



Teachers' Perceptions and Experiences of Integrating AI-Based Tools in Classroom Practices in Indonesia

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Abstract


The increasing presence of artificial intelligence (AI) in education raises important questions about preservice teachers' readiness to integrate AI into future instructional practice. This study examined the extent to which attitudes toward AI predict readiness for AI integration. A quantitative, cross-sectional survey design was used with 212 preservice teachers from an Indonesian university. Data were collected using a validated 22-item Attitudes Toward AI in Education Scale measuring perceived usefulness, ethical and privacy concerns, pedagogical confidence, and professional identity. Descriptive statistics, confirmatory factor analysis, and multiple regression were conducted. Results showed that all four attitudinal dimensions significantly predicted AI readiness, with perceived usefulness emerging as the strongest positive predictor and ethical concerns demonstrating a negative association. These findings highlight the multidimensional nature of AI readiness and underscore the importance of addressing both competence and ethical awareness in teacher preparation. The study contributes empirical evidence to support AI literacy development in teacher education.

Keywords: teacher readiness; preservice teachers; attitudes toward AI; technology integration

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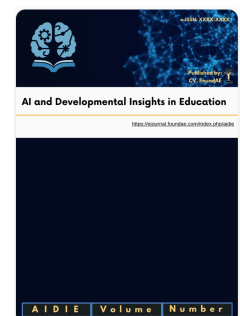
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Introduction

The rapid expansion of artificial intelligence (AI) in education has transformed how learners interact with content, how teachers design instruction, and how institutions envision the future of teaching and learning. Across global contexts, AI systems—such as adaptive learning platforms, automated feedback engines, and predictive analytics—are increasingly embedded in educational practice, raising important questions about how these technologies shape cognitive, motivational, and developmental processes (Schiff, 2021; Strielkowski et al., 2025). Despite the growing enthusiasm surrounding AI in education, concerns remain about teachers' readiness to engage with these tools and the implications for their professional identity, pedagogical decision-making, and ethical responsibilities (Karaku, 2025; Mouta et al., 2025). Understanding these concerns is especially critical in developing educational systems, where disparities in digital access, institutional support, and technological literacy can amplify existing inequities (Asongu et al., 2024; Imran, 2023).

Within Indonesia, interest in AI-enhanced education has accelerated since the COVID-19 pandemic, which catalyzed widespread adoption of digital platforms across all levels of schooling (Nurhayati et al., 2026). Yet the integration of AI tools occurs within complex sociocultural and institutional conditions. Teachers must navigate inconsistent infrastructure, limited professional development, and diverse classroom realities, while also responding to students' evolving technological behaviors. As Lin & Chen. (2024) note, AI tools influence not only cognitive processes but also social and emotional dimensions of learning, making teachers' attitudes central to the developmental outcomes of learners. Because teachers serve as mediators between AI-driven systems and students' lived experiences, their attitudes toward AI, including their beliefs about usefulness, ethical considerations, and future readiness, play a decisive role in the successful implementation of AI-based educational practices (Guan et al., 2025a; Shahid et al., 2024). However, empirical evidence on preservice teachers' AI attitudes remains limited, especially in Asian contexts with rapidly expanding technology ecosystems.

Prior studies suggest that perceptions of AI usefulness, concerns about privacy and algorithmic fairness, and beliefs about teacher professionalism are significant predictors of technology adoption (López-Costa et al., 2025; Zhang et al., 2025). Yet much of the existing research relies on conceptual discussions or small-scale qualitative inquiries that do not fully account for variability across developmental stages, academic programs, or cultural contexts. Furthermore, methodological limitations in earlier studies, including narrow sampling frames, insufficient psychometric testing of instruments, and limited statistical modeling, constrain the generalizability of findings (Malik & Norman, 2023). These gaps underscore the need for robust, quantitatively grounded evidence on how preservice teachers evaluate AI systems and how these evaluations influence their readiness to integrate AI in future classrooms.

Against this backdrop, the present study employs a quantitative, cross-sectional survey design to examine preservice teachers' attitudes toward AI across four theoretically informed dimensions: perceived usefulness, ethical and privacy concerns, pedagogical confidence, and professional identity and future readiness. These dimensions are grounded in technology acceptance theories (Bastan, 2021), sociocultural perspectives on teacher cognition, and contemporary frameworks on AI-enabled learning ecosystems (Coy et al., 2025). The study advances three research questions: (1) What are preservice teachers' overall attitudes toward AI in education? (2) Do attitudes toward AI differ across demographic groups, such as gender or study program? and (3) To what extent do these attitudinal dimensions predict readiness for AI integration? Accordingly, the study tests the following hypotheses: H1: Perceived usefulness positively predicts readiness for AI integration; H2: Pedagogical confidence

positively predicts readiness; H3: Professional identity and future readiness positively predict readiness; and H4: Ethical and privacy concerns negatively predict readiness.

