

The Impact of AI Literacy Training through Community-Based Education on Teachers' Readiness to Integrate Generative AI in Learning

Nurlaiha Ibrahim^{1*}, Happy Sapulete²

¹ STIKIP Ita Wotu Nusa, Indonesia

² Universitas Pattimura, Indonesia

Corresponding Email:nurlaihaibrahim@gmail.com

Abstract

The rapid advancement of generative artificial intelligence (GenAI) is transforming educational practices and creating new demands for teachers to develop the knowledge, skills, and critical awareness required for responsible AI integration. However, teachers' limited AI literacy, uncertainty regarding pedagogical applications, and concerns related to ethics, accuracy, privacy, and academic integrity may hinder their readiness to adopt GenAI in learning environments. This study aims to examine the impact of AI literacy training delivered through community-based education on teachers' readiness to integrate generative AI into teaching and learning. A quantitative quasi-experimental design was employed involving teachers who participated in a structured community-based AI literacy training program. The training emphasized fundamental AI concepts, practical use of generative AI tools, prompt design, AI-assisted instructional planning, critical evaluation of AI-generated content, and ethical and responsible AI practices. Data were collected using validated AI literacy and GenAI integration readiness questionnaires administered before and after the intervention. Descriptive statistics, paired-samples t-tests, correlation analysis, and regression analysis were used to evaluate changes in participants' competencies and determine the contribution of AI literacy to teachers' readiness. The findings indicate that community-based AI literacy training significantly improved teachers' understanding of AI, practical competence in using generative AI, critical evaluation skills, ethical awareness, and confidence in integrating AI into pedagogical practices. Furthermore, AI literacy was found to have a positive and significant effect on teachers' readiness to integrate GenAI, suggesting that higher levels of AI literacy are associated with stronger technological, pedagogical, and ethical preparedness.

Keywords: AI literacy; community-based education; generative artificial intelligence

Introduction

The rapid development of artificial intelligence (AI) has become one of the key drivers of global educational transformation, particularly through changes in how knowledge is produced, accessed, personalized, and used in the learning process. This transformation is entering an increasingly significant phase with the emergence of generative artificial intelligence (GenAI) AI-based technology capable of generating various forms of new content based on user instructions, including text, images, learning materials, assessment questions, feedback, and support for the planning and development of learning activities. UNESCO (2023) emphasizes that the development of GenAI opens new opportunities to support curriculum design, teaching, learning, and research; however, its use must be situated within a human-centered framework to ensure that the technology continues to strengthen human agency and capacity. In line with this, systematic reviews indicate that GenAI has emerged as a tool for pedagogical enhancement, increased

productivity, professional skill development, and interdisciplinary learning (Yusuf et al., 2024). Thus, educational technology no longer functions merely as an administrative tool or a medium for conveying information but is gradually evolving into a pedagogical partner that can help teachers design learning experiences that are more adaptive, responsive, and oriented toward students' needs.

The integration of GenAI also offers strategic opportunities to enhance learning personalization, teacher efficiency, creativity in content development, access to learning resources, and the provision of more flexible learning support. Empirical evidence summarized in a meta-analysis indicates that the use of ChatGPT in educational contexts can have a positive impact on academic performance, affective-motivational states, and higher-order thinking skills, although its effectiveness remains dependent on the quality of pedagogical design and the context of its implementation (Deng et al., 2025). These changes also have significant implications for teachers' professional competencies, as the presence of AI requires the education system to reevaluate the knowledge, skills, and attitudes needed for future learning processes (OECD, 2025). In fact, the OECD Digital Education Outlook 2026 identifies GenAI as a technology that is reshaping the educational landscape and emphasizes the importance of its effective use to achieve learning objectives (OECD, 2026). Therefore, teacher professionalism in the GenAI era cannot be supported solely by conventional digital competencies; it must be expanded to include AI literacy, the ability to critically evaluate AI outputs, an understanding of AI ethics and risks, and the capacity to integrate GenAI in a pedagogically sound, responsible, and human-centered manner.

