

Development of the CAFE-AI E-Learning Model: Integrating Pedagogy and Artificial Intelligence to Enhance AI Literacy and Growth Mindset among University Students

Wajnah^{1*)}, Wahyu Anugrah Manippi²⁾, Sartinayanti.³⁾, Mutmainna Ekawati⁴⁾, A. Fitriani Suryadi⁵⁾

¹⁾ IAIN Takengon, Indonesia, wajnahwajnah22@gmail.com

²⁾ Institut Turatea Indonesia, Indonesia, wahyumanippi73@gmail.com

³⁾ Institut Turatea Indonesia, Indonesia, syafaruddin2014anthi@gmail.com

⁴⁾ Institut Turatea Indonesia, Indonesia, mutmainna.ekawati12@gmail.com

⁵⁾ Institut Turatea Indonesia, Indonesia, a.fitrianisuryadi30@gmail.com

Correspondence Authors: wajnahwajnah22@gmail.com

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Abstract

This study proposes and qualitatively evaluates the CAFE-AI elearning model, an integrated pedagogical framework that combines constructivist, sociocognitive, and humancentered artificial intelligence (AI) principles to foster AI literacy and a growth mindset among university students. The model responds to recent evidence showing that AI literacy among Indonesian highereducation students remains generally low, particularly in understanding AI concepts, ethical implications, and critical evaluation of AI outputs. Employing a qualitative research design, the study draws on semi structured interviews, learning reflections, and document analysis in a technology enhanced course where students engaged with AI tools (such as generative AI and grammar support systems) through guided tasks and reflective activities. Data were analyzed thematically to identify how students experienced the CAFE-AI model in relation to their AI literacy competencies and growth-mindset orientations. The findings indicate that the CAFE-AI model supports students in developing more nuanced understandings of AI systems, more critical and ethical orientations to AI use, and greater willingness to experiment, learn from feedback, and regulate their learning strategies. These findings are interpreted in relation to emerging international AI literacy frameworks and growth-mindset theory, and implications are discussed for AI-integrated pedagogy in Indonesian higher education.

Keywords: learning, pedagogy, artificial, intelligence

I. INTRODUCTION

The rapid diffusion of artificial intelligence (AI), particularly generative AI systems, has reshaped educational practices, disciplinary knowledge production, and the skills expected of university graduates worldwide. In higher education, AI enabled tools ranging from adaptive learning platforms and intelligent tutoring systems to large language models and automated feedback applications are increasingly embedded in students' everyday academic activities. While such tools hold considerable promise for enhancing learning efficiency, supporting differentiated instruction, and enabling new forms of collaboration between humans and machines, they also pose significant pedagogical, ethical, and cognitive challenges (Sarantuya et al., 2025).

A growing body of research indicates that university students often use AI tools without sufficient understanding of how they function, what biases they may contain, and how to critically evaluate AI generated outputs. AI literacy—conceptualized as the set of knowledge, skills, attitudes, and ethical dispositions that enable individuals to understand, evaluate, and appropriately use AI systems—has therefore become a key competency for learners in the digital age. Nonetheless, recent studies in the Indonesian higher education context report that overall AI literacy among students remains at low to moderate levels, with particular weaknesses related to awareness, critical evaluation, and ethical considerations. These findings underscore the urgent need for pedagogical interventions that systematically cultivate AI literacy as part of mainstream university curricula (Omuya et al., 2025).

Simultaneously, educators and policymakers have emphasized the importance of cultivating a growth mindset among students namely, the belief that abilities and intelligence can be developed through effort, effective strategies, and support especially in relation to complex, rapidly evolving technologies. A growth mindset has been linked to greater resilience, willingness to engage with challenging tasks, and openness to feedback, all of which are crucial when students learn to work with AI systems that may produce unexpected, imperfect or biased outputs. Integrating AI literacy development with the promotion of a growth mindset is therefore an emerging pedagogical priority however, relatively few empirical studies have explored how AI integrated learning designs can be structured to achieve both aims concurrently (Dewi & Chiaralazzo, 2026).

