI literacy*

Students adopted multiple strategies to enhance their AI literacy, particularly in the context of English language learning. The most frequently mentioned approach was self-directed learning and exploration. Many students reported using AI tools independently without formal instruction. They engaged in trial-and-error experimentation with ChatGPT, Perplexity, and Gemini platforms. This approach helped them recognize the strengths and limitations of each tool depending on the task. Some used AI to generate an essay outline, while others explored its potential for vocabulary building and translation support. This exploration process cultivated confidence and adaptability in navigating digital tools for academic purposes.

“I don’t just use one tool. If I need to brainstorm ideas for an essay, I use ChatGPT. But if I need sources with citations, I try Perplexity.” (P12)

Another commonly reported strategy involved developing prompt engineering skills. Rather than using basic commands, students experimented with varied prompt structures to influence AI responses. They learned that precision in phrasing, inclusion of context, and word choice significantly impacted the relevance and accuracy of AI output. This awareness developed gradually through repeated practice and reflection. Many students moved from general questions to specific, task-oriented instructions, showing a progression in their ability to guide the AI meaningfully.

"At first, I just asked simple questions, and the answers were very general. Over time, I realized the key is in the keywords." (P7)

Critical verification and content adaptation also emerged as a key strategy. Students emphasized that they did not rely unthinkingly on AI-generated responses. Instead, they treated AI outputs as preliminary drafts that required careful review. Most respondents reported checking information against trusted academic sources, such as journals and textbooks, especially when dealing with writing or factual content. They then revised the AI output using their own words to ensure accuracy and originality, reflecting a strong awareness of academic integrity.

"I never just copy-paste. I always double-check with Google Scholar and then rewrite it in my own words." (P3)

In addition to individual efforts, a smaller group of participants described engaging in structured and collaborative learning. They participated in workshops, training sessions, or informal discussions with peers. Sharing tools, prompting techniques, and ethical concerns through peer collaboration expanded their understanding and provided faster solutions to technical challenges. Although less dominant, this strategy proved helpful for students who preferred learning through social interaction.

"Besides learning on my own, I often discuss with my friends. We share the new AI tools we've found and the kinds of prompts that work best." (P9)

In summary, these findings show that students are not only users but also critical and reflective learners of AI tools. Their strategies demonstrate agency, adaptability, and an emerging awareness of using AI effectively and responsibly in English language learning contexts.

Factors hindering the effective use of AI

To answer the third research question, thematic analysis of interview and FGD data identified five main themes that hinder students from effectively utilizing AI. These factors are summarized in Figure 2 and elaborated upon below.

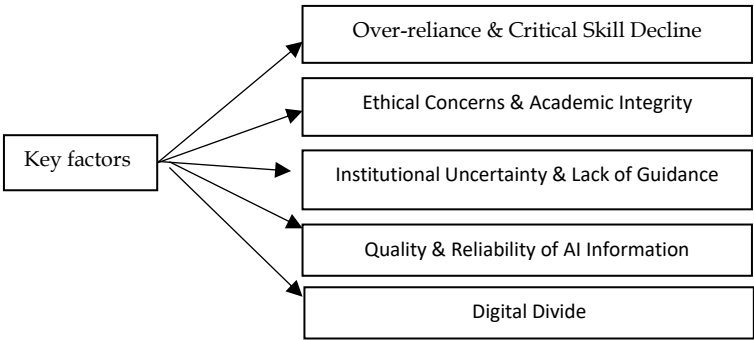


Figure 2. *Key factors hindering AI use*

The most frequent concern expressed by participants was the tendency to rely too much on AI tools. They explained that the availability of instant answers reduced their motivation to think independently. Instead of reading sources or analyzing topics independently, they often turned to ChatGPT or similar platforms at the beginning of an assignment. This pattern led to less engagement with reading materials and reduced the habit of deep reflection.

