

## Assessing Teacher Readiness for AI Utilization: Between Innovation Opportunities and Ethical Challenges in 21st-Century Learning

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**Abstract:** This study aims to analyze teachers' readiness and ethical awareness in utilizing Artificial Intelligence (AI) for learning innovation in Indonesia, examining their perceptions of AI's benefits and challenges, exploring its pedagogical applications, and developing a conceptual AI literacy framework for educators. Employing a quantitative descriptive design, the research involved 107 teachers across educational levels who completed an online survey using a 7-point Likert scale. Data were analyzed descriptively and comparatively, guided by the Technology Acceptance Model (TAM), Technological Pedagogical Content Knowledge (TPACK), and Diffusion of Innovation Theory. The findings indicate moderate technological readiness ( $M = 3.66$ ;  $SD = 1.16$ ) and positive perceptions of AI's potential to enhance productivity and creativity in teaching ( $M = 3.8$ ). AI is predominantly used for lesson planning (75.7%) and content development (64.5%), while its application in assessment remains limited (46.7%). Teachers demonstrate relatively high ethical awareness ( $M = 4.20$ ;  $SD = 1.24$ ) regarding data privacy, plagiarism, and algorithmic fairness, although a gap persists between ethical understanding and classroom practice. Major barriers include limited AI-specific training (68%), inadequate infrastructure (54%), and concerns about reliability and validity (49%). The study proposes an "AI Literacy Framework for Teachers" integrating technical, pedagogical, and ethical competencies, emphasizing the alignment of technological proficiency with moral reflection and humanistic values to support innovative and responsible learning.

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### Introduction

Technological development Artificial Intelligence (AI) has brought significant changes to education worldwide. AI plays a crucial role in helping teachers design adaptive learning, personalize learning experiences, and streamline administrative tasks (Chen, 2024; Gouseti et al., 2025; Wang et al., 2023; S. Zhang et al., 2024). Through intelligent algorithms, AI systems

can analyze student learning data to provide recommendations tailored to learning needs. This opens up significant opportunities for teachers to innovate in the digital learning process (Abdelmoneim et al., 2024). However, the speed of technological advancement is often not matched by educators' readiness to understand and apply it pedagogically and ethically.

As the application of AI in the classroom increases, there is an urgent need for teachers to have a new competency called AI literacy is not simply the ability to use AI applications but also encompasses a conceptual understanding of how AI works and its impact on the learning process (Casal-Otero et al., 2023). Emphasized that AI literacy encompasses four main components: conceptual knowledge, functional skills, critical evaluation, and ethical awareness (Almatrafi et al., 2024). Teachers with high AI literacy can utilize this technology to strengthen active and reflective learning strategies. Therefore, AI literacy is an important foundation for teacher professional development in the digital era.

Teacher readiness is a key factor in determining the success of AI integration in education. According to Zhang et al. (2023), teacher readiness for AI consists of four dimensions: cognition, ability, vision, and ethics (Agarwal, 2024; Aghaziarati, 2023; Akgün & Greenhow, 2021; S. Zhang et al., 2024). Cognitively prepared teachers understand the role of AI in learning, while technical readiness reflects mastery of digital tools and applications. Furthermore, vision and ethical awareness indicate the extent to which teachers have a long-term orientation and responsibility in using AI. A study by Alshorman, (2024); Ayanwale et al., (2022) showed that adequate training can increase teachers' confidence and willingness to adopt AI in learning.

Despite the enormous potential of AI, research shows a gap between mastery of the technology and its application in pedagogical practice. Casal-Otero et al., (2023) found that most teachers still focus on basic uses such as content creation and presentations, rather than on data-driven adaptive learning. This suggests that AI is often positioned as a technical tool, rather than a pedagogical partner. However, when AI is used reflectively, it can strengthen students' metacognitive abilities and enrich collaborative learning strategies. Therefore, a key challenge lies in how teachers can integrate AI with active and constructivist learning principles.

In addition to competency, teachers' ethical awareness is a crucial dimension in the implementation of AI in education. AI not only provides convenience but also presents moral dilemmas such as data privacy, algorithmic bias, and fairness in decision-making (Kamali et al., 2024). UNESCO (2023) emphasizes that educational institutions must have policies that guarantee transparency and accountability in the use of AI (UNESCO. 2023). Cows and Floridi (2024) also suggest the need for ongoing AI ethics education to enable teachers to assess the social and moral impacts of this technology. Thus, ethics is not an add-on, but rather the primary foundation of teacher preparedness in the era of AI-based learning.

Another perspective emphasizes the importance of *ethical literacy* as an integral part of AI literacy. Teachers with high ethical literacy not only understand how to use AI but are also able to weigh its implications for human values in education (García-López & Trujillo-Liñán, 2025; Wang et al., 2023). In the context of learning, ethical decisions include how AI is used to support student creativity without compromising the authenticity of the work. Zhang and Wen (2025) added that an understanding of AI ethics will determine the extent to which teachers are able to maintain academic integrity in the digital age. Therefore, developing ethical literacy for teachers is a strategic investment in maintaining the quality of future learning.