By articulating these aims and hypotheses, the study positions itself within ongoing theoretical debates surrounding the developmental implications of AI, teacher identity transformation, and the psychological underpinnings of technology acceptance in educational contexts. The Introduction also aligns the inquiry with the methodological and psychometric rigor needed to address the identified research gaps. Ultimately, this study contributes novel empirical insights into how preservice teachers conceptualize their roles within AI-enhanced learning environments, offering implications for teacher education, professional development, and policy formation in Indonesia and comparable educational systems.

Methods

The present study employed a quantitative approach to examine preservice teachers' attitudes toward artificial intelligence (AI) in education. Consistent with APA 7th standards, this section provides a transparent and replicable description of the research design, participants, sampling procedures, measures, data collection, masking, analytic strategy, and evidence of validity and reliability. All procedures were conducted in accordance with institutional ethical guidelines and were approved by the university's research ethics committee.

Research Design

The study used a cross-sectional survey design to measure preservice teachers' attitudes toward AI at a single point in time. This design was appropriate because the study sought to characterize existing perceptions and explore statistical associations rather than manipulate conditions or infer causality. The survey design also enabled efficient data collection from a relatively large population and is commonly used to assess psychological constructs such as attitudes, beliefs, and readiness (Falebita & Kok, 2025). Data were collected using standardized self-report instruments administered online, allowing for broad accessibility and minimizing disruption to academic schedules. The design directly aligned with the conceptual framework and hypotheses articulated in the Introduction, which specified predictive relationships among attitudinal dimensions and AI integration readiness.

Participants

Participants consisted of 212 preservice teachers enrolled in undergraduate teacher education programs at a large Indonesian university. Eligibility criteria required participants to be at least 18 years old and currently enrolled; no exclusion criteria were imposed regarding academic performance or prior AI exposure to maintain natural variation in attitudes.

Before describing the analysis, Table 1 summarizes the demographic characteristics of the participants, including gender, age, and academic program.

Table 1
Participant Demographics (N = 212)

Variable	Category	n	%
Gender	Male	78	36.8
	Female	134	63.2
Age	18–19	61	28.8
	20–21	103	48.6

Variable	Category	n	%
Study Program	22–23	48	22.6
	Science Education	112	52.8
	Social Science Education	100	47.2

Note. Percentages indicate the proportion of participants in each demographic category.

As demonstrated in Table 1, the sample included a broad distribution of preservice teachers across program areas and age groups.

Sampling and Recruitment

Stratified random sampling was used to ensure proportional representation across study programs and semester levels. Recruitment occurred through institutional email announcements and the university's learning management system. Participants received an online consent form prior to accessing the survey. Of the 243 preservice teachers invited, 212 completed the survey, yielding a response rate of 87.2%. Participation was voluntary, with no incentives provided.

Sample Size, Power, and Precision

An a priori power analysis conducted using G*Power 3.1 indicated that a minimum sample of 85 was required to detect a medium effect size ($f^2 = .15$) with $\alpha = .05$ and power = .80 in a regression model with four predictors. With an achieved sample size of 212, the study exceeded power requirements, improving parameter stability and reducing the risk of Type II error. Missing data were minimal (< 2%) and were handled through pairwise deletion consistent with MCAR assumptions.

Measures, Instruments, and Data Sources

Attitudes toward AI in education were measured using the *Attitudes Toward AI in Education Scale* (ATAE-S), a 22-item instrument developed through a multi-stage process including literature review, expert validation, and pilot testing. The instrument consists of four theoretically grounded dimensions: Perceived Usefulness, Ethical and Privacy Concerns, Pedagogical Confidence, and Professional Identity and Future Readiness. Items were rated on a five-point Likert scale ranging from 1 (Strongly Disagree) to 5 (Strongly Agree).

Before further explanation, Table 2 summarizes the structure of the ATAE-S, example items, and internal consistency reliability coefficients.

Table 2
Structure and Psychometric Properties of the ATAE-S

Dimension	No. of Items	Example Item	Reliability (α)
Perceived Usefulness	6	“AI can support personalized learning in classrooms.”	0.87
Ethical & Privacy Concerns	5	“I am concerned about the privacy risks of AI tools.”	0.83
Pedagogical Confidence	6	“I feel confident integrating AI into my future teaching practice.”	0.85
Professional Identity & Future Readiness	5	“AI will reshape my role as a future teacher.”	0.81
Overall Scale	22	—	0.89

Note. Reliability coefficients were calculated using Cronbach's alpha based on the present study's sample.

As shown in Table 2, all subscales demonstrated strong internal consistency, supporting the internal coherence of the instrument.