"I feel like I'm becoming lazy to think. I used to open books or journals for assignments. Now, I open ChatGPT first. It feels like my brain is rarely used for in-depth analysis anymore." (P5)

Participants also raised concerns about the ethical use of AI. Many students felt uncertain about whether using AI-generated content would violate academic rules. They were unsure how much AI output could be used or adapted. The unclear boundary between support and plagiarism made them hesitant. They feared their work might be rejected even if they had tried to paraphrase and revise the content.

"The biggest challenge while using AI is the rules on plagiarism. I find it difficult to create a truly original work because I'm afraid the result will be too similar to what the AI produced and be considered plagiarism."
(P11)

This problem became worse because of inconsistent guidance from lecturers. Some teachers allowed AI to be used for idea generation. Others did not allow any use of AI at all. Students were unsure which rules to follow. They often used AI cautiously because they did not want to be accused of cheating. The absence of a clear policy made them unsure about what was acceptable.

"Lecturer A says we can use AI for ideas, but Lecturer B forbids it completely. There's no uniform rule on the campus. So we use it hesitantly, worried about being blamed when our intention is just to learn." (P2)

Another barrier involved the accuracy of AI-generated content. Students realized that AI tools sometimes gave vague or incorrect answers. Some of the information lacked clear sources or contained errors. They had to verify the content by checking with academic references to avoid mistakes. This process often took more time than expected and reduced the benefits of using AI.

"AI answers are often unclear or off-topic, so I verify them using credible sources." (P13)

Several students also mentioned problems with access to AI tools. Some of their peers could not use advanced platforms because of weak internet connections or limited devices. This condition affected students in rural areas more severely. Those who lived in cities found it easier to explore AI features. This difference created unequal opportunities for learning and practice.

"My friend from my hometown often complains that they can't use heavy AI tools because their internet signal is poor. So, those of us in the city are clearly at an advantage. It's not fair." (P14)

The five challenges described above show that the use of AI in English learning is not only shaped by the tool itself. It is also affected by students' habits, institutional rules, content quality, and access to technology. These factors must be addressed to support more effective and responsible use of AI in the Indonesian ELT context.

DISCUSSION

The significant gap between students' ability to Use & Apply AI and their capacity to Evaluate & Create with it points to a form of instrumentalism in their technological adoption. In other words, many students appear to view AI primarily as a functional tool for completing tasks rather than as a complex system that requires critical interrogation and reflective judgment. This pattern aligns with Morgan et al. (2022), who reported a "critical deficit" in students' digital competencies related to higher-order engagement. The standard deviations across domains ($SD = 0.95-1.25$) suggest meaningful variability in students' performance, indicating that proficiency is not uniform across participants. This variability may reflect differences in prior exposure, learning opportunities, and task experience with GenAI, particularly for higher-order domains such as Evaluate & Create and Ethics. For pre-service teachers, such uneven proficiency is especially concerning: while some may be competent in using AI for personal productivity, others may struggle with the evaluative, creative, and ethical dimensions needed to support learners. Consequently, they may be less prepared to model responsible use, address bias and reliability concerns, and facilitate principled classroom integration of AI (Wu et al., 2025).

The students' frequent use of efficiency-oriented tactics within broader strategies such as self-directed exploration and prompt engineering can be understood as a rational adaptation to academic demands rather than mere laziness. This pattern is consistent with

cognitive offloading, whereby learners delegate portions of comprehension and text production to reduce cognitive load in contexts of information abundance (Gerlich, 2025). In the context of generative AI, this offloading becomes a pragmatic strategy for managing workload, although it risks bypassing the desirable difficulties necessary for deep learning (Abbas et al., 2024). The qualitative data reveal a tension between this pragmatic efficiency and the more demanding, innovative use of AI for pedagogical design. The rarity of students using AI for higher-order tasks, such as creating teaching materials, reflects a gap in their Technological Pedagogical Content Knowledge (TPACK), suggesting that students are unlikely to move beyond an instrumental use (McDonald et al., 2025).