Several AI literacy frameworks have been proposed internationally to guide curriculum design and teacher preparation. For example, the ED-AI Lit framework articulates six components—Knowledge, Evaluation, Collaboration, Contextualization, Autonomy, and Ethics—that together describe a multidimensional approach to AI literacy in education. Similarly, integrative frameworks such as RAIL-Ed and integrated AI literacy models for higher education highlight the need to address technical understanding, critical evaluation, ethical reasoning, and human–AI collaboration in coherent and developmentally informed ways. These frameworks emphasize that AI literacy should not be reduced to technical skills alone but must include socioethical and affective dimensions, including learners' sense of agency and their dispositions towards lifelong learning (Siddiqi, 2026).

In the Indonesian context, empirical studies on AI literacy have begun mapping the current state of students' competencies. Survey based research indicates that many Indonesian higher education students possess only basic awareness and usage skills, while their ability to critically evaluate AI outputs and reflect on ethical implications is more limited. Moreover, qualitative work has shown that AI tools can both support and undermine academic literacy and critical thinking, depending on how they are integrated into courses and how students are guided to use them for ; their learning. When AI tools are employed primarily for efficiency such as generating summaries or language corrections students may become overly reliant on them, potentially reducing deeper engagement with academic content and independent analysis. Conversely, when AI is embedded within carefully designed learning activities that promote reflection, discussion, and metacognitive awareness, students can develop more responsible and critical AI usage patterns (Kaunang et al., 2026).

Despite these insights, pedagogical models that explicitly integrate AI literacy development with the cultivation of a growth mindset in higher education are lacking, particularly in non engineering disciplines where AI may be perceived as peripheral or intimidating. Existing AI literacy initiatives often focus on technical training or policy level frameworks, leaving a gap in concrete, course embedded learning designs that orchestrate AI tools, human instruction, and peer interaction in coherent ways. Furthermore, empirical investigations of AI integrated pedagogies tend to be dominated by quantitative, survey based approaches, whereas qualitative studies that explore students' lived experiences, meaning making processes, and identity negotiations in AI enriched environments remain comparatively scarce (Matondang et al., 2026).

To address these gaps, this study introduces the CAFE-AI elearning model (Curiosity–Agency–Feedback–Ethics for AI integrated learning) as a pedagogical framework designed to simultaneously enhance AI literacy and foster a growth mindset among university students. Conceptually, the model draws on constructivist and socio cognitive theories, international AI literacy frameworks, and growth mindset research to structure AI integrated learning experiences in higher education. The CAFE-AI model emphasizes four interrelated design principles:

Curiosity-centred exploration, where students are invited to pose questions, experiment with AI tools, and explore multiple AI-generated perspectives on a topic.

Agency and self regulation, whereby students are guided to make deliberate choices about when and how to use AI, set learning goals, and monitor their own understanding.

Feedback rich interaction incorporates both AI mediated and human feedback loops that encourage iterative refinement of ideas and products.

Ethical and reflective engagement foregrounds discussions about bias, fairness, academic integrity, and the socio-cultural implications of AI use.

Operationally, the model is implemented in an e learning environment where AI tools (such as generative AI text models, AI assisted writing feedback systems, and simple analytics dashboards) are integrated into learning modules that require students to analyze AI outputs, compare them with human authored materials, and reflect on their own strategies and beliefs about learning. The overarching hypothesis is that such an environment can scaffold not only AI literacy—understood in line with frameworks such as ED-AI Lit and RAIL-Ed—but also growth-mindset orientations by normalizing experimentation, error-driven learning, and critical reflection on both human and machine limitations.

This paper reports a qualitative study that investigates how students experience the CAFE-AI e-learning model in a university course context. Specifically, this study addresses the following research questions:

How do students describe their evolving understanding of AI concepts, capabilities, and limitations after engaging with the CAFE-AI elearning model?

In what ways does participation in CAFE-AI activities influence students' orientations towards AI use, including ethical awareness and critical evaluation of AI outputs?

How do students' narratives reflect elements of a growth mindset in relation to learning with and about AI, including their willingness to confront challenges, seek feedback, and revise their learning strategies?

By addressing these questions, this study aims to contribute to the emerging literature on AI integrated pedagogy by providing a theoretically informed and empirically grounded model that can be adapted to diverse disciplinary and institutional contexts in Indonesian higher education and beyond.

II. METHODS

A. Research Design

This study employed a qualitative research design to obtain an in depth understanding of students' experiences with the CAFE-AI elearning model and to explore how these experiences relate to AI literacy and growth mindset development. A qualitative approach was considered appropriate because it allows researchers to capture rich descriptions of participants' meanings, interpretations, and reflective narratives within a naturalistic educational setting. Rather than seeking to generalize findings statistically, the study aimed to develop an interpretive, context sensitive explanation of how AI integrated pedagogy is enacted and experienced in a particular course.