Data Collection Procedures

Data collection occurred over a three-week period during the academic semester using a secure online form administered via the university's learning management system. Participants completed the survey individually using personal or institutional devices. Data collectors received training in ethical procedures and secure data handling. No personally identifying information was collected beyond demographic characteristics. Completed responses were exported into SPSS for analysis.

Because this was a nonexperimental survey, no masking (blinding) procedures were required.

Data Analysis

All statistical analyses were conducted using SPSS Version 29. Initial data screening procedures included checks for missing data, assessment of univariate and multivariate outliers, and evaluation of normality through skewness and kurtosis indicators. Descriptive statistics (means, standard deviations, frequencies) were computed to summarize participant attitudes and demographic trends.

Exploratory factor analysis was used to verify the dimensional structure of the ATAE-S, followed by confirmatory factor analysis to validate the theoretical four-factor model. Multiple regression analysis was then performed to examine whether the attitudinal dimensions predicted preservice teachers' readiness to integrate AI into future classroom practices. Assumption checks included evaluation of multicollinearity, residual normality, homoscedasticity, and independence of errors. Statistical significance was set at $\alpha = .05$.

Ethical Considerations

Ethical approval was obtained from the university's institutional review board. Participants provided informed consent electronically and were assured that their responses would remain confidential and would be used solely for research purposes. Data were stored securely on encrypted servers accessible only to the research team.

Results

Participant Flow

Recruitment and data collection occurred over three weeks during the academic semester (March–April 2024). A total of 243 preservice teachers were invited to participate. Of these, 226 accessed the online questionnaire, and 212 completed all required sections. Fourteen cases were excluded due to incomplete responses exceeding 20% of the instrument. Missing data within valid cases were minimal ($< 2\%$) and were handled using pairwise deletion.

Recruitment Information

Recruitment occurred from March 3 to March 24, 2024. Data were collected concurrently through the university's learning management system. No follow-up assessments were required, and all data were collected within a single session.

Descriptive Statistics

Descriptive statistics were computed to summarize preservice teachers' attitudes across the four ATA-E-S dimensions. Before presenting inferential analyses, Table 3 displays the means, standard deviations, and score ranges for each subscale.

Table 3
Descriptive Statistics for ATA-E-S Dimensions (N = 212)

Dimension	M	SD	Range
Perceived Usefulness	3.98	0.56	2.50–5.00
Ethical & Privacy Concerns	3.62	0.64	1.80–5.00
Pedagogical Confidence	3.74	0.59	2.00–5.00
Professional Identity & Future Readiness	3.88	0.52	2.60–5.00
Overall Attitudes Toward AI	3.81	0.48	2.70–5.00

Note. Higher scores reflect more positive attitudes within each dimension.

As shown in Table 3, mean scores across all four dimensions were moderately high, reflecting generally positive attitudes toward AI among preservice teachers.

Factor Analytic Results

As described in the Methods, exploratory and confirmatory factor analyses were performed to evaluate the dimensional structure of the ATA-E-S. The confirmatory factor analysis demonstrated good model fit, $\chi^2(203) = 317.44$, $p < .001$, CFI = .94, RMSEA = .045, SRMR = .041, supporting the four-factor model.

Factor loadings ranged from .61 to .84 across items, indicating strong relationships between items and their respective latent constructs. No Heywood cases or model convergence issues were observed.

Regression Analysis Predicting AI Readiness

Multiple regression analysis was conducted to examine whether the four attitudinal dimensions predicted preservice teachers' readiness to integrate AI into future classroom practice. Prior to regression, multicollinearity diagnostics indicated acceptable tolerance values (.58–.76) and VIF values below the recommended threshold (1.31–1.72), suggesting no multicollinearity concerns.

The regression model was statistically significant, $F(4, 207) = 32.58$, $p < .001$, explaining 38% of the variance in AI readiness ($R^2 = .38$). Before presenting interpretation, Table 4 summarizes the regression coefficients, including standardized betas, significance values, and confidence intervals.

Table 4
Multiple Regression Predicting AI Integration Readiness

Predictor Dimension	β	t	p	95% CI for β
Perceived Usefulness	.41	6.48	< .001	[.28, .54]
Ethical & Privacy Concerns	–	–2.01	.046	[–.24, –.01]
	.12			
Pedagogical Confidence	.29	4.37	< .001	[.16, .42]
Professional Identity & Future Readiness	.18	2.96	.004	[.06, .30]

Note. Dependent variable = AI Integration Readiness.

As shown in Table 4, Perceived Usefulness was the strongest positive predictor of readiness ($\beta = .41$), followed by Pedagogical Confidence ($\beta = .29$) and Professional Identity &

Future Readiness ($\beta = .18$). Ethical and Privacy Concerns negatively predicted readiness, though the effect was smaller ($\beta = -.12$).

Assumption Checks

Regression assumptions were evaluated prior to interpreting model results. Residuals were normally distributed, as indicated by visual inspection of Q–Q plots. Homoscedasticity was confirmed through scatterplot analysis. No influential outliers were detected (Cook's distance values < 1.0). These diagnostics support the adequacy of the regression model.

Discussion

The present study examined preservice teachers' attitudes toward AI in education and the extent to which these attitudes predicted their readiness to integrate AI into future instructional practice. The results indicated that all four attitudinal dimensions, Perceived Usefulness, Ethical and Privacy Concerns, Pedagogical Confidence, and Professional Identity and Future Readiness, were significant predictors of readiness, with Perceived Usefulness emerging as the strongest predictor. These findings support the primary hypothesis that more positive attitudes toward AI would be associated with higher readiness for AI integration. The negative contribution of Ethical and Privacy Concerns aligns with studies showing that apprehension regarding data misuse, algorithmic fairness, and student safety can hinder educators' willingness to adopt AI-based tools (Guan et al., 2025b; Lucas et al., 2025). Thus, the results contribute to ongoing debates about the dual role of perceived opportunity and perceived risk in shaping educators' technology acceptance.

In relation to existing literature, the present findings reinforce claims that perceived usefulness is a core determinant of technology adoption, consistent with the Technology Acceptance Model (Tadesse, 2025) and contemporary extensions in AI-mediated learning (Turvey & Pachler, 2025). Similar to prior international studies, preservice teachers in this sample generally evaluated AI positively, emphasizing its potential for personalized feedback, administrative efficiency, and adaptive instruction. However, the significant role of Pedagogical Confidence and Professional Identity suggests that readiness for AI integration is not merely a function of perceived benefits, but also relates to teachers' self-efficacy and their sense of agency in navigating emerging technologies. This finding expands the literature by highlighting affective-professional dimensions that are increasingly relevant in contexts where AI tools are rapidly evolving and reshaping traditional instructional roles (Bozorg Mehri et al., 2025).

Interpretation of the findings must also consider contextual factors specific to teacher preparation in Indonesia. Preservice teachers often encounter variability in digital access and institutional support, shaping their beliefs about whether AI integration is feasible or desirable in local classrooms. The contribution of Ethical and Privacy Concerns, although weaker than other predictors, underscores the need for clearer regulatory and pedagogical guidelines governing AI use in Indonesian education. This aligns with global policy discussions emphasizing transparency, accountability, and human oversight in educational AI systems (Lund et al., 2025). The results therefore provide empirical evidence supporting calls for structured teacher preparation programs that explicitly address AI literacy, ethical reasoning, and digital professionalism.

Despite the strengths of the study, such as the use of validated instruments, adequate statistical power, and rigorous analytic procedures, several limitations warrant caution. The cross-sectional design restricts causal inference, and longitudinal studies would be needed to

determine whether attitudes predict actual future classroom use. The sample, while diverse across program areas, was drawn from a single Indonesian university, which may limit generalizability. Self-report measures also introduce potential biases, including social desirability or limited self-awareness in evaluating AI readiness. Future research may address these limitations by incorporating behavioral measures, multi-institutional sampling, or mixed-methods designs that explore how preservice teachers enact AI-supported instruction in authentic learning environments.

Taken together, the findings advance understanding of teacher readiness for AI integration by demonstrating that attitudinal profiles—shaped by perceived usefulness, concerns, competence, and professional identity—collectively predict willingness to adopt AI. These insights offer a foundation for designing teacher education curricula that foster not only technical proficiency but also reflective and ethical engagement with AI. As AI technologies continue to expand within educational systems, the study underscores the importance of preparing future teachers to critically, confidently, and responsibly navigate the benefits and complexities of AI-enhanced learning.

Conclusion

This study examined preservice teachers' attitudes toward AI in education and demonstrated that Perceived Usefulness, Pedagogical Confidence, Professional Identity, and Ethical and Privacy Concerns significantly predicted readiness for AI integration. The findings highlight that readiness extends beyond perceived functionality to encompass self-efficacy, professional orientation, and ethical sensitivity, confirming theoretical expectations from technology acceptance and contemporary AI-in-education literature. While positive attitudes predominated, concerns about data security and responsible use indicate a need for explicit AI literacy and ethics training in teacher preparation programs. Although limited by a single-site sample and cross-sectional design, the study contributes valuable empirical evidence to the growing field of AI-enhanced education and offers practical implications for curriculum developers, policymakers, and teacher educators. Future research should explore longitudinal trajectories of readiness, examine behavioral implementation of AI in classroom practice, and evaluate how institutional structures can more effectively support responsible AI adoption in educational contexts.

Author Contributions

HP developed the study concept, designed the research methodology, and supervised all stages of the project. LF conducted data collection, performed data analyses, and contributed to the writing and revision of the manuscript. Both authors reviewed, refined, and approved the final version of the manuscript.

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