The barriers students face are not discrete obstacles but symptoms of a systemic failure within the educational ecosystem. The personal anxieties regarding plagiarism and skill decline are direct outcomes of pedagogical inaction. The policy vacuum described by participants creates a high-risk, low-trust environment that discourages the experimentation needed to develop sophisticated AI literacy. This lack of clear institutional guidance, a consistent finding in the literature (An et al., 2025), encourages students to adopt safer, less creative uses of AI (Hastomo et al., 2025). This inaction is further compounded by structural inequities, such as the digital divide, which remains a significant barrier to equitable AI access in Indonesia (Haetami, 2025).

Additionally, our findings suggest that isolated interventions targeting individual student skills are insufficient. Addressing the AI literacy paradox necessitates a comprehensive approach acknowledging the interconnection of personal, pedagogical, and structural factors. As long as institutional policies remain ambiguous and assessments fail to demand higher-order thinking, students will rationally choose the path of least resistance, perpetuating the cycle of instrumental use and critical deficit (Jin, Yan, et al., 2025). Therefore, fostering genuine AI literacy necessitates systemic change, including reforming assessment practices, establishing clear ethical guidelines,

and ensuring equitable access to technology and training. Without such a critical, systemic perspective, educational institutions risk promoting a superficial form of digital competence that is inadequate for the future (Schiff, 2022).

In comparison with prior empirical studies, our proficiency pattern both converges and diverges in important ways. It converges with cross disciplinary evidence that learners' AI literacy tends to be asymmetrical across dimensions rather than uniformly developed. For example, Laupichler et al. (2024) reported that medical students' self-assessed technical understanding was lower than their reported practical use and critical appraisal of AI, indicating an uneven profile. However, our findings diverge in the location of the weakness, since in the ELT cohort higher order evaluation, creation, and ethics remain comparatively underdeveloped despite strong functional use. This contrast suggests that disciplinary task ecologies in language education may privilege routine productivity uses while offering fewer structured opportunities to practice evaluative judgment and ethical deliberation.

Our findings are also consistent with methodological work showing that performance-based assessment can reveal higher order gaps that may be less visible in perception-based measures. Jin et al. (2025) introduced the GLAT test and reported strong psychometric evidence for objective measurement, supporting the view that test-based instruments can more clearly differentiate competence levels than self-perceived proficiency. This helps explain why our multiple-choice assessment identified clearer weaknesses in evaluation and ethics even though qualitative accounts showed strategic behaviors such as verification and prompt refinement. Overall, comparison with earlier studies implies that strengthening higher order AI literacy in ELT requires not only exposure to tools, but also instructional and assessment practices that explicitly require critical evaluation, source justification, and ethical reasoning, as emphasized in institutional policy research and ethics-oriented scholarship (An et al., 2025; Schiff, 2022).

CONCLUSION

This study reveals a significant paradox in the AI literacy of pre-service English teachers. Quantitative findings indicate that while students demonstrate high proficiency in the practical application of AI tools (“Use & Apply”), their competency in foundational understanding (“Know & Understand”) and, more critically, in higher-order domains (“Evaluate & Create” and “Ethics”) remains limited. Qualitative evidence further suggests that this instrumentalist orientation is reflected in students’ self-developed learning strategies, which are predominantly autonomous and efficiency-driven through tool exploration and prompt engineering, whereas structured, collaborative learning is reported less frequently. Although a subset of participants engages in peer-supported practices, sustained collaborative inquiry is not yet the dominant pattern. These behaviors are further constrained by an interconnected system of barriers, including anxiety about skill decline, pedagogical inaction stemming from unclear institutional guidance, and structural inequities such as the digital divide. Without systemic intervention, future educators may enter the profession as proficient AI users but remain insufficiently prepared to model the critical judgment and ethical dispositions required for responsible 21st-century pedagogy.