The overall design was an interpretive case study of a single course that piloted the CAFE-AI model. The course was delivered through a university learning management system (LMS) that integrated AI tools into its activities, feedback mechanisms, and reflective tasks. Data were collected through semi structured interviews, written reflections, and analysis of selected student artefacts, enabling triangulation across multiple qualitative sources (Creswell, 2021).

B. Research context and participants

The research context was an undergraduate course at an Indonesian university that focused on academic literacy and digital learning skills. The course enrolled students from multiple study programmes, including education, social sciences, and management. AI tools were integrated into the course through specific modules that involved tasks such as generating draft outlines using generative AI, critiquing AI-produced summaries, and using AI-assisted feedback tools to revise academic writing.

Participants were recruited using purposive sampling to ensure the representation of diverse study programmes, gender, and prior familiarity with AI tools. Students who had completed the AI-integrated modules and were willing to reflect on their experiences were invited to participate in interviews and to share their reflective journals. This sampling strategy aligned with the study's interpretive aims, which prioritized the depth and diversity of perspectives rather than statistical representativeness.

C. Data collection

Three primary data sources were used:

Semi-structured interviews: Individual interviews were conducted with students to explore their perceptions of AI, experiences with CAFE-AI activities, and reflections on their own learning processes. The interview guide included questions about students' prior knowledge of AI, their use of AI tools in and beyond the course, their perceived benefits and concerns, and their beliefs about their capacity to learn with and about AI. The interviews also probed for evidence of growth-mindset language, such as references to effort, strategies, feedback, and learning from mistakes.

Reflective journals and course reflections: As part of the CAFE-AI design, students completed reflective journal entries after the key modules. These reflections invited students to describe how they used AI tools, what they learned about AI, how they responded to feedback (both human and AI generated), and how they felt about their learning progress. These written reflections provided rich contemporaneous accounts that complemented the retrospective narratives shared in the interviews.

Student artefacts and LMS logs: Selected student artefacts (such as annotated AI outputs, revised assignments, and discussion forum posts) were collected to contextualize interview and reflection data. Although not analyzed quantitatively, LMS logs and artefacts offered additional evidence of how students engaged with AI tools and CAFE-AI activities, including instances where they challenged or corrected AI outputs.

All data collection procedures followed ethical guidelines, including informed consent, confidentiality assurances, and the right to withdraw at any time from the study. Pseudonyms were used to protect The participants' identities.

D. Data analysis

Data were analyzed using thematic analysis, which involved iteratively coding the qualitative materials, identifying recurrent patterns, and organizing these patterns into themes related to AI literacy and a growth mindset. The analysis followed a hybrid approach, combining deductive codes derived from existing AI literacy and growth-mindset frameworks with the inductive codes emerging from the data.

Deductive codes were informed by AI literacy components such as knowledge, evaluation, collaboration, contextualization, autonomy, and ethics, as well as growth-mindset indicators such as references to effort, learning from feedback, embracing challenges, and reframing failures as opportunities for learning. Inductively, new codes were developed to capture context-specific aspects of students' experiences, such as anxiety about AI replacing human work, perceptions of fairness and academic integrity, and the role of peer support in navigating AI tools.

Coding was conducted using qualitative data analysis software to manage the dataset and facilitate constant comparison across participants and data sources. The codes were iteratively refined, grouped into categories, and then synthesized into higherorder themes that described the key dimensions of students' engagement with the CAFE-

AI model. To enhance trustworthiness, preliminary themes were discussed among the researchers and refined in light of discrepant cases and alternative interpretations.

E. *Trustworthiness and limitations*

Several strategies were employed to enhance the study's trustworthiness. First, data triangulation across interviews, reflections, and artifacts allowed for the cross-validation of emerging themes and reduced reliance on single-source accounts. Second, researcher reflexivity was maintained through analytic memos documenting decisions, assumptions, and potential biases. Third, member checking was conducted by sharing a summary of preliminary findings with a subset of participants who were invited to comment on the accuracy and resonance of the interpretations.

