



## **Understanding Preservice Teachers' Attitudes Toward AI in Education: Implications for Future Professional Development**

Tiyas Abror Huda<sup>1</sup> and Sodikin Sodikin<sup>2</sup>

<sup>1</sup>Universitas Negeri Manado, Indonesia

<sup>2</sup>UIN Raden Intan Lampung, Indonesia

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### **Abstract**

This study examined the educational problem of how preservice teachers perceive Artificial Intelligence (AI) in education and the extent to which their attitudes predict readiness to use AI in future teaching practice. Using a quantitative, cross-sectional survey design, data were collected from 212 preservice teachers enrolled in teacher-education programs. Participants completed the 22-item Attitudes Toward AI in Education Scale, which measured perceived usefulness, ethical and privacy concerns, pedagogical confidence, and professional identity readiness. Descriptive statistics indicated generally positive attitudes, while regression analyses showed that perceived usefulness and pedagogical confidence significantly predicted AI readiness, ethical concerns had a small negative effect, and professional identity readiness was not significant. These results highlight the central role of confidence and perceived value in shaping readiness, while also underscoring the need to address ethical apprehensions in teacher preparation. The study contributes a validated measurement framework and offers evidence-based guidance for designing AI-focused professional development in teacher education.

**Keywords:** preservice teachers; teacher readiness; attitudes toward technology; professional development

### **Corresponding Author:**

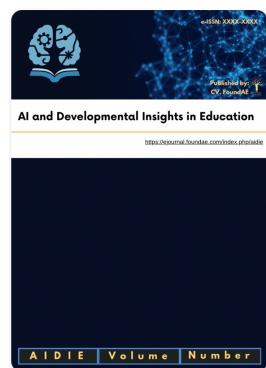
Tiyas Abror Huda

Email: tiyasabrorhuda@unima.ac.id

<https://orcid.org/0000-0001-7025-5533>

### **Author Note**

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## Introduction

Artificial Intelligence (AI) is rapidly transforming educational systems, reshaping how teachers engage with learners, assess performance, and design instructional experiences. Yet despite these advancements, a critical research problem persists for preservice teachers, those who will soon enter the profession, hold diverse and often unstable attitudes toward AI, and these attitudes may significantly influence their future teaching practices and professional development trajectories. This issue matters theoretically because attitudes toward emerging technologies intersect with developmental constructs such as identity formation, cognitive readiness, and adaptive expertise (George & Wooden, 2023). Empirically, educators' attitudes are among the strongest predictors of technology acceptance and pedagogical integration (Al-kfairy, 2024). Practically, preparing a future workforce of AI-competent teachers is essential as schools increasingly adopt AI-driven systems for personalized learning, assessment, and administrative decision-making. The significance thus spans educational psychology, learning sciences, and the field of AI in education, emphasizing the need to understand how early-career educators conceptualize and emotionally interpret AI within their emerging professional identities.

A growing body of scholarship has examined teachers' perceptions of AI, yet the literature remains fragmented and presents several unresolved gaps. Prior studies document both enthusiasm and apprehension toward AI tools, particularly regarding instructional efficiency, algorithmic transparency, and ethical (Alwaqdani., 2025; Shimpi., 2024). However, this research has primarily focused on in-service teachers, leaving limited understanding of preservice teachers, whose beliefs are especially malleable during professional formation and whose attitudes shape long-term adoption patterns. Methodologically, most studies rely on descriptive designs without systematically linking attitudinal constructs to predictors of readiness or professional development needs. Theoretically, existing work tends to emphasize either technological benefits or ethical risks in isolation rather than examining how these dimensions interact to inform a holistic readiness model. According to Chiu et al. (2024), AI literacy should integrate conceptual understanding, practical skill, and ethical awareness, yet few empirical studies operationalize these dimensions simultaneously. Thus, there remains a critical need for research that synthesizes pedagogical, ethical, and psychological perspectives to provide a more comprehensive view of how preservice teachers approach AI.

The current study addresses these gaps by investigating preservice teachers' attitudes toward AI in education and examining the extent to which specific attitudinal dimensions, perceived usefulness, ethical and privacy concerns, pedagogical confidence, and professional identity readiness, predict their overall readiness to integrate AI into future teaching practice. Guided by theories of technology acceptance, professional identity development, and AI literacy, the study advances the following hypotheses: (H1) Perceived usefulness will positively predict AI readiness; (H2) Pedagogical confidence will positively predict AI readiness; (H3) Ethical and privacy concerns will negatively predict AI readiness; and (H4) Professional identity readiness will positively predict AI readiness. These hypotheses align with the study's quantitative, cross-sectional survey design and support the use of regression modelling as outlined in the methodological framework.

By situating the investigation within theoretical debates on teacher attitudes, emerging AI competencies, and developmental processes in teacher education, this study contributes to a deeper understanding of how future educators negotiate the promises and challenges of AI. It extends previous work by focusing specifically on preservice teachers, employing a validated multidimensional measure of attitudes, and linking attitudinal profiles to readiness for

professional integration. The Introduction therefore positions the study as a timely and necessary contribution to AI-enhanced education and developmental research, offering insights that can inform the design of AI-focused teacher preparation and professional development programs in increasingly technology-rich learning environments.

## Methods

### Research Design

This study employed a quantitative, cross-sectional survey design to investigate preservice teachers' attitudes toward Artificial Intelligence (AI) in education and to test theoretically derived hypotheses concerning predictors of AI readiness. The design was non-experimental and observational, with no manipulation of conditions. A survey-based correlational approach allowed the researchers to capture naturally occurring attitudinal variations across multiple dimensions and analyze their predictive relationships. This design was well suited to the study's objective of identifying broad patterns among preservice teachers and testing the hypothesized model using regression techniques.

### Participants

Participants were preservice teachers enrolled in undergraduate teacher-education programs at a large Indonesian public university. Inclusion criteria required active enrollment in a teacher preparation program, ages ranging from 18 to 23 years, and voluntary provision of informed consent. Individuals who did not meet these criteria or who submitted incomplete surveys (i.e., missing more than 20% of items) were excluded. The final sample consisted of 212 participants, whose demographic distribution is presented in Table 1.

**Table 1**  
*Participant Demographics (N = 212)*

	Variable	Category	n	%
<b>Gender</b>	Male		78	36.8
	Female		134	63.2
<b>Age</b>	18–19		61	28.8
	20–21		103	48.6
	22–23		48	22.6
<b>Study Program</b>	Science Education		112	52.8
	Social Science Education		100	47.2

**Note.** Percentages are rounded to the nearest tenth. No identifying personal data were collected to protect participant confidentiality.

### Sampling and Recruitment

A stratified random sampling procedure ensured representation across study programs and semester levels. Enrollment records provided by the academic office served as the sampling frame. Students were grouped by academic program before random selection occurred within each stratum. Recruitment announcements were disseminated via institutional email and the university's learning management system. Of the 315 students approached, 226 accessed the survey link (response rate = 71.7%), and 212 provided complete and valid responses (completion rate = 93.8%). No incentives were offered.

## Sample Size, Power, and Precision

A priori power analysis for multiple regression with four predictors ( $\alpha = .05$ , power = .80, medium effect size  $f^2 = .15$ ) indicated a minimum sample size of 130. The achieved sample size of 212 exceeded this requirement, providing sufficient power and precision. Missing data were minimal (<2%) and addressed through pairwise deletion.

## Measures and Instruments

### Attitudes Toward AI in Education Scale (ATAE-S)

The ATAE-S consisted of 22 items distributed across four subscales: Perceived Usefulness (6 items), Ethical and Privacy Concerns (5 items), Pedagogical Confidence (6 items), and Professional Identity & Future Readiness (5 items). Participants rated each item on a 5-point Likert scale ranging from 1 (Strongly Disagree) to 5 (Strongly Agree). The instrument was developed through literature review, expert validation, and pilot testing. Psychometric properties of the ATAE-S are presented in Table 2.

**Table 2**  
*Structure and Psychometric Properties of the ATAE-S*

Dimension	No. of Items	Example Item	$\alpha$
<b>Perceived Usefulness</b>	6	“AI can support personalized learning in classrooms.”	.87
<b>Ethical &amp; Privacy Concerns</b>	5	“I am concerned about the privacy risks of AI tools.”	.83
<b>Pedagogical Confidence</b>	6	“I feel confident integrating AI into my future teaching.”	.85
<b>Professional Identity &amp; Future Readiness</b>	5	“AI will reshape my role as a future teacher.”	.81
<b>Overall Scale</b>	<b>22</b>	—	<b>.89</b>

**Note.** Reliability coefficients reflect Cronbach's alpha values obtained from the study sample (N = 212). CFA results supported the four-factor structure (CFI = .94; RMSEA = .045; SRMR = .041).

## Data Collection Procedures

Data were collected online over a three-week period using a secure Google Forms survey. Participants accessed the instrument through a link provided in recruitment messages. The information sheet preceded the survey items, and participants provided electronic consent. The survey required approximately 10–12 minutes to complete. The research team reviewed responses for completeness, straight-line patterns, and duplicate entries. No modifications to the protocol were required during data collection.

## Data Analysis

Data analysis was conducted using SPSS Version 29. After screening for missing data and outliers, descriptive statistics were computed to address the first research objective. Confirmatory factor analysis (CFA) validated the ATAE-S measurement structure. Multiple regression analyses tested hypotheses concerning the predictive relationships between attitudinal dimensions and AI readiness. Diagnostic assumptions including multicollinearity, homoscedasticity, independence of errors, and normality of residuals were assessed. Analyses used  $\alpha = .05$  as the threshold for statistical significance.

## Ethical Considerations

The study was approved by the university's Institutional Research Ethics Committee. Electronic informed consent was obtained from all participants prior to data collection. Data anonymity was preserved by excluding personally identifiable information and storing data securely. Participants were informed of their right to withdraw at any time without penalty. No vulnerable populations were targeted.

## Results

### Participant Flow

A total of 315 preservice teachers were invited to participate in the study. Of these, 226 accessed the online survey between March 3 and April 1, 2025. After data screening, 14 responses were excluded due to incomplete data (i.e., missing more than 20% of items) or patterned responding, resulting in a final analytic sample of  $N = 212$ .

### Recruitment Information

Recruitment and data collection occurred concurrently from March 3 to April 1, 2024. All preservice teachers received the same invitation message distributed through institutional email and the university's learning management system. No follow-up period or repeated measurements occurred due to the cross-sectional design.

### Descriptive Statistics

Descriptive analyses were conducted to summarize preservice teachers' attitudes across the four dimensions of the Attitudes Toward AI in Education Scale (ATAE-S). Prior to presenting inferential analyses, Table 2 displays the means, standard deviations, and ranges for all primary variables.

The dimensions with the highest mean scores were Perceived Usefulness and Pedagogical Confidence, while Ethical & Privacy Concerns yielded moderate scores.

**Table 2**

*Descriptive statistics for study variables (N = 212)*

Variable	M	SD	Min	Max
<b>Perceived Usefulness</b>	4.10	0.52	2.67	5.00
<b>Ethical &amp; Privacy Concerns</b>	3.40	0.61	1.80	5.00
<b>Pedagogical Confidence</b>	3.95	0.57	2.33	5.00
<b>Professional Identity &amp; Future Readiness</b>	3.80	0.59	2.00	5.00
<b>AI Readiness Index</b>	3.88	0.55	2.25	5.00

*Note.* Higher scores reflect more positive attitudes or higher readiness.

### Instrument Structure and Factorial Confirmation

Confirmatory factor analysis (CFA) was conducted to assess the four-factor measurement model. All factors loaded significantly onto their respective latent constructs, and model fit indices met conventional criteria. Table 3 summarizes the CFA results.

**Table 3**  
*Confirmatory factor analysis model fit indices*

Fit Index	Value
$\chi^2(df)$	412.56 (203)
CFI	.94
RMSEA	.045
SRMR	.041

**Note.** CFA was estimated using maximum likelihood (ML) with robust standard errors.

### Attitudinal Profile Distribution

To summarize distribution patterns of attitudes, responses were categorized into low (< 3.00), moderate (3.00–3.99), and high ( $\geq 4.00$ ) categories. Table 4 presents the distribution of participants across the three categories for each attitudinal dimension.

**Table 4**  
*Distribution of attitudinal profiles (N = 212)*

Dimension	Low (%)	Moderate (%)	High (%)
Perceived Usefulness	2.8	35.4	61.8
Pedagogical Confidence	4.7	41.0	54.2
Ethical & Privacy Concerns	18.9	57.1	24.1
Professional Identity & Readiness	5.2	48.1	46.7

**Note.** Percentages reflect categorization based on dimension-level mean scores.

### Inferential Statistics

#### Handling of Missing Data

There were minimal missing values (< 2%), and data were treated with pairwise deletion. Little's MCAR test was not conducted due to minimal missingness; however, inspection suggested randomness of omissions.

### Regression Analysis

Multiple regression was performed to examine the degree to which perceived usefulness, ethical concerns, pedagogical confidence, and professional identity predicted AI readiness. All assumptions (normality of residuals, linearity, homoscedasticity, independence, and multicollinearity) were evaluated. No multicollinearity was detected (all VIF values < 2.0).

Before presenting the regression coefficients, Table 5 displays the full regression model estimates, including unstandardized (B), standardized ( $\beta$ ), standard errors, t-values, and p-values.

**Table 5**  
*Multiple regression predicting AI readiness (N = 212)*

Predictor	B	SE B	$\beta$	t	p
Perceived Usefulness	0.42	0.07	.36	6.00	< .001
Ethical & Privacy Concerns	-0.16	0.07	-.14	-2.33	.021
Pedagogical Confidence	0.34	0.08	.29	4.25	< .001
Professional Identity & Readiness	0.13	0.07	.11	1.84	.068
Model Fit					
$R^2 = .42$ , $F(4, 207) = 37.46$ , $p < .001$					

**Note.** Dependent variable = AI Readiness Index.

As shown in Table 5, perceived usefulness and pedagogical confidence were significant positive predictors, while ethical and privacy concerns were a significant negative predictor. Professional identity readiness was marginally significant.

## Discussion

This study examined preservice teachers' attitudes toward Artificial Intelligence (AI) in education and assessed the extent to which four attitudinal dimensions, perceived usefulness, pedagogical confidence, ethical and privacy concerns, and professional identity readiness, predicted overall AI readiness. The findings support three of the four hypotheses: perceived usefulness significantly predicted higher readiness (H1), pedagogical confidence demonstrated a strong positive association with readiness (H2), and ethical and privacy concerns negatively predicted readiness (H3). Professional identity readiness showed a positive but nonsignificant