Pedagogically, this study contributes by identifying specific gaps in teacher preparation programs that require immediate attention. The findings suggest that pre-service teachers need structured support to strengthen (1) foundational understanding of AI concepts and limitations, (2) evaluative and creative competencies for critical and pedagogically sound AI use, and (3) ethical sensitivity and decision-making aligned with responsible academic and classroom practice. These insights can inform curriculum designers, teacher educators, and policymakers to integrate AI literacy training that balances efficiency with responsibility, while leveraging scaffolded and collaborative learning opportunities that some participants already identified as beneficial.

Despite offering a comprehensive snapshot, several limitations should be acknowledged. The findings are contextualized within Indonesian higher education and may not be universally generalizable. In addition, the cross-sectional design provides a static picture and does not capture the longitudinal development of AI literacy over time. Future research should therefore employ longitudinal designs to trace AI literacy trajectories across teacher education programs and intervention-based studies to test pedagogical models that strengthen the identified weak points—particularly in the “Evaluate & Create” and “Ethics” domains. Further investigations should also examine how structured critical reflection, collaborative AI-supported tasks, and clear university-wide AI policies shape students’ learning strategies, evaluative capacity, and ethical behavior.

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DECLARATION OF AI AND AI-ASSISTED TECHNOLOGIES

While preparing this work, the authors used Gemini and Grammarly to optimize language and readability. The authors have reviewed and edited the content as needed and take full responsibility for the publication's content after using this tool/service.

REFERENCES

- Abbas, M., Jam, F. A., & Khan, T. I. (2024). Is it harmful or helpful? Examining the causes and consequences of generative AI usage among university students. *International Journal of Educational Technology in Higher Education*, 21(1), 1–22.
<https://doi.org/10.1186/s41239-024-00444-7>

- Alam, A., & Mohanty, A. (2023). Educational technology: Exploring the convergence of technology and pedagogy through mobility, interactivity, AI, and learning tools. *Cogent Engineering*, 10(2), 1-37. <https://doi.org/10.1080/23311916.2023.2283282>
- Almatrafi, O., Johri, A., & Lee, H. (2024). A systematic review of AI literacy conceptualization, constructs, and implementation and assessment efforts (2019–2023). *Computers and Education Open*, 6, 100173. <https://doi.org/10.1016/j.caeo.2024.100173>
- An, Y., Yu, J. H., & James, S. (2025). Investigating the higher education institutions' guidelines and policies regarding the use of generative AI in teaching, learning, research, and administration. *International Journal of Educational Technology in Higher Education*, 22(1), 10. <https://doi.org/10.1186/s41239-025-00507-3>
- Braun, V., Clarke, V., & Rance, N. (2015). How to use thematic analysis with interview data. In A. Vossler & N. Moller (Eds.), *The Counselling & Psychotherapy Research Handbook*, (pp. 183–197). Sage. <https://doi.org/10.4135/9781473909847.n13>
- Cardon, P., Fleischmann, C., Aritz, J., Logemann, M., & Heidewald, J. (2023). The challenges and opportunities of AI-assisted writing: Developing AI literacy for the AI age. *Business and Professional Communication Quarterly*, 86(3), 257–295. <https://doi.org/10.1177/2329490623117651>
- Carolus, A., Koch, M. J., Straka, S., Latoschik, M. E., & Wienrich, C. (2023). MAILES - Meta AI literacy scale: Development and testing of an AI literacy questionnaire based on well-founded competency models and psychological change- and meta-competencies. *Computers in Human Behavior: Artificial Humans*, 1(2), 100014. <https://doi.org/10.1016/j.chbah.2023.100014>

Febriyanti, Nurchurifiani, E., Hastomo, T., Wicaksono, A., & Nasution, S. S. (2026). AI literacy of pre-service English teachers: Proficiency, strategies, and barriers. *JEELS (Journal of English Education and Linguistics Studies*, 13(1), 155-186.