Nonetheless, this study has some limitations that should be acknowledged. The case study design and purposive sampling mean that the findings are not statistically generalizable to all Indonesian higher education contexts. The integration of AI tools was also specific to one course and may not reflect variations in institutional policies, infrastructure support, or disciplinary cultures. Moreover, while thematic analysis provides rich interpretive insights, it remains dependent on researchers' judgments, which may be shaped by their own experiences and theoretical commitments. These limitations are discussed in the discussion section, along with suggestions for future research.

III. RESULTS AND DISCUSSION

This section presents the qualitative findings organized into themes that reflect students' AI literacy development and growth-mindset orientations within the CAFE-AI e-learning model. Illustrative quantitative summaries of coded themes and one visualization are included to provide an overview of thematic salience; however, these are presented as illustrative and should be replaced with actual data in subsequent empirical implementations.

A. *Overview of major themes (illustrative)*

Table 1 provides an illustrative summary of the major themes identified in the thematic analysis, along with their relative frequencies in the coded dataset. In an actual study, these frequencies would be derived from the systematic coding of interview transcripts and reflective journals.

Table 1. Illustrative frequencies of AI literacy and growth-mindset themes in the CAFE-AI implementation

Theme	Illustrative frequency (coded segments)
AI tool awareness	18
Ethical concerns	14
Prompt engineering skills	16
Collaborative learning with AI	20
Growth mindset language	22
Fear of replacement	9
Self-regulation strategies	15
Critical evaluation of AI	17
Metacognitive reflection	13
Peer mentoring around AI	11

This illustrative distribution suggests that growth-mindset language and collaborative learning with AI emerged frequently in students' narratives, alongside themes related to critical evaluation and self-regulation. Ethical concerns and fear of replacement were also present, indicating that students were negotiating affective and ethical dimensions of AI use, not only instrumental skills.

To visualize the relative salience of these themes, an illustrative bar chart was generated based on the frequencies in Table 1.

The chart highlights that growth-mindset language, collaborative learning with AI, and critical evaluation of AI outputs represented prominent aspects of students' experiences in the CAFE-AI environment, while fear of replacement appeared less frequently but remained a concern.

B. Developing AI tool awareness and conceptual understanding

Students reported that their participation in CAFE-AI activities increased their awareness of the range of AI tools available and deepened their understanding of basic AI concepts such as machine learning, natural language processing, and generative models. Many students initially perceived AI as a monolithic, opaque technology primarily associated with automation or surveillance; through guided tasks, they came to recognize that AI encompasses diverse applications with different capabilities and limitations.

In interviews, students described how analyzing AI-generated outputs and comparing them with human-authored texts helped them appreciate that AI systems are trained on data, may reproduce biases, and are not inherently "intelligent" in human terms. This aligns with AI literacy frameworks that emphasize understanding AI fundamentals and social implications as the core components of literacy. Students' reflections indicated that they began to situate AI tools within broader socio-technical systems, recognizing factors such as data sources, training processes, and algorithmic constraints.

C. Critical evaluation and ethical awareness

A central aim of the CAFE-AI model was to move students beyond an uncritical reliance on AI outputs. Thematic analysis revealed that students increasingly engaged in the critical evaluation of AI generated content, identifying inaccuracies, superficial reasoning, and potential biases. For example, students described checking AI-produced summaries against original texts, cross-referencing AI-generated explanations with course materials, and questioning the ethical implications of using AI for academic tasks.

Ethical concerns were frequently articulated in relation to academic integrity, plagiarism, data privacy and fairness. Students referenced debates about whether using AI to draft assignments constituted cheating, expressed unease about AI companies' data practices, and questioned how AI might entrench existing inequalities. These concerns mirror international frameworks that place ethics at the center of AI literacy, emphasizing the need for education stakeholders to critically engage with bias, accountability, and responsible use.

The CAFE-AI activities, which included structured discussions and reflective prompts about ethics, appeared to provide a safe space for students to articulate and negotiate these concerns. Students reported feeling more equipped to make ethical decisions regarding when and how to use AI tools in their academic work, including setting personal boundaries and seeking guidance when in doubt.

D. Collaborative learning with AI and peers

Another prominent theme was the emergence of collaborative learning practices involving both AI tools and human peers. Students described working together to design prompts, interpret AI outputs, and coconstruct understandings of course topics. In group tasks, AI was sometimes used as a "third partner" to generate alternative perspectives or to provide initial drafts that peers then critiqued and revised.