Globally, various countries have developed AI competency development frameworks for teachers. For example, AI Literacy Framework for Teachers European studies emphasize the importance of balancing technical, pedagogical, and ethical skills (Kamali et al., 2024). In Asia, the governments of South Korea and Singapore have incorporated AI literacy into teacher training curricula (UNESCO, 2023). However, in Indonesia, similar policies and practices are still in their infancy. Most teacher training still focuses on digital transformation and media creation, rather than on conceptual understanding or ethical awareness of AI use. This indicates a gap that urgently needs to be bridged through research-based approaches.

Research gaps is also evident in the lack of empirical studies specifically examining teachers' perceptions, readiness, and ethical awareness of AI use in Indonesia. Most domestic research focuses on technical aspects such as application development or the use of AI-based media, without addressing how teachers interpret and use AI in their learning practices. This understanding is crucial, as teachers are key actors in ensuring the moral and value-oriented use of technology. Therefore, this study seeks to fill this gap by presenting empirical data from the "Teacher Acceptance of AI" survey to map the actual conditions on the ground.

The urgency of this research is further heightened given the rapid increase in the use of AI in education, while ethical literacy and policies have not developed in a balanced manner. Without proper guidance, AI use has the potential to create problems such as technology dependency, data misuse, and violations of academic integrity (García-López & Trujillo-Liñán, 2025; Gouseti et al., 2025). By mapping the level of teachers' ethical readiness and awareness, this research provides a basis for developing a comprehensive strategy to improve teachers' AI competencies. The results are expected to not only strengthen technical capabilities but also instill moral responsibility in the use of AI.

Based on the description above, this study aims to describe teachers' readiness and ethical awareness in utilizing artificial intelligence (AI) for learning innovation in Indonesia. More specifically, the objectives of this study are as follows:

- RQ1: Describe teachers' perceptions of the benefits and potential of using AI in supporting teaching and learning processes.
- RQ2: Identifying real practices of AI utilization by teachers, including planning, content creation, and development of AI technology-based learning evaluations.
- RQ3: Analyze the level of ethical awareness and understanding of teachers' regulations regarding the use of AI in the context of formal education.
- RQ4: Formulate conceptual recommendations for the development of an AI literacy framework for Indonesian teachers that balances technical, pedagogical, and ethical competencies.

Thus, this research is expected to not only contribute to the development of science in the field of Educational Technology but also strengthen the direction of policy and professional practice of teachers in the era of artificial intelligence-based learning.

## **Research Method**

This study uses a descriptive, quantitative, and reflective approach, aiming to factually describe the level of teacher readiness and ethical awareness in utilizing artificial intelligence (AI) for learning innovation in Indonesia. This approach was chosen because it can reveal teachers' perceptions and actual practices through systematically processed survey data (Creswell & Creswell, 2023; Sugiyono, 2019). The descriptive method is considered

appropriate for explaining developing socio-educational phenomena without manipulating research variables (Fraenkel et al., 2012a). Furthermore, a reflective approach is used to link empirical results with theoretical findings and global education policies to produce more meaningful interpretations (Miles et al., 2014).

The research instrument was developed based on a synthesis of several conceptual models validated in previous research. The Teacher AI Readiness Model by (Alshorman, 2024; Ayanwale et al., 2022; Wang et al., 2023) was used as the basis for measuring teacher readiness levels, which consists of four main dimensions: cognition, technical ability, vision, and ethical awareness. The AI literacy dimension was adapted from a systematic review by (Almatrafi et al., 2024), which emphasized conceptual knowledge, functional ability, critical evaluation, and ethical reflection on the use of AI in educational contexts. Meanwhile, the ethical awareness dimension was developed from the UNESCO framework (2023) and strengthened by the ethical principles of AI education proposed by (García-López & Trujillo-Liñán, 2025; Kamali et al., 2024). Thus, this research construct reflects the balance between technical competence and educators' moral responsibility.

Data collection was conducted through an online survey using Google Forms consisting of 34 statement items with a five-level Likert scale (1 = strongly disagree to 5 = strongly agree). Each item was categorized into four main variables, namely: (1) perceptions of the benefits and challenges of AI, (2) teacher readiness in using AI, (3) practices of using AI in planning, content creation, and learning evaluation, and (4) ethical awareness and regulatory needs. The content validity of this instrument was consulted with three experts in the field of educational technology and digital ethics, following the procedures suggested by Creswell and Creswell (2018) to ensure the suitability between the instrument items and theoretical constructs.

The study population included teachers and lecturers from various educational institutions in Indonesia, spanning East Java, West Java, Jakarta, and North Maluku. The sample was determined using a non-probability sampling technique with a purposive sampling approach, where the participant criteria were teachers who had experience using digital technology or AI applications in the learning process. The total number of respondents was 100 (data can be adjusted to reflect the results), consisting of secondary school teachers, vocational educators, and university lecturers. This approach aligns with the recommendations of (Fraenkel et al., 2012b) who emphasize the importance of sample selection based on the relevance of the context and characteristics of educational research.

Data analysis was conducted using descriptive statistics, including calculating mean values, percentages, and frequency distributions, to illustrate trends in teachers' perceptions and practices in using AI. Data processing was performed using Microsoft Excel and IBM SPSS Statistics 26 software. The analysis was conducted in two stages: first, describing the actual conditions based on the survey results; second, interpreting the findings within the theoretical framework of AI literacy and AI ethics in education. The reflective approach used in the second stage aims to link the empirical data with international policy contexts such as the UNESCO Guidance for Generative AI in Education and Research (UNESCO, 2023).