Chiu, T. K. F., Ahmad, Z., Ismailov, M., & Sanusi, I. T. (2024). What are artificial intelligence literacy and competency? A comprehensive framework to support them. *Computers and Education Open*, 6, 100171. <https://doi.org/10.1016/j.caeo.2024.100171>

Creswell, J. W., & Clark, V. L. P. (2023). Revisiting Mixed Methods Research Designs Twenty Years Later. In *The Sage Handbook of Mixed Methods Research Design* (pp. 21–36). Sage Publications Ltd. <https://doi.org/10.4135/9781529682663.n6>

Dakakni, D., & Safa, N. (2023). Artificial intelligence in the L2 classroom: Implications and challenges on ethics and equity in higher education: A 21st century Pandora's box. *Computers and Education: Artificial Intelligence*, 5, 100179. <https://doi.org/10.1016/j.caeai.2023.100179>

Deng, G., & Zhang, J. (2023). Technological pedagogical content ethical knowledge (TPCEK): The development of an assessment instrument for pre-service teachers. *Computers & Education*, 197, 104740. <https://doi.org/10.1016/j.compedu.2023.104740>

Ferguson, F., & Takane, Y. (1989). *Statistical analysis in psychology and education*. McGraw-Hill.

Gerlich, M. (2025). AI tools in society: Impacts on cognitive offloading and the future of critical thinking. *Societies*, 15(1), 1–28. <https://doi.org/10.3390/soc15010006>

Haetami. (2025). AI-Driven educational transformation in Indonesia: From learning personalization to institutional management. *AL-ISHLAH: Jurnal Pendidikan*, 17(2), 1819–1832. <https://doi.org/10.35445/alishlah.v17i2.7448>

Harrington, D. (2009). *Confirmatory factor analysis*. Oxford University Press.

Febriyanti, Nurchurifiani, E., Hastomo, T., Wicaksono, A., & Nasution, S. S. (2026). AI literacy of pre-service English teachers: Proficiency, strategies, and barriers. *JEELS (Journal of English Education and Linguistics Studies*, 13(1), 155-186.

Hastomo, T., Mandasari, B., & Widiati, U. (2024). Scrutinizing Indonesian pre-service teachers' technological knowledge in utilizing AI-powered tools. *Journal of Education and Learning (EduLearn)*, 18(4), 1572-1581.
<https://doi.org/10.11591/edulearn.v18i4.21644>

Hastomo, T., Sari, A. S., Widiati, U., Ivone, F. M., Zen, E. L., & Andianto, A. (2025). Exploring EFL teachers' strategies in employing AI chatbots in writing instruction to enhance student engagement. *World Journal of English Language*, 15(7), 93-102.
<https://doi.org/10.5430/wjel.v15n7p93>

Helmiatin, Hidayat, A., & Kahar, M. R. (2024). Investigating the adoption of AI in higher education: A study of public universities in Indonesia. *Cogent Education*, 11(1), 1-15.
<https://doi.org/10.1080/2331186X.2024.2380175>

Jin, Y., Martinez-Maldonado, R., Gašević, D., & Yan, L. (2025). GLAT: The generative AI literacy assessment test. *Computers and Education: Artificial Intelligence*, 9, 100436.
<https://doi.org/10.1016/j.caeai.2025.100436>

Jin, Y., Yan, L., Echeverria, V., Gašević, D., & Martinez-Maldonado, R. (2025). Generative AI in higher education: A global perspective of institutional adoption policies and guidelines. *Computers and Education: Artificial Intelligence*, 8, 100348.
<https://doi.org/10.1016/j.caeai.2024.100348>

Laupichler, M. C., Aster, A., Meyerheim, M., Raupach, T., & Mergen, M. (2024). Medical students' AI literacy and attitudes towards AI: a cross-sectional two-center study using pre-validated assessment instruments. *BMC Medical Education*, 24(1), 401.
<https://doi.org/10.1186/s12909-024-05400-7>

Lee, I., Ali, S., Zhang, H., DiPaola, D., & Breazeal, C. (2021). Developing Middle School Students' AI Literacy. *Proceedings of the 52nd*