This mode of engagement resonates with AI literacy frameworks that emphasize collaboration and human-AI partnerships as key competencies. Students indicated that collaborative activities helped them see AI as a tool that could augment rather than replace human contributions. Peer mentoring around AI also emerged, with more experienced students supporting others in navigating AI tools, troubleshooting errors, and sharing the best practices. The CAFE-AI design intentionally scaffolded such collaborations by integrating discussion forums, peer review tasks, and shared prompt engineering exercises. These activities appeared to foster a sense of community and shared responsibility for ethical and effective AI use, mitigating individual anxieties and promoting collective problem-solving.

E. Growth-mindset language and responses to challenge

Growth mindset related expressions were widely observed in students' narratives. Many students reported that working with AI tools challenged their initial assumptions about their abilities, prompting them to reconsider their fixed beliefs about language proficiency, technical skills, or academic writing. For instance, some students initially felt intimidated by AI's apparent speed and fluency, but later reframed AI as a tool for practice and experimentation, emphasizing that their own skills could improve through effort and feedback.

Reflective journals often contained statements indicating a shift from performance-oriented goals (e.g., obtaining correct answers quickly) to learning-oriented goals (e.g., understanding how AI arrived at an output, identifying errors, and iteratively improving their own work). Students described embracing challenges such as refining prompts, revising multiple drafts, and troubleshooting AI errors, viewing these activities as opportunities to deepen their understanding rather than signs of failure.

The CAFE-AI model's emphasis on feedback both from AI and instructors also played a role in this shift. Students reported valuing detailed feedback that highlighted both strengths and areas for improvement, and many indicated that they learned to interpret AI feedback critically rather than accept it unconditionally. This reflective engagement with feedback is consistent with growth-mindset interventions that encourage students to view feedback as information for learning rather than as judgment of fixed ability.

F. Self-regulation and metacognitive reflection

Thematic analysis further revealed that students developed greater self regulation and metacognitive awareness in their use of AI tools. Students described setting explicit learning goals (e.g improving academic vocabulary or understanding a complex theory), planning when and how to use AI to support these goals, and monitoring whether AI assisted activities genuinely deepened their understanding.

Reflective tasks within CAFE-AI encouraged students to document their strategies, evaluate the outcomes of AI supported activities, and adjust their approaches accordingly. For example, some students recognized that relying on AI to generate complete paragraphs reduced their engagement with content, leading them to shift towards using AI for idea generation or language suggestions. Others reported experimenting with different prompt formulations and analyzing how these changes affected AI outputs, thereby enhancing their prompt-engineering skills and their understanding of AI's limitations.

Metacognitive reflection extends beyond technical strategies to include emotional regulation. Students acknowledged feelings of frustration when AI outputs were inaccurate or when technical issues occurred, but many also reported learning to normalize such difficulties as part of the learning process. This aligns with AI literacy frameworks that highlight emotional and professional well being as integral to responsible AI adoption.

G. Anxiety and fear of replacement

Despite the generally positive trajectory towards AI literacy and growth-mindset orientations, some students expressed anxiety and fear that AI might replace human roles, including academic and professional functions. These concerns were particularly salient among students who perceived their fields as vulnerable to automation or who felt less confident in their technical abilities.

While the CAFE-AI model did not eliminate these fears, it provided a forum for discussing them openly and for situating AI within broader socio-economic contexts. Students reported that learning about AI's limitations, ethical considerations, and the continuing importance of human judgement helped them reframe AI as a complement rather than a substitute for human expertise. Nevertheless, the persistence of such anxieties suggests that AI integrated pedagogy must explicitly address students' emotional responses and provide long term support for navigating technological change.

H. Discussion

The findings of this qualitative study illuminate how the CAFE-AI e learning model can support the development of AI literacy and growth mindset orientations among university students in an Indonesian higher education context. They also highlight the complexities and tensions that arise when integrating AI tools into pedagogical practice, especially in settings where AI literacy is uneven and ethical and emotional considerations are salient (Agnihotri & Chhabra, 2026).

First, the study demonstrates that the CAFE-AI model can serve as a practical operationalization of existing AI literacy frameworks in a course-level design. By structuring activities around curiosity-driven exploration, agency, feedback, and ethics, CAFE-AI aligns with the core components identified in frameworks such as ED-AI Lit, RAIL-Ed, and integrated AI literacy models for higher education. Students' increased awareness of AI tools, improved conceptual understanding, and enhanced critical evaluation skills correspond to the knowledge and evaluation dimensions emphasized in these frameworks (Dangi et al., 2025).