Generative artificial intelligence (GenAI) represents an emerging category of artificial intelligence capable of generating new content—including text, images, audio, code, simulations, and other learning resources—based on user prompts and patterns learned from large-scale datasets. In educational contexts, these capabilities extend the function of digital technologies beyond information delivery toward interactive support for teaching, learning, and instructional decision-making. GenAI can assist teachers in *lesson planning*, developing contextualized instructional materials, generating questions and assessment instruments, providing formative feedback, differentiating learning activities, and adapting content to students' varying levels of ability and learning needs. It can also support personalized learning experiences by providing explanations, examples, and learning activities that can be adjusted to individual learners, while simultaneously creating new opportunities for teachers and students to explore ideas, generate content, and strengthen creativity (Lo, 2023; Miao & Holmes, 2023). These affordances indicate a gradual transformation in educational practice in which technology is no longer positioned merely as a supplementary instructional tool but increasingly functions as an interactive pedagogical resource. Nevertheless, meaningful integration should be driven by explicit learning objectives and sound instructional design rather than technological novelty. Despite these pedagogical opportunities, the integration of GenAI into teaching and learning introduces substantial technical, ethical, cognitive, and social challenges that require critical consideration. GenAI systems may produce *hallucinations* or plausible but factually inaccurate information, reproduce biases embedded in training data, and create concerns regarding privacy, data security, intellectual property, authorship, plagiarism, and

academic integrity (Kasneci et al., 2023; Miao & Holmes, 2023). Excessive reliance on AI-generated responses may also encourage superficial learning and potentially reduce opportunities for students to independently engage in critical thinking, problem solving, argumentation, and knowledge construction when AI is used without appropriate pedagogical guidance. Moreover, unequal access to AI technologies and differences in teachers' and students' digital and AI competencies may reinforce existing educational inequalities, while limited transparency concerning how generative models produce their outputs can complicate the evaluation of accuracy, accountability, and credibility. These challenges demonstrate that access to GenAI does not automatically translate into high-quality educational integration. Instead, effective adoption requires teachers who possess sufficient AI literacy to verify generated information, recognize bias and limitations, protect student data, maintain academic integrity, and determine when AI use is pedagogically appropriate.

Artificial intelligence literacy (AI literacy) has emerged as a critical professional competency for teachers as artificial intelligence becomes increasingly embedded in contemporary educational environments. In educational contexts, AI literacy can be understood as a multidimensional capacity that enables individuals to understand fundamental AI concepts and mechanisms, interact effectively with AI systems, critically evaluate their outputs, and make informed and ethical decisions regarding their use (Long & Magerko, 2020; Ng et al., 2021). Unlike conventional *digital literacy*, which primarily emphasizes the ability to access, operate, evaluate, communicate, and create information through digital technologies, AI literacy requires an additional understanding of algorithmic processes, data-driven decision making, the limitations and biases of AI systems, and human responsibility in AI-mediated activities. For teachers working with generative AI (GenAI), this competency can be conceptualized through several interconnected dimensions: AI knowledge and understanding, AI application skills, prompting competence, critical evaluation of AI-generated content, ethical AI awareness, and responsible AI use. These competencies enable teachers not only to operate GenAI tools but also to formulate effective prompts, verify the accuracy and relevance of AI-generated information, identify potential hallucinations and biases, protect privacy, maintain academic integrity, and determine whether particular AI applications align with pedagogical objectives. Accordingly, AI literacy should be regarded as an emerging component of teachers' professional competence because meaningful GenAI integration requires a combination of technological knowledge, pedagogical judgment, critical thinking, and ethical responsibility (UNESCO, 2023).

Previous studies have increasingly demonstrated that teachers' AI literacy constitutes an important foundation for the meaningful integration of artificial intelligence into educational practice. A scoping review by Sperling et al. (2024) found that AI literacy was becoming an important topic in education, yet remained relatively underdeveloped specifically within teacher education, particularly regarding the integration of epistemic, practical, and ethical knowledge needed for pedagogical practice. More recent empirical evidence further indicates that teachers' AI literacy is closely associated with AI acceptance, willingness to use AI, computational thinking, and AI anxiety, suggesting that readiness for AI integration is influenced not only by technical competence but also by

motivational and psychological factors (Deshen et al., 2026). Importantly, professional development appears capable of strengthening these competencies: a six-week training program involving mid-career teachers produced significant improvements in AI-related technological-pedagogical knowledge and supported teachers' ability to envision innovative and ethically informed applications of AI in teaching and assessment. Similarly, professional development that supports teachers' autonomy, competence, and relatedness has been shown to improve AI literacy and sustain engagement within professional learning communities, reinforcing the value of collaborative professional learning for AI integration. Nevertheless, a systematic review of 43 empirical studies published between 2020 and 2025 revealed that research on in-service teachers' AI literacy remains conceptually fragmented and characterized by substantial variation in professional-development approaches and institutional support.

Research Methods

This study employed a community-based participatory action approach within a community service (*Pengabdian kepada Masyarakat/PkM*) framework to strengthen teachers' AI literacy and readiness to integrate generative artificial intelligence (GenAI) into teaching and learning. The program positioned teachers not merely as recipients of technological training but as active partners involved in identifying instructional needs, participating in collaborative learning activities, practicing GenAI applications, and reflecting on their implementation in authentic educational contexts. Participants consisted of teachers from partner schools or teacher communities selected purposively based on their willingness to participate in the entire community service program and their need for professional development related to AI-supported learning. The intervention was implemented through several interconnected stages: needs assessment, program preparation, AI literacy training, hands-on mentoring, collaborative practice, reflection, and evaluation. The training materials covered fundamental AI and GenAI concepts, basic *prompt engineering*, AI-assisted lesson planning, development of instructional materials and assessments, generation and evaluation of AI-based feedback, critical verification of AI-generated information, academic integrity, data privacy, ethical considerations, and responsible AI use. Community-based learning principles were operationalized through interactive workshops, demonstrations, small-group discussions, peer learning, problem-solving activities, direct practice with GenAI platforms, and mentoring, thereby allowing teachers to develop AI competencies through collaborative engagement with instructional problems encountered in their own professional contexts.

The effectiveness of the community service program was evaluated using a pretest–posttest quantitative evaluation supported by observation, participant feedback, and documentation of training activities. Prior to the intervention, participants completed a pretest questionnaire to establish their initial levels of AI literacy and readiness to integrate GenAI, followed by a posttest administered after the completion of training and mentoring activities. AI literacy was assessed through dimensions of AI knowledge and understanding, AI application skills, prompting competence, critical evaluation of AI-generated content, ethical AI awareness, and responsible AI use, while GenAI integration readiness encompassed technological, pedagogical, psychological, critical, and ethical

readiness. Quantitative data were analyzed using descriptive statistics to identify changes in mean scores and participant competency levels, while a *paired-samples t-test* was employed to determine whether differences between pre-intervention and post-intervention scores were statistically significant. Effect-size analysis was also used to determine the magnitude of improvement generated by the program. In addition, observations, reflective discussions, participant responses, and documentation were analyzed descriptively to provide contextual evidence concerning teachers' engagement, practical competencies, perceived benefits, and challenges during the program. This evaluation framework enabled the community service activity to assess not only short-term improvements in teachers' AI literacy but also their practical preparedness to apply GenAI in a pedagogically meaningful, critical, ethical, and responsible manner, thereby supporting sustainable teacher professional development through community-based education.

Result and Dicussion

The pre-training assessment revealed that teachers' initial levels of AI literacy and readiness to integrate generative artificial intelligence (GenAI) were generally within the moderate category table 1.

Table 1.Pre-Training Levels of AI Literacy and GenAI Integration Readiness

Construct	Dimension	Mean	SD	Category
AI Literacy	AI Knowledge and Understanding	3.24	0.55	Moderate
	AI Application Skills	2.94	0.57	Moderate
	Prompting Competence	2.68	0.63	Moderate
	Critical Evaluation of AI-Generated Content	2.79	0.61	Moderate
	Ethical AI Awareness	3.18	0.58	Moderate
	Responsible AI Use	3.21	0.54	Moderate
	Overall AI Literacy	3.01	0.56	Moderate
GenAI Integration Readiness	Technological Readiness	3.19	0.54	Moderate
	Pedagogical Readiness	2.81	0.59	Moderate
	Psychological Readiness	3.04	0.56	Moderate
	Critical Readiness	2.76	0.62	Moderate
	Ethical Readiness	2.96	0.55	Moderate
	Overall GenAI Integration Readiness	2.95	0.57	Moderate

Table 2 presents the baseline conditions of teachers' AI literacy prior to participating in the community-based AI literacy training program. The findings indicate that the overall level of AI literacy was categorized as moderate ($M = 3.01$, $SD = 0.56$), suggesting that participants had developed a basic understanding of artificial intelligence but had not yet acquired comprehensive competencies for its effective application in educational settings. Among the six dimensions, AI knowledge and understanding recorded a relatively high mean score ($M = 3.24$, $SD = 0.55$), followed by responsible AI use ($M = 3.21$, $SD = 0.54$)

and ethical AI awareness ($M = 3.18$, $SD = 0.58$). These results indicate that teachers were relatively aware of fundamental AI concepts and recognized the importance of responsible and ethical use. However, lower scores were observed for AI application skills ($M = 2.94$, $SD = 0.57$), critical evaluation of AI-generated content ($M = 2.79$, $SD = 0.61$), and particularly prompting competence ($M = 2.68$, $SD = 0.63$). The relatively weak performance in these dimensions demonstrates that teachers' familiarity with AI had not yet been fully translated into practical competencies, particularly their ability to formulate effective prompts and critically assess the accuracy, relevance, credibility, and potential bias of AI-generated information.

A similar pattern was identified in teachers' readiness to integrate GenAI into teaching and learning, with the overall readiness score falling within the moderate category ($M = 2.95$, $SD = 0.57$). Technological readiness obtained the highest mean score ($M = 3.19$, $SD = 0.54$), indicating that teachers generally possessed sufficient confidence and basic technological capacity to access and operate digital tools. Psychological readiness was also moderate ($M = 3.04$, $SD = 0.56$), suggesting a relatively positive disposition toward adopting GenAI. Nevertheless, pedagogical readiness ($M = 2.81$, $SD = 0.59$) and critical readiness ($M = 2.76$, $SD = 0.62$) remained comparatively weak, while ethical readiness reached $M = 2.96$ ($SD = 0.55$). These findings reveal an important discrepancy between teachers' basic technological preparedness and their capacity to make pedagogically and critically informed decisions regarding GenAI integration. Thus, the baseline data provide empirical justification for implementing community-based AI literacy training that extends beyond technical familiarity by strengthening prompting skills, instructional design, critical evaluation, ethical decision-making, and responsible AI practices. Such competencies are essential for transforming teachers from passive users of emerging AI technologies into informed and pedagogically purposeful practitioners capable of integrating GenAI meaningfully into learning environments. The paired-samples t-test demonstrated that community-based AI literacy training produced a statistically significant improvement in teachers' readiness to integrate generative artificial intelligence (GenAI) into teaching and learning table 2.

Table 2. Effect of Community-Based AI Literacy Training on Teachers' GenAI Integration Readiness

Variable	Pretest M (SD)	Posttest M (SD)	Mean Gain	<i>t</i>	<i>df</i>	<i>p</i>	Cohen's <i>d</i>	Decision
GenAI Integration Readiness	2.95 (0.57)	4.12 (0.48)	1.17	12.86	39	< .001	2.03	H1 Supported

Table 3 demonstrates that the community-based AI literacy training produced a substantial improvement in teachers' readiness to integrate generative artificial intelligence (GenAI) into teaching and learning. The participants' mean readiness score increased from 2.95 ($SD = 0.57$) at the pretest stage to 4.12 ($SD = 0.48$) at the posttest stage, resulting in a mean gain of 1.17 points. The paired-samples t-test confirmed that this increase was statistically significant, $t(39) = 12.86$, $p < .001$, indicating a meaningful difference in teachers' readiness before and after participation in the training program. Furthermore, the effect-size analysis yielded Cohen's $d = 2.03$, representing a very large effect and demonstrating that the intervention had strong practical significance in addition to statistical significance. The magnitude of this improvement suggests that the collaborative and practice-oriented characteristics of community-based education—including hands-on

GenAI activities, peer learning, prompt development, pedagogical application, critical evaluation, and ethical reflection were effective in strengthening teachers' technological, pedagogical, psychological, critical, and ethical preparedness for AI-supported instruction. Accordingly, the findings provide empirical support for H1, confirming that community-based AI literacy training significantly improves teachers' readiness to integrate GenAI into teaching and learning.



Figure1 .Pengabdian kepada Masyarakat

Discussion

The findings demonstrate that community-based AI literacy training substantially strengthened teachers' readiness to integrate generative artificial intelligence (GenAI) into teaching and learning. The increase in the overall readiness score from the pretest ($M = 2.95$, $SD = 0.57$) to the posttest ($M = 4.12$, $SD = 0.48$), supported by a statistically significant paired-samples t -test, $t(39) = 12.86$, $p < .001$, and a very large effect size (Cohen's $d = 2.03$), indicates that structured and practice-oriented professional development can produce meaningful changes in teachers' preparedness for AI-supported education. This finding is consistent with the conceptualization of AI literacy as a multidimensional competency involving not only knowledge of AI but also the capacity to apply, evaluate, and ethically engage with AI systems (Long & Magerko, 2020; Ng et al., 2021). The results further suggest that teachers' readiness cannot be developed merely through exposure to GenAI technologies; rather, it requires systematic opportunities to understand how AI operates, practice its educational applications, evaluate generated information critically, and reflect on its pedagogical and ethical implications. In this regard, the findings support UNESCO's (2024) AI competency framework for teachers, which emphasizes that effective AI integration requires a combination of human-centered values, AI ethics, foundational AI knowledge and applications, AI pedagogy, and continuous professional learning.

The improvement observed after the intervention can also be explained by the pedagogical characteristics of the community-based training model. Rather than positioning participants as passive recipients of technological information, the program

engaged teachers in workshops, hands-on experimentation, prompt development, peer learning, collaborative instructional design, critical evaluation of AI outputs, and reflective discussion. Such activities enabled teachers to translate abstract knowledge about AI into contextually relevant pedagogical practices. This result aligns with previous research emphasizing that the educational benefits of GenAI depend substantially on how technological capabilities are connected to pedagogical objectives and instructional contexts (Chiu, 2024; Kasneci et al., 2023). Kasneci et al. (2023), for example, argued that large language models offer considerable opportunities for personalized learning, feedback, content generation, and instructional support, but their educational value depends on teachers' capacity to recognize limitations such as inaccurate information, bias, and inappropriate reliance on generated content. Similarly, Chiu (2024) highlighted the importance of pedagogical competence, teacher professional development, and human-centered approaches when transforming educational practices through GenAI. Therefore, the strong post-training improvement identified in this study suggests that community-based professional learning may provide an effective mechanism for bridging the gap between technological availability and pedagogically meaningful AI adoption.

Another important finding concerns the shift from teachers' relatively moderate initial readiness toward stronger technological, pedagogical, psychological, critical, and ethical preparedness following the intervention. Prior to the training, prompting competence and critical evaluation of AI-generated content represented particularly weak dimensions of AI literacy, while pedagogical and critical readiness also remained comparatively limited. This pattern illustrates that conventional digital competence does not necessarily translate directly into AI competence because GenAI requires users to formulate appropriate instructions, interrogate generated outputs, recognize hallucinations and biases, and make informed decisions concerning privacy, authorship, academic integrity, and responsible use. This interpretation is consistent with Ng et al. (2021), who distinguished AI literacy as a set of competencies involving understanding, application, evaluation, and ethical engagement with AI, as well as with Long and Magerko (2020), who emphasized that AI literacy encompasses competencies necessary for critically interacting with AI technologies. Furthermore, UNESCO (2023) warns that GenAI adoption in education should not be driven solely by technological innovation, but should protect human agency, data privacy, inclusion, and educational quality. The present findings consequently reinforce the argument that teacher readiness should be understood as a multidimensional construct: teachers need to know how to use AI, but equally need to understand why, when, and under what ethical and pedagogical conditions AI should be used.

Overall, the findings extend previous scholarship by demonstrating the potential of community-based education as a professional-development strategy for strengthening AI literacy and GenAI integration readiness. While much of the existing literature has focused on conceptualizing AI literacy, identifying opportunities and risks of GenAI, or examining teachers' attitudes and intentions toward emerging technologies, the present study provides intervention-based evidence showing that collaborative AI literacy training can substantially improve teachers' preparedness for actual pedagogical integration. This finding is particularly relevant to the argument of Lo (2023), who identified considerable

educational potential for ChatGPT while emphasizing the need for educators to develop appropriate strategies for addressing its limitations and implications. It also complements the recommendations of UNESCO (2023, 2024), which call for sustained capacity building and teacher professional development to ensure human-centered and responsible AI adoption. Accordingly, the contribution of this study lies not merely in demonstrating a statistically significant improvement in readiness, but in showing that community-based, collaborative, contextual, and practice-oriented training can function as a viable model of continuous professional development in the GenAI era. Educational institutions and teacher communities should therefore move beyond short-term tool-oriented training toward sustained professional learning ecosystems that combine AI knowledge, prompting skills, pedagogical design, critical evaluation, ethical awareness, peer collaboration, and reflective practice. Such an approach can strengthen teachers' agency and ensure that GenAI is integrated not as a substitute for professional judgment, but as a responsible pedagogical resource for enhancing the quality, creativity, personalization, and relevance of teaching and learning.

Conclusion

The findings indicate that community-based AI literacy training significantly improved teachers' understanding of AI, practical competence in using generative AI, critical evaluation skills, ethical awareness, and confidence in integrating AI into pedagogical practices. Furthermore, AI literacy was found to have a positive and significant effect on teachers' readiness to integrate GenAI, suggesting that higher levels of AI literacy are associated with stronger technological, pedagogical, and ethical preparedness.

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