ACM Technical Symposium on Computer Science Education, 191–197. <https://doi.org/10.1145/3408877.3432513>

Lintner, T. (2024). A systematic review of AI literacy scales. *Npj Science of Learning*, 9(1), 50. <https://doi.org/10.1038/s41539-024-00264-4>

Long, D., Roberts, J., Magerko, B., Holstein, K., DiPaola, D., & Martin, F. (2023). AI literacy: Finding common threads between education, design, policy, and explainability. *Extended Abstracts of the 2023 CHI Conference on Human Factors in Computing Systems*, 1–6. <https://doi.org/10.1145/3544549.3573808>

McDonald, N., Johri, A., Ali, A., & Collier, A. H. (2025). Generative artificial intelligence in higher education: Evidence from an analysis of institutional policies and guidelines. *Computers in Human Behavior: Artificial Humans*, 3, 100121. <https://doi.org/10.1016/j.chbah.2025.100121>

Morgan, A., Sibson, R., & Jackson, D. (2022). Digital demand and digital deficit: conceptualising digital literacy and gauging proficiency among higher education students. *Journal of Higher Education Policy and Management*, 44(3), 258–275. <https://doi.org/10.1080/1360080X.2022.2030275>

Ng, D. T. K., Leung, J. K. L., Chu, S. K. W., & Qiao, M. S. (2021). Conceptualizing AI literacy: An exploratory review. *Computers and Education: Artificial Intelligence*, 2, 100041. <https://doi.org/10.1016/j.caeai.2021.100041>

Ng, D. T. K., Wu, W., Leung, J. K. L., Chiu, T. K. F., & Chu, S. K. W. (2024). Design and validation of the AI literacy questionnaire: The affective, behavioural, cognitive and ethical approach. *British Journal of Educational Technology*, 55(3), 1082–1104. <https://doi.org/10.1111/bjet.13411>

Febriyanti, Nurchurifiani, E., Hastomo, T., Wicaksono, A., & Nasution, S. S. (2026). AI literacy of pre-service English teachers: Proficiency, strategies, and barriers. *JEELS (Journal of English Education and Linguistics Studies*, 13(1), 155-186.

Schiff, D. (2022). Education for AI, not AI for education: The role of education and ethics in national AI policy strategies. *International Journal of Artificial Intelligence in Education*, 32(3), 527-563. <https://doi.org/10.1007/s40593-021-00270-2>

Stolpe, K., & Hallström, J. (2024). Artificial intelligence literacy for technology education. *Computers and Education Open*, 6, 100159. <https://doi.org/10.1016/j.caeo.2024.100159>

Wu, Y., Zhang, W., & Lin, C. (2025). Generative Artificial Intelligence in University Education. *IT Professional*, 27(2), 69-74. <https://doi.org/10.1109/MITP.2025.3545629>

Zhang, J., & Zhang, Z. (2024). AI in teacher education: Unlocking new dimensions in teaching support, inclusive learning, and digital literacy. *Journal of Computer Assisted Learning*, 40(4), 1871-1885. <https://doi.org/10.1111/jcal.12988>

Zulianti, H., Hastuti, H., Nurchurifiani, E., Hastomo, T., Maximilian, A., & Ajeng, G. D. (2024). Enhancing novice EFL teachers' competency in AI-powered tools through a TPACK-based professional development program. *World Journal of English Language*, 15(3), 117-131. <https://doi.org/10.5430/wjel.v15n3p117>

Appendix

Generative AI Literacy Assessment Test (GLAT)

A. Know & Understand (8 items)

1. Which of the following best describes "Generative AI"?

- a. AI that creates new content such as text, images, or music from learned data
- b. AI designed only for translating languages
- c. AI used mainly for organizing large databases