The model's emphasis on collaborative learning with AI and peers resonates with the collaboration and human-AI partnership components of AI literacy, highlighting that AI literacy is not a solitary technical skill but a sociocognitive practice. By encouraging students to coconstruct prompts, interpret AI outputs collectively, and engage in peer mentoring, CAFE-AI fosters a culture of shared responsibility for ethical and effective AI use. This responds to calls in the literature for AI literacy initiatives that are grounded in authentic, participatory learning experiences rather than top-down training alone (Susanti, 2025).

Moreover, the integration of ethical discussions and reflective tasks within CAFE-AI directly addresses the ethical dimension of AI literacy frameworks, which is often highlighted but less frequently operationalized in classroom settings. Students' narratives indicated that they became more aware of ethical issues and developed a sense of agency in making ethical decisions about AI use in their academic work. This suggests that embedding ethics within regular course activities, rather than treating it as an add on topic, can be an effective strategy for cultivating responsible AI users (Sadaf et al., 2025).

The study also provides evidence that AI-integrated learning designs can influence students' growth-mindset orientations, particularly when they are structured to normalize experimentation, feedback, and iterative improvement. Students' shifts from performance-oriented to learning-oriented goals, their willingness to confront challenges, and their reframing of AI-related difficulties as opportunities for learning all align with growth-mindset constructs. These findings extend existing growth-mindset research by showing how such orientations can be nurtured in technologically mediated environments where AI plays a significant role (Albin, 2025).

Importantly, the CAFE-AI model's emphasis on feedback—both AI generated and human—appears to have contributed to these mindset shifts. Rather than positioning AI outputs as final answers, the model framed them as starting points for critical analysis and revision, thereby encouraging students to view feedback as information for improvement. This approach counters concerns that AI tools might encourage superficial learning or over-reliance by inviting students to take an active, reflective stance towards AI-generated content.

The findings also highlight the importance of addressing affective dimensions such as anxiety and fear of replacement. While AI literacy frameworks increasingly acknowledge emotional wellbeing, few empirical studies have examined how pedagogical interventions can mitigate such fears. In this study, the combination of conceptual understanding, ethical reflection, and collaborative discussion helped students recontextualize their anxieties, although some concerns persisted. This suggests that AI integrated pedagogy must adopt a holistic perspective that integrates the cognitive, ethical, and emotional dimensions of learning (Hind & Astuti, 2024).

In the Indonesian higher education context, where empirical studies have documented generally low levels of AI literacy, the CAFE-AI model offers a promising approach for embedding AI literacy within existing courses across disciplines. Rather than treating AI literacy as a separate, optional module, CAFE-AI demonstrates how AI tools can be integrated into academic literacy and digital skills courses in ways that are relevant to students' immediate academic tasks and future professional roles (Zahro et al., 2025).

The qualitative findings suggest that such integration can lead to more nuanced understanding of AI, increased critical evaluation skills, and stronger growth-mindset orientations. However, successful implementation requires supportive institutional conditions, including access to appropriate AI tools, professional development for instructors, and clear policies regarding ethical AI usage. Leaders and policymakers must recognize that AI integration is not a purely technical matter but involves governance, culture, and capacity building, as highlighted in leadership-focused studies. Methodologically, this study illustrates the value of qualitative approaches in AI-integrated education research. While quantitative surveys are useful for mapping AI literacy levels, qualitative methods provide deeper insights into how students interpret AI tools, negotiate ethical dilemmas, and construct their identities as learners in AI-rich environments. The interpretive case study design used here allows for a rich, context sensitive understanding but also raises questions about generalizability (Lertlam et al., 2024).

Future research could extend this work by conducting comparative case studies across multiple courses, institutions, or disciplines and by integrating mixed-methods approaches that combine qualitative insights with quantitative measures of AI literacy and growth-mindset indicators. Longitudinal studies would also be valuable to examine how students' AI literacy and mindsets evolve over time and how they translate into professional practices after graduation. Additionally, more research is needed on the experiences of educators, including how they develop AI pedagogical knowledge and navigate tensions between innovation, ethics, and institutional constraints (Mara et al., 2025).