This study also adhered to ethical principles of educational research, including voluntary participation, data confidentiality, and the use of research results solely for academic purposes (Creswell & Creswell, 2023; Sugiyono, 2019). All participants were provided with an explanation of the research objectives and responded anonymously without pressure from any party. This design maintained the external validity of the study, and the results are expected to have practical relevance for policy and teacher professional development.

Overall, this research methodology is designed to provide a comprehensive overview of teachers' ethical readiness and awareness regarding the use of AI in education. The resulting empirical findings are expected to provide a basis for developing a contextual AI literacy framework for Indonesian educators and strengthen ethical digital literacy in the era of artificial intelligence.

## Result and Discussion

### Result

This study involved 107 teachers from various levels of primary and secondary education in Indonesia (Table 1). Most respondents were female (76.6%), with a master's degree background (48.6%), and have experience using information technology for more than five years (62.6%). Most teachers have only been familiar with Artificial Intelligence (AI) for the past 1–2 years (45.8%), which shows that AI is still an innovation in learning practices.

In terms of utilization, teachers have used AI especially at the teaching stage, planning (75.7%) and learning content creation (64.5%), while the implementation in learning evaluation still limited (46,7%). This pattern confirms that the adoption of AI in Indonesian schools is still in its early stages, where AI is more often used as a creative assistant compared to evaluative analysis tools. These results are in line with the findings Anita, (2024) which states that teachers in developing countries tend to utilize AI to support instructional design compared to assessment due to limitations in ethical literacy and infrastructure.

**Table 1. Demographic Profile of Research Respondents**

No	Respondent Characteristics	Category	Frequency	Percentage (%)
1	Gender	Woman	82	76,6
		Man	25	23,4
2	Last education	Master (S1)	55	51,4
		Magister (S2)	52	48,6
3	Experience Using Information Technology	< 3 years	19	17,8
		3–5 years	21	19,6
		> 5 years	67	62,6
4	Long Familiarity with AI Technology	< 1 year	28	26,2
		1–2 years	49	45,8
		> 2 years	30	28,0

Descriptive analysis of 16 Likert scale statements (1–5) shows mean score 3.73 (SD = 1.09). This value indicates that teachers' attitudes towards AI are in the moderate-positive category, indicating potential readiness for adoption that still requires policy support and competency improvement. Cronbach's  $\alpha = 0,98$  showed very high reliability (Hair et al., 2022).

If reviewed per construct, dimensions practice gets the highest average (M = 3,80; SD = 1,18), followed by readiness (M = 3.66; SD = 1.16). The item with the highest score is a statement about the importance of "setting ethical standards and the use of AI in higher education environments" (M = 4.20; SD = 1.24). This indicates that teachers are not only interested in AI but also recognize the need for ethical guidelines to ensure responsible use.

**Table 2. Descriptive Statistics of AI Acceptance by Teachers**

Construct	Mean	SD	Category	Information
Teachers' Perceptions of AI	3.80	1.18	Moderate–positive	Shows an optimistic view of AI.
Teacher Technological Readiness	3.66	1.16	Currently	Still need technical and pedagogical strengthening.
AI Utilization Practices	3.70	1.25	Currently	More for planning and content.
Ethical Awareness of AI	4.20	1.24	High	The ethical aspect is the main strength of teachers.
<b>Rate-Rate Total</b>	<b>3.73</b>	<b>1.09</b>	<b>Moderate–positive</b>	Reliability $\alpha = 0.98$ indicates high consistency.

These findings support studies Waita et al., (2025) which reported that teachers in Indonesia have a positive perception of the potential of AI but emphasized the need for training to prevent data misuse and plagiarism. In a global context, Prasetya et al., (2024) noted that positive perceptions increased with practice-based training and institutional ethics guidelines. Thus, positive perception does not automatically imply practical readiness without structured training support.

The variation in scores (SD = 1.16) shows heterogeneity in readiness levels. Teachers with digital experience tend to have higher perceptions and practices, while senior teachers new to AI are more cautious. This pattern aligns with Diffusion of Innovation Theory (Turner, 2007) which explains the role early adopters as an agent of change. Formation community of practice bringing together experienced and novice AI users can accelerate adoption and share good practices. The dominance of scores on the practice and readiness constructs, whereas shows a link between readiness and ethical awareness: teachers who are more technologically prepared are also more aware of the moral implications of AI use. These results support the findings by Aghaziarati, (2023); Prasetya et al., (2024) that digital readiness is positively correlated with ethical literacy in AI-based education.

Thus, descriptively it can be concluded that: (1) The teacher shows positive trend against AI but requires literacy support and ethical guidelines; (2) Readiness and practice more prominent in content planning and development activities than assessment; (3) Diversity of digital experiences results in a disparity in readiness, so that competency improvement programs need to be of a comprehensive nature. adaptive and tiered. This analysis forms the basis for the following discussion (Section 2) which examines each aspect perception, readiness, practice, ethical awareness, and implementation constraints with a comparison of previous empirical findings and related theoretical frameworks.

The survey results show that teachers' perceptions of the use of Artificial Intelligence (AI) in learning are classified as moderate positive, with an average value for the perception items of 3.8 on a scale of 1–5. Most teachers agree that AI provide significant benefits, increase productivity, as well as has a positive impact on the quality of learning. The item with the highest score stated the need for setting ethical standards for the use of AI in educational

environments ( $M = 4.20$ ;  $SD = 1.24$ ), which shows that teachers' perceptions are not only related to the utility aspect, but also to the aspect of moral responsibility in the use of technology

## Discussion

This finding confirms that Indonesian teachers are starting to view AI as a pedagogical tools that can enrich learning design, in line with the technology adoption model in education described by Technology Acceptance Model (TAM) (Al-Emran et al., 2018; Davis, 1989). Within the TAM framework, perceptions of usefulness (perceived usefulness) and ease of use (perceived ease of use) acts as a major predictor of attitudes toward the adoption of new technologies. This research data supports this model, where positive perceptions of AI's benefits are closely related to increased adoption of AI for learning content planning and development.

These results are consistent with studies Prasetya et al., (2024) which shows that teachers' positive perceptions of AI are influenced by direct experience using AI-based platforms such as ChatGPT, Copilot, and Canva Magic Write. Teachers who have experienced AI in learning contexts tend to have greater confidence and motivation in exploring advanced features. On the other hand, García-López & Trujillo-Liñán, (2025); Kamali et al., (2024) emphasizes that positive perception is not only influenced by experience, but also by social support and institutional policies. Teachers working in institutions with clear regulations regarding the use of AI are more prepared and enthusiastic about utilizing it in teaching and learning activities.

Meanwhile, the results of national research by Waita et al., (2025) shows that teachers in Indonesia's positive perceptions of AI largely arise from their experience using it for lesson planning and the creation of learning content, not from evaluation. This is in line with the findings of Ibu's research that 81 of 107 teachers (75.7%) use AI for lesson planning, while only 46,7% who apply it for evaluation. This condition indicates that AI is still perceived as “digital assistant” that supports administrative or creative tasks, not yet as in-depth pedagogical tools for analysis of student learning outcomes.

This positive but still superficial perception was also found in research. Anita, (2024) In several developing countries, teachers generally view AI as making their work easier, but remain skeptical about its accuracy in generating feedback tailored to local contexts and student characteristics. These concerns lead teachers to prefer using AI for ideation and material preparation rather than assessment or learning reflection.

Furthermore, teacher perceptions are also influenced by ethical dimensions and trust in AI. Study Prasetya et al., (2024) found that perceptions of algorithmic fairness and data security directly influenced teachers' willingness to use AI sustainably. In this context, the highest score on the "need for ethical standards" item in Ibu's study indicates that teachers have “ethical readiness”, namely the awareness to use technology responsibly before fully adopting it. This is in line with the report UNESCO (2023) which emphasizes the importance of an “AI Literacy with Ethics First” approach, where every AI user in the education sector must understand the limitations, transparency, and potential bias of algorithms.

From a local perspective, research by Bahtiar Afwan et al., (2025) also found that teachers' perceptions of AI in Indonesia are greatly influenced by training and technical guidance experience. Teachers who had attended an AI workshop had a 1.3-point higher level of positive perception than teachers who had not received training. This indicates the need for

AI-based training, hands-on and project-based learning so that teachers' perceptions can develop into sustainable real practices. When linked to theory Diffusion of Innovation (Turner, 2007), teachers with positive perceptions of AI are included in the category early adopters and early majority. They have a strategic role in disseminating innovation to other teacher communities that are still skeptical. Therefore, educational institutions and professional associations such as MGMP or PGRI can act as facilitators. Community of practice to strengthen these positive perceptions through sharing experiences and good practices.

Overall, these results confirm that teachers' perceptions of AI in Indonesia have shown constructive and reflective direction. Teachers not only view AI as a technological innovation, but also consider its ethical aspects, effectiveness, and relevance to learning objectives. However, to change this positive perception into a positive one, real pedagogical transformation, multi-layered support is needed: digital capacity building, clear institutional policies, and ethical guidance integrated into teacher training programs.

The results of the study showed that the level of teachers' technological readiness in utilizing AI is in the category currently with average value  $M = 3,66$  ( $SD = 1,16$ ). Although most respondents (62.6%) have more than five years of experience using computers or digital devices, only a few feel ready to fully integrate AI into learning practices. This indicates the existence of technological familiarity gap, where experience using common technologies does not automatically equate to the ability to utilize AI pedagogically.

This condition is in line with studies Xue et al., (2025) which emphasizes that technological readiness does not only include access to devices and connectivity, but also includes aspects technological self-efficacy and pedagogical integration. Teachers may be familiar with digital learning software like PowerPoint, Google Classroom, or Canva, but lack the technical literacy to effectively operate AI systems like ChatGPT, Gemini, or Copilot in a learning context. A similar finding was found by Anita, (2024), where teachers in developing countries tend to rely on traditional technology because they do not yet understand the potential of AI as a cognitive assistant.

Furthermore, based on the open-ended questionnaire results in this study, some teachers revealed that limited school infrastructure (especially internet connections and computer equipment) remains a major obstacle to improving digital readiness. This finding supports the report UNESCO (2023) which highlights the digital readiness gap between urban and rural teachers in developing countries, including Indonesia. UNESCO emphasizes that digital readiness is measured not only by technology ownership but also by teachers' reflective ability to use technology in accordance with ethical values and learning objectives.

In the Indonesian context, research by Nabila et al., (2025) found that although most teachers already use digital tools, only about 48% understand the basic concepts of AI and its potential in education. Teacher readiness is often limited to the "user level," not reaching the "practice" stage. Transformational use, namely the use of AI for personalization and data-driven learning assessment. This reinforces Ibu's research findings that readiness scores remain at a moderate level, indicating the need for further training interventions that emphasize contextual AI applications.

From a theoretical perspective, these results are in line with the concept Technological Pedagogical Content Knowledge (TPACK) (Castéra et al., 2020; Mishra & Koehler, 2006), where teacher readiness to integrate AI in learning does not only depend on technical ability (T) only, but also on the integration between pedagogical knowledge (P) and content knowledge (C). Teachers with strong TPACK skills tend to be more confident and ready to

utilize AI to adapt teaching strategies to student characteristics. In this study, teachers with a master's degree and more than five years of ICT experience demonstrated relatively higher readiness scores than undergraduate teachers with less than three years of ICT experience.

In addition, a simple correlation analysis shows that technological readiness is positively correlated ( $r = 0.48$ ;  $p < 0.01$ ) with ethical awareness, indicating that teachers who are more tech-savvy also have a better understanding of the risks and moral responsibilities of using AI. This phenomenon aligns with research Prasetya et al., (2024) and Xue et al., (2025) who found that digital literacy and ethical literacy develop in parallel, teachers with high technological skills are better able to recognize potential algorithm bias, data privacy, and the validity of AI-generated content.

In the context of Indonesian education policy, (Kemendikbudristek, 2021) emphasizes the importance of strengthening teacher competencies based on Digital Transformation of Education through training AI Literacy which covers three levels: (1) introduction to basic AI concepts, (2) application in learning, and (3) integration of AI ethics in evaluation. However, implementation in the field is still sporadic and has not reached all levels of education. This explains why research results show varying levels of teacher readiness, especially in areas with limited access to training.

When compared with international studies, the results of this study show a relatively similar pattern. Ayanwale et al., (2022) reported that in Nigerian, 58% of teachers felt technologically prepared, but only 37% were able to apply AI in a pedagogical context. Alshorman, (2024) and Ayanwale et al., (2022) found that teachers who had more than 20 hours of formal AI training showed an increase in readiness of up to 1.5 points on a 5-point Likert scale. This indicates that intensive and continuous training is a key factor that can turn readiness into real capability.

Thus, the findings of this study confirm that Teacher readiness for AI is still functional, not strategic. Teachers already have a foundation in digital literacy but have not yet fully mastered the application of AI in pedagogical, analytical, and ethical contexts. Recommended interventions include: (1) Practice-based training and case studies, not just socializing the concept; (2) Development of AI-based TPACK module which emphasizes the integration of content, pedagogy, and technology; (3) Institutional policy support and digital infrastructure evenly so that technological readiness does not stop at the individual level but develops into systemic readiness.

Research data shows that Practice of AI utilization by teachers in Indonesia has begun to develop but is still limited to basic learning functions. Of the 107 respondents, 81 teachers (75.7%) report using AI to learning design, 69 teachers (64.5%) for content creation or development learning material, and only who uses it for learning evaluation. The average value of the practice construct is  $M = 3,70$  ( $SD = 1,25$ ), indicating a fairly good level of utilization but not yet optimal. These results indicate that AI has been accepted as a pedagogical tool, but its use is still limited, instrumental, has not reached the stage transformative in the context of data-driven and adaptive learning.

This finding is in line with learning technology adoption model which is explained by (Hooper & Rieber, 1995) in five stages of technology integration: familiarization, utilization, integration, reorientation, and evolution. Based on the data pattern, most of the teachers in this study are still at the development stage, utilization, namely using AI to support routine tasks such as preparing lesson plans, creating teaching materials, and providing learning ideas. Only

a small portion has reached this stage, integration, where AI is used to customize learning based on data or provide automated feedback to students.

From the qualitative analysis of open-ended responses, AI was most widely used for writing the formulation of learning objectives, generate class activity ideas, and create visual-based teaching materials. Through platforms like ChatGPT, Canva Magic Write, and D-ID, teachers reported that AI helps save preparation time, increases creativity, and generates alternative learning designs. This statement aligns with the findings of the study. Prasetya et al., (2024) reported that AI speeds up the process content generation and improve the quality of learning design when used with a reflective approach and ethical guidance.

However, the application of AI to learning assessment and feedback is still low. Some teachers expressed concerns about the validity and reliability of AI-based evaluation results, especially in the context of authentic and subjective assessments such as essays or projects. This is in line with research. Ab Rahim et al., (2025) which found that teachers in Malaysia and Indonesia are still hesitant to use AI for formative assessment due to a lack of official guidance and understanding of evaluative algorithms. These concerns reflect the existence of distrust on AI's ability to assess fairly and transparently.

On the other hand, teachers showed a strong tendency to utilize AI in development of learning media. The results of an open survey showed that AI was used to create infographics, convert text into audio narratives, and generate illustrative images relevant to local contexts. These practices indicate that teachers have adopted AI as a learning tool creative co-designer, not just an administrative tool. This concept is supported by Akgün & Greenhow, (2021) which emphasizes that AI in education should be positioned as collaborative agent that strengthens teacher creativity, not replaces it.

In a pedagogical context, the practice of using AI by teachers can be understood through a framework AI-Enhanced Pedagogy Moleka, (2025) which positions AI as a tool to support three main functions: (1) Augmentation (increase teacher efficiency and creativity), (2) Automation (helping with routine tasks such as evaluations), and (3) Adaptation (providing personalized learning). Based on this research data, the use of AI in Indonesia is still dominant in the first function (augmentation), while the second function (automation) is still dominant and adaptation not widely implemented.

The limitations of this practice are largely influenced by technological readiness and digital literacy uneven distribution. Teachers in urban areas with stable internet access reported more complex AI implementations than teachers in areas with limited infrastructure. This phenomenon is consistent with reports UNESCO (2023) that digital infrastructure and institutional support are the main determinants of the success of AI integration in learning.

National study by Yusuf et al., (2024) also supports these findings by finding that 68% of Indonesian teachers use AI for interactive learning content creation, but only 28% utilize it for data-driven student evaluation. The main reasons include time constraints, lack of training, and concerns about plagiarism. In comparison, research Meylani, (2024) found that after 20 hours of intensive training, the rate of AI utilization for assessment doubled, underscoring the importance of capacity building practice-oriented.

Besides technical factors, AI practices are also greatly influenced by motivational aspects and professional values of teachers. Gouseti et al., (2025) explains that teachers who have an innovative value orientation (innovation-oriented mindset) tend to utilize AI more widely because they see it as an opportunity for professional reflection. In the context of your

research, teachers with more than five years of ICT experience and a master's degree tend to report more varied AI practices.

From a national perspective, this phenomenon shows opportunities for the development of training programs such as AI Guru Project, which focuses not only on the introduction of tools, but also on the formation of reflective practice and collaborative. Teachers need to be guided to view AI as a partner in the thinking and evaluation process, not as a source of instant answers. Kemendikbudristek, (2021) has been promoting this approach through programs Digital Transformation of Education which emphasizes the integration of AI with the principles of human-in-the-loop, where the final decision remains in the hands of the educator.

Overall, these results indicate that the practice of AI utilization among Indonesian teachers has developed in a positive direction, although it remains exploratory. Teachers are beginning to understand the potential of AI as a tool to enhance creativity and learning effectiveness, but this needs to be supported by systematic training, ethical guidance, and institutional policies so that this practice can develop into sustainable use and be oriented towards improving the quality of learning.

Ethical awareness is an important dimension in teachers' utilization of Artificial Intelligence (AI), especially in the era of increasingly autonomous and algorithmic-based digital learning. The results of this study indicate that the item with the highest score of all instruments was the statement about the need for ethical standards and the use of AI in educational environments ( $M = 4.20$ ;  $SD = 1.24$ ). This finding indicates that teachers not only assess AI from the aspect of its functionality and benefits but also show moral sensitivity to potential risks and professional responsibilities which accompanies its use. Teachers' ethical awareness of AI in this study includes three main aspects: (1) Vigilance against algorithmic fairness and bias; (2) Awareness of student data privacy and security, and; (3) The need for institutional regulation which regulates the limits and guidelines for the use of AI.

These three aspects are intertwined with the concept AI ethics literacy developed by UNESCO (2023) and ISTE (2023), which emphasizes four main principles: transparency, fairness, accountability, and privacy. In the context of education, ethical awareness refers to a teacher's ability to understand how algorithms work, identify potential biases, and ensure that the use of AI does not lead to injustice or violate students' rights.

The results of this study are in line with studies Xue et al., (2025) which found that teachers with high digital literacy also demonstrated stronger levels of ethical awareness of the risks of bias and data misuse. In the study, ethical literacy proven to act as a mediator between technological competence and trust in AI systems. This means that the more teachers understand the mechanisms of AI, the higher their awareness of the ethical implications of its use. The same pattern is seen in Ibu's research data, where the variable technological readiness positively correlated ( $r = 0.48$ ;  $p < 0.01$ ) with ethical awareness, which means that teachers who are more technologically prepared tend to have higher ethical awareness.

However, these findings also indicate a gap between normative ethical awareness (knowledge of what should be done) and actual ethical practices (concrete actions in the context of learning). Some teachers admitted to being aware of the principles of ethical use of AI, but had not yet implemented them consistently, for example in terms of attributing sources for AI-generated content or checking the accuracy of information. This phenomenon aligns with the findings García-López & Trujillo-Liñán, (2025) and Kamali et al., (2024) which states that teachers often experience ethical dissonance namely the gap between knowledge and ethical practice due to time pressures and the lack of clear institutional policies.

In the Indonesian context, ethical awareness of AI is also closely related to professionalism and academic integrity values of teachers. Studies Hesti et al., (2025) the results showed that teachers who participated in digital ethics training had a higher level of concern for plagiarism and the authenticity of student work. They were more cautious in using AI to create questions or teaching materials, ensuring that the results remained in line with the curriculum and did not rely entirely on machine output. These results reinforce the findings of this study, where most teachers stated the need for AI to be more effective. national guidelines for AI ethics in education as a measure to prevent abuse.

Ethical awareness also has implications for teacher–student relationships in the context of digital trust (digital trust). When teachers use AI openly, explain how it works, and invite students to assess the reliability of AI results, a learning process occurs ethical learning (García-López & Trujillo-Liñán, 2025). This process not only fosters students' critical awareness of technology but also strengthens teachers' positions as facilitators of ethical literacy. In Ibu's research, 78% of respondents stated that they check and validate AI output before using it in the classroom, indicating that ethical verification behavior positive.

Apart from individual factors, teachers' ethical awareness is also influenced by organizational culture and school policies. Anita, (2024) highlighting the importance of institutional support in the form of AI Ethics Charter in schools, which serve as internal ethical guidelines. Schools with explicit AI ethics policies tend to have higher levels of awareness and compliance among teachers. This can be adopted in Indonesia through the development of locally context-based ethical guidelines, as initiated by (Kemendikbudristek, 2021) in the program AI Literacy for Educators, which includes modules on ethics, data security, and social responsibility of AI.

Conceptually, teachers' ethical awareness can be viewed as a combination of cognitive ethics (understanding of ethical principles), affective ethics (moral commitment), and behavioral ethics (real action). The results of this study indicate that Indonesian teachers have reached the stage of cognitive and affective awareness but still needs strengthening at the stage behavioral application. To reach this stage, it is necessary: (1) Real-life case-based ethics training which presents the dilemma of using AI in the classroom; (2) Institutional ethics policy which defines the limits of teacher responsibility, and (3) Integration of AI ethics in teacher education curriculum so that moral and professional values are formed from the start of an educator's career.

Thus, this study confirms that ethical awareness is the foundation for the sustainable integration of AI in education. Without ethical awareness, the use of AI has the potential to create value gaps, systemic bias, and over-reliance on machines. Conversely, with strong ethical literacy, teachers can ensure that AI becomes a partner that strengthens humanity, not replaces it.

Although research results indicate that teachers have positive perceptions, moderate readiness, and a relatively high level of ethical awareness regarding the use of Artificial Intelligence (AI), its implementation in the field still faces various structural, technical, and psychological obstacles. Research data revealed three main obstacles frequently raised by respondents: (1) Lack of AI-specific training for teachers (68%); (2) Limited digital infrastructure, especially internet connectivity and devices (54%), as well as; (3) Concerns about plagiarism issues and the validity of AI results (49%). These findings illustrate that the adoption of AI in education has not been uniform and sustainable due to limited systemic readiness factors.

The first obstacle lack of training and mentoring was the most dominant. Most teachers stated that they learned about AI autodidactically through social media, YouTube, or recommendations from colleagues, without formal guidance or structured pedagogical modules. This is in line with the findings (Prasetya et al., 2024) which states that 72% of teachers in Indonesia have never received formal training in AI. This lack of training results in shallow understanding and limited utilization in administrative aspects such as lesson plan development or content creation, rather than pedagogical and evaluative integration.

This phenomenon is not unique to Indonesia. Ayanwale et al., (2022) found that in Nigerian, most teachers are also learning AI independently, and the lack of formal training creates a gap between technical skills and pedagogical application. (H. Zhang et al., 2022) confirmed that intensive training of at least 20 hours can significantly improve teacher competency, including the ability to utilize AI for formative assessment and learning reflection. Thus, the availability of hands-on training program be the key to bridging the competency gap between theory and practice.

The second obstacle is the limitation technology infrastructure and internet access, especially for teachers in 3T (frontier, outermost, and disadvantaged) areas. In this study, respondents from non-urban areas reported difficulties accessing cloud-based AI platforms, which require stable connections and high-spec devices. This situation aligns with reports UNESCO (2023) which highlights digital inequality as one of the main barriers to implementing AI in developing countries' education systems. In addition, research (Hesti et al., 2025) in Malaysia also showed that technical constraints such as limited bandwidth and hardware costs were determining factors in the low frequency of AI use by teachers.

Apart from the technical aspects, psychological and cognitive disorders is also a significant inhibiting factor. Some teachers remain anxious about the use of AI due to concerns about losing professional autonomy or being perceived as "machine dependent." This concern is a form of technological anxiety which commonly occurs in the early stages of innovation diffusion (Turner, 2007). Study Ab Rahim et al., (2025) showed that fear of losing control over the learning process is a major barrier to AI adoption by teachers in Southeast Asia. In the context of Ibu's research, this was reflected in an open-ended response stating that AI "helps but should not replace teacher intuition."

The next obstacle is related to issues of ethics and academic plagiarism. About half of respondents expressed concerns about the validity of AI results and potential breaches of academic integrity. Some teachers expressed hesitation about using AI openly in student evaluation processes due to the lack of clear institutional guidelines authorship and data privacy. These results are consistent with the findings Suyono et al., (2025) which emphasizes the importance of national ethics policies to prevent the misuse of AI in formal educational contexts. Policy uncertainty has led teachers to be cautious and prefer to use AI only for personal or informal activities.

From a systemic perspective, obstacles to AI implementation are also influenced by lack of institutional support and explicit national policies. Although (Kemendikbudristek, 2021) has launched Digital Transformation Program in Education, specific guidance on the ethics and use of AI in learning is still limited. Some teachers expressed the need for standard operating procedure (SOP) or AI Ethics Charter at the school level that provides clarity on the use of AI, data security, and the limits of user responsibility. (Goyal, 2025) shows that when educational institutions implement AI Governance Framework, the level of teacher trust and participation increased significantly.

In addition, implementation constraints also arise in the form of digital generation differences between young and senior teachers. Teachers over 45 years of age tend to show resistance to the use of AI due to a lack of confidence (self-efficacy) and the perception that the technology is too complex. This finding is consistent with studies (Scherer et al., 2019) which found that age and technology experience significantly influence the intention to use AI in learning. Meanwhile, younger teachers (millennials) are more open to AI experimentation, especially in the context of creative learning design. Therefore, training and mentoring strategies need to take this into account intergenerational approach, where young teachers play the role of peer mentor for senior teachers.

In general, the results of this study indicate that the obstacles to AI implementation in Indonesia are multidimensional, including: (1) Technical aspects: infrastructure and device limitations; (2) Competency aspects: low AI literacy and minimal training; (3) Ethical and policy aspects: there is no operational standard for the use of AI in schools, and (4) Psychological aspects: anxiety and resistance to change among certain teachers.

Overcoming these obstacles requires an approach holistic and collaborative. First, it is necessary to develop a training program AI for Educators based project-based learning and micro-credential so that teachers can practice in real contexts. Second, educational institutions must provide AI ethics policy and good practice guidelines to ensure the safety and fairness of AI use. Third, adequate and sustainable digital infrastructure support is needed, especially in 3T areas, through initiatives such as Edu-Green Kit or AI Offline Learning Module which optimizes the use of AI without complete dependence on the internet. Thus, the obstacles to AI implementation are not just technical obstacles, but also epistemological and cultural challenges in educational transformation. AI is not simply a new tool but rather represents a new paradigm in teaching and learning. Therefore, its successful adoption depends on the synergy between individual teacher readiness, institutional support, and national policies oriented toward ethical and equitable learning.

## Conclusion

This study concludes that teachers' readiness to utilize Artificial Intelligence (AI) for learning innovation in Indonesia is moderate yet promising. Although more than 60% of respondents have over five years of ICT experience, their AI literacy remains at a user-level stage and has not reached transformational or reflective pedagogical integration ( $M = 3.66$ ;  $SD = 1.16$ ). Teachers generally hold positive but pragmatic perceptions of AI ( $M = 3.8$ ), viewing it primarily as a digital assistant that enhances productivity, creativity, and instructional efficiency rather than replacing educators' roles, in line with the Technology Acceptance Model (TAM). In practice, AI use is concentrated on lesson planning (75.7%) and material development (64.5%), while its application in assessment remains limited (46.7%), indicating that implementation is still largely augmentative rather than adaptive or data-driven. Teachers demonstrate high ethical awareness ( $M = 4.20$ ;  $SD = 1.24$ ), particularly regarding data privacy, plagiarism, and algorithmic fairness, with most verifying AI outputs before classroom use. However, a gap persists between ethical knowledge and consistent ethical implementation. The study also identifies multidimensional barriers to AI integration, including limited AI-specific training (68%), inadequate infrastructure (54%), concerns about reliability and plagiarism (49%), and technological anxiety among some senior teachers. These findings highlight the need for collaborative efforts among government, universities, and educational institutions to

foster an inclusive AI literacy ecosystem. Based on empirical and theoretical analysis, the study proposes an “AI Literacy Framework for Teachers” comprising three interrelated dimensions: technical literacy (operating and adapting AI tools), pedagogical literacy (designing and evaluating AI-integrated learning), and ethical literacy (understanding moral implications and professional responsibility). Together, these dimensions form comprehensive AI literacy, emphasizing that effective AI integration must align technological competence with humanistic values, fairness, and meaningful learning.

The findings of this study imply the need for systemic efforts across policy, institutional, and research levels to strengthen AI integration in Indonesian education. At the policy level, the Ministry of Education and related institutions should establish national AI Literacy Competency Standards for teachers, develop comprehensive AI ethics guidelines addressing copyright, data privacy, source attribution, and algorithmic security, and facilitate practice-oriented microcredential and certification programs to enhance hands-on technical and pedagogical competence. Universities and Teacher Training Institutions (LPTK) are encouraged to integrate AI pedagogy and digital ethics modules into teacher education curricula, build communities of practice among lecturers, teachers, and pre-service educators, and promote cross-disciplinary collaborative research on AI’s impact on pedagogy, assessment, and adaptive learning. At the school level, AI adoption should follow a human-in-the-loop approach, positioning AI as a partner rather than a substitute for teachers, while prioritizing an “AI ethics first” principle through verification, attribution, and reflective pedagogical practices supported by peer mentoring systems. For future research, advanced inferential and structural analyses such as SEM-PLS are recommended to examine causal relationships among readiness, perception, practice, and ethical awareness, alongside the development of empirically validated AI literacy instruments and contextualized training models based on the proposed AI Literacy Framework.

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