- d. AI that predicts student test scores automatically
 - e. AI that only retrieves data without modification
2. What does a “Large Language Model (LLM)” primarily do?
- a. Translates text into multiple languages instantly
 - b. Predicts the next word in a sequence to generate text**
 - c. Summarizes entire textbooks automatically
 - d. Provides real-time internet updates for classroom teaching
 - e. Generates images and audio only
3. Which task can Generative AI accomplish most effectively in an ELT context?
- a. Diagnosing student learning difficulties in all subjects
 - b. Making complex ethical judgments
 - c. Generating human-like explanations or practice texts based on prompts**
 - d. Predicting national exam outcomes
 - e. Designing laboratory experiments
4. What is “zero-shot learning” in the context of AI?
- a. Performing a task without task-specific training**
 - b. Training a model with no data
 - c. Reducing training time to zero
 - d. Generating synthetic training data
 - e. Memorizing all possible answers to exam questions
5. In prompt-based AI use for lesson design, what is the main challenge?
- a. AI can only produce yes/no answers
 - b. Crafting prompts that capture classroom context accurately**
 - c. Need for expensive feature engineering
 - d. Requiring labeled data for every lesson
 - e. AI’s inability to handle English vocabulary
6. In Generative AI, what does “token” mean?
- a. A word or sub-word unit processed by the model**
 - b. A reward for students who use AI
 - c. A password for accessing AI systems
 - d. A fixed-length passage of text
 - e. A new method for compressing grammar rules
7. Which is NOT a feature of Artificial General Intelligence (AGI)?

- a. Learning new tasks without intervention
 - b. Performing across domains with human-like ability
 - c. Predicting students' future academic success with perfect accuracy**
 - d. Understanding and generating natural language
 - e. Adapting to different teaching contexts
8. How does Retrieval-Augmented Generation (RAG) improve LLMs in education?
- a. By enhancing grammar and style automatically
 - b. By providing real-time relevant academic resources**
 - c. By speeding up word tokenization
 - d. By reducing computational costs only
 - e. By recognizing handwriting in student assignments
- B. Use & Apply (8 items)**
9. Which strategy is LEAST effective when using AI to support lesson planning?
- a. Giving AI information about students' needs
 - b. Asking AI to include key teaching objectives
 - c. Using AI to create interactive learning materials
 - d. Providing AI with details of unrelated commercial products**
 - e. Supplying AI with examples of classroom tasks
10. An AI-based writing assistant often gives outdated examples. What should a pre-service teacher do?
- a. Encourage students to use it without checking
 - b. Regularly update AI with new teaching content
 - c. Compare AI outputs with recent textbooks or sources**
 - d. Escalate all tasks to supervisors
 - e. Ignore the problem as AI will self-correct
11. Why is RAG useful when preparing reading comprehension tasks?
- a. To generate unrelated fiction stories
 - b. To reduce model size
 - c. To retrieve specific texts from academic databases**
 - d. To translate passages into unrelated languages
 - e. To avoid student plagiarism detection
12. As a pre-service teacher, how can AI best help in lesson planning?
- a. Automatically grade all students' essays
 - b. Generate examples and exercises at different CEFR levels**

- c. Replace classroom teaching fully
- d. Ensure zero errors in students' writing
- e. Conduct oral practice without supervision

13. Which of the following shows good use of AI in English learning?

- a. Using AI to brainstorm role-play dialogues for speaking practice**
- b. Asking AI to predict students' exam scores
- c. Using AI as the sole grammar teacher
- d. Using AI to replace textbooks entirely
- e. Letting AI give grades without teacher feedback

14. What is the main benefit of giving AI detailed prompts for ELT tasks?

- a. It prevents token usage
- b. It produces responses closer to teachers' intent**
- c. It reduces teaching workload automatically
- d. It guarantees perfect answers
- e. It avoids any bias completely

15. Which action demonstrates effective AI use in group projects?

- a. Using AI to suggest collaborative writing outlines**
- b. Replacing group discussions with AI answers
- c. Allowing AI to assign group grades
- d. Avoiding AI in group learning activities
- e. Using AI only for spelling checks

16. Which of the following best reflects differentiated instruction with AI?

- a. Producing identical tasks for all students
- b. Generating exercises tailored to students' proficiency levels**
- c. Using AI only for high-achieving students
- d. Avoiding AI in mixed-level classes
- e. Limiting AI to vocabulary translation only

C. Evaluate & Create (7 items)

17. How should a student approach LLM-generated learning materials?

- a. Trust them fully without checking
- b. Compare with reliable sources before use**
- c. Assume they are more reliable than textbooks
- d. Use them without citation
- e. Consider them less reliable than teacher's input

18. Why might an LLM not provide up-to-date educational resources?

- a. Because of knowledge cutoff in training data**
- b. Because AI cannot summarize academic texts
- c. Because AI avoids educational data
- d. Because it updates automatically
- e. Because it cannot access the internet always

19. After receiving an AI-generated summary of a research article, what should pre-service teachers do?

- a. Accept as accurate without checking
- b. Verify with the original article**
- c. Discard the summary immediately
- d. Use another AI tool only
- e. Avoid AI summaries altogether

20. Which of the following indicates a video is NOT AI-generated?

- a. High-quality resolution
- b. Smooth editing transitions
- c. Familiarity of the lecturer's real voice**
- d. Polished professional look
- e. An AI watermark present

21. How can AI best support creativity in ELT teaching?

- a. Brainstorming lesson ideas and classroom activities**
- b. Replacing teachers' pedagogical decisions
- c. Producing final exams automatically
- d. Avoiding traditional teaching approaches
- e. Generating identical exercises repeatedly

22. What is the best way to handle possible bias in AI outputs used for teaching?

- a. Ignore them as minor
- b. Cross-check with textbooks or human experts**
- c. Accept all AI responses
- d. Remove AI tools from classrooms
- e. Avoid discussing bias

23. Which example shows evaluative use of AI in ELT?

- a. Comparing AI-generated grammar exercises with coursebooks**
- b. Asking AI to conduct oral exams independently
- c. Allowing AI to assign grades directly

- d. Replacing teacher's written feedback fully
- e. Avoiding evaluation of AI outputs

D. Ethics (7 items)

24. What is a potential risk when AI is used in student assessment?

- a. Misinterpreting essay formatting
- b. Reinforcing existing grading biases**
- c. Ignoring students' creativity and effort
- d. Translating texts incorrectly
- e. Overvaluing superficial features

25. Pre-service teachers do not fully trust AI writing feedback because they cannot see how it was generated. This illustrates:

- a. Lack of dataset diversity
- b. AI as a "black box" problem**
- c. Incorrect grading rubrics input
- d. Outdated training data
- e. Poor classroom management

26. What is a copyright concern when using AI-generated texts in assignments?

- a. Checking the AI tool's licensing policy**
- b. No restrictions apply for classroom use
- c. Paying a mandatory fee always
- d. Impossible to use in student projects
- e. AI texts are automatically public domain

27. Should restrictions be placed on AI outputs for education?

- a. Yes, to prevent harmful or misleading content**
- b. Yes, to reduce computing costs
- c. No, to ensure full student freedom
- d. No, because AI is always neutral
- e. No, since restrictions hinder creativity

28. What is a privacy risk of using AI in classrooms?

- a. AI always encrypts students' data safely
- b. AI cannot reveal personal information
- c. AI might output sensitive student data due to training**
- d. Quantum computing ensures full protection
- e. AI ignores private information automatically

29. Why should AI-generated content be cited in academic assignments?

- a. To acknowledge its role as a source**
- b. To avoid bias
- c. To make tasks look more attractive
- d. To improve AI performance
- e. To bypass plagiarism detection

30. What is a potential risk of over-relying on AI tools in ELT?

- a. Encouraging deeper creativity in learners
- b. Weakening students' critical thinking skills**
- c. Increasing teacher-student interaction
- d. Promoting collaborative learning
- e. Guaranteeing ethical AI use