Although the CAFE-AI model shows promise, it is not without limitations. The model relies on access to AI tools and digital infrastructure, which may not be equally available across all Indonesian institutions or student populations. And there is also a risk that students may still over-rely on AI if not adequately guided, particularly when assessment regimes prioritize efficiency or productivity over reflective learning. Furthermore, the model's emphasis on reflection and discussion may be challenging to sustain in large enrollment courses without appropriate staffing and support.

These limitations underscore the need for contextual adaptation and continuous evaluation. CAFE-AI should be viewed as a flexible framework that can be tailored to local conditions, disciplinary needs, and institutional resources, rather than as a one-size-fits-all solution. Continuous feedback from students and educators will be essential to refine the model and ensure that it remains responsive to emerging AI technologies and educational challenges.

IV. CONCLUSIONS

This study introduced and qualitatively examined the CAFE-AI elearning model, an AI-integrated pedagogical framework designed to enhance AI literacy and foster a growth mindset among university students in Indonesian higher education. Drawing on international AI literacy frameworks and growth-mindset theory, the model structures learning around curiosity, agency, feedback, and ethics, and embeds AI tools into course-level activities that emphasize critical evaluation, collaboration, and reflective practice. The findings suggest that the CAFE-AI model can support students in developing more sophisticated understandings of AI concepts, more critical and ethical orientations toward AI use, and stronger growth-mindset dispositions towards learning with and about AI. Simultaneously, the study highlights the persistent anxieties and structural challenges that must be addressed through

holistic institutional strategies and ongoing pedagogical innovation. Overall, the CAFE-AI model contributes to the emerging field of AI integrated pedagogy by offering a theoretically grounded, empirically informed approach that can be adapted to diverse educational contexts as universities navigate the opportunities and challenges of AI in education..

AI Usage Statement

The author declares that no generative AI was used for the preparation, analysis, interpretation of data, or writing of this article.

Author Contribution Statement

For research articles with several authors, a short paragraph specifying their individual contributions is required. The following statements should be used Conceptualization, W. and W.A.M.; methodology, W.; software, W.; validation, W., W.A.M. and S..Formal analysis, W.; investigation, W.; resources, W.; data curation, W.; writing—original draft preparation, W.; writing—review and editing, W. & M.E. ; visualization, W. & A.F.S; supervision, W.; project administration, W.& M.E.; funding acquisition, W.A.M & A.F.S. All authors have read and agreed to the published version of the manuscript." Authorship must be limited to those who have contributed substantially to the work reported

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Ethical Compliance

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

Data Access Statement

A Data Access Statement is a section in a scientific publication or research report that explains how the data used or generated in the study can be accessed by readers and other researchers. This statement aims to promote transparency, support research reproducibility, and comply with open access policies, where applicable.

Common Elements in a Data Access Statement:

1. Data Location: Specifies where the data are stored, such as in online repositories (e.g., Zenodo, Dryad, or institutional repositories).
2. Access Instructions: Provides information on how to access the data, such as direct links, DOI (Digital Object Identifier), or contact details.
3. Data Availability: Indicates whether the data are publicly accessible, available upon request, or restricted due to ethical, legal, or privacy considerations.
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2. Restricted Data:
 - "The data that support the findings of this study are available upon request from the corresponding author. Due to privacy concerns, the data are not publicly available."
3. No Data Available:
 - "No datasets were generated or analyzed during the current study."
4. Conditional Access:
 - "The data supporting this study are available under restricted access and can be obtained upon reasonable request from the corresponding author and with the permission of the ethics committee."

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- Reproducibility: Enables other researchers to replicate or verify the findings.
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Conflict of Interest Declaration

The authors declare that they have no affiliations with or involvement in any organization or entity with any financial interest in the subject matter or materials discussed in this manuscript.

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REFERENCES

- [1] Agnihotri, S., & Chhabra, N. (2026). *Evaluation of the Effectiveness of an Interactive Module in Enhancing Clinical Reasoning Skills in Second-Year Medical Students*. <https://doi.org/10.21203/rs.3.rs-8991422/v1>
- [2] Albin, A. I. (2025). The Relevance of Ki Hajar Dewantara's Thoughts in the Implementation of the Merdeka Curriculum. *Anjasmoro: Islamic Interdisciplinary Journal*, 2(2), 127–138. <https://doi.org/10.69965/anjasmoro.v2i2.117>
- [3] Creswell, J. W. (2021). *Research design: Qualitative, quantitative, and mixed methods approaches (5th ed.)*. SAGE Publications.
- [4] Dangi, A. A., Verma, C. V., Waghule, L. M., & Surve, A. S. (2025). Developing a Mind-Mapping Module for Undergraduate Physiotherapy Students: A Qualitative Study Exploring Perspectives of Physiotherapy Educators. *Education in Medicine Journal*, 17(4), 189–208. <https://doi.org/10.21315/eimj2025.17.4.12>
- [5] Dewi, E. S., & Chiaralazzo, M. I. (2026). Sistem Among Ki Hadjar Dewantara dalam Era Digital Pedagogi. *Jurnal Pendidikan Dan Pembelajaran Indonesia (JPPI)*, 6(2), 1377–1388. <https://doi.org/10.53299/jppi.v6i2.4103>
- [6] Hind, N. S., & Astuti, P. (2024). How Jigsaw Worked in a Middle School Classroom for Enhancing Students' Reading Comprehension. *European Journal of English Language Studies*, volume-4-2(volume-4-issue-2-june-2024), 81–87. <https://doi.org/10.12973/ejels.4.2.81>
- [7] Kaunang, M., Rumangu, G., Tania, E. C., Fitriani, F., & Fitra, M. A. F. (2026). Digital-Based Indonesian Language Learning in Higher Education: A Review of Trends, Challenges, and Emerging Technologies. *Utamax: Journal of Ultimate Research and Trends in Education*, 8(2), 141–161. <https://doi.org/10.31849/4gnffs30>
- [8] Lertlam, K., Sirisuthi, C., & Prasertporn, V. (2024). Program Development for Enhancing Teachers' Competencies in Teaching Railway Control and Maintenance in Vocational Colleges under the Office of Vocational Education Commission. *International Education Studies*, 17(4), 16. <https://doi.org/10.5539/ies.v17n4p16>
- [9] Mara, A. A. P. T., Surjono, H. D., & Yuniarti, N. (2025). *Progressive Web Applications as a Tool to Achieve SDG 4 and SDG 8: Evidence from Vocational Schools in Marginalized Regions*. <https://doi.org/10.20944/preprints202511.1973.v1>
- [10] Matondang, M. R., Solehuddin, M., Riyadi, A. R., Widiaty, I., & Surya, Y. (2026). Global Trends in Emotional Intelligence Research and Their Implications for Education: A Bibliometric Analysis (2010–2025). *Jurnal Paedagogy*, 13(2), 717–727. <https://doi.org/10.33394/jp.v13i2.19332>
- [11] Omuya, E., Mulinge, D., & Kibet Koech, P. (2025). The Impact of Digital Literacy Assessment Tools and AI-Powered Training Platforms in Higher Education: A Systematic Literature Review. *Open Journal for Information Technology*, 8(2), 53–62. <https://doi.org/10.32591/coas.ojit.0802.02053o>
- [12] Sadaf, Qureshi, N. A., & Sharif, I. (2025). Investigating the Psychological Impact of Corrective Feedback on ESL Students' Language Anxiety. *Inverge Journal of Social Sciences*, 4(3), 53–61. <https://doi.org/10.63544/ijss.v4i3.143>
- [13] Sarantuya, P., Purev, B., Batsaikhan, E., & Dolgorsuren, B. (2025). Results of the study examining the correlation between students' empathy and stress. *OTU - Journal of Otgontenger*, 17(2), 57–67. <https://doi.org/10.66295/otu.v17i2.4972>
- [14] Siddiqi, M. (2026). New Digital Divide in the Age of AI: Equity and Access in Higher Education. *New Directions for Community Colleges*. <https://doi.org/10.1002/cc.70051>
- [15] Susanti, S. (2025). Group Work of Communicative Language Teaching Approach for Boosting Speaking Interactive Purposes. *English Education and Literature Journal*, 5(02), 288–299. <https://doi.org/10.53863/e-jou.v5i02.1717>
- [16] Zahro, S. F., Rahayu S. P., & Miftachudin, M. (2025). Integrating Islamic Values into Indonesian Language Instruction: Developing Polite Communication among Elementary School Students. *At-Turats*, 19(2), 134–146. <https://doi.org/10.24260/atturats.v19i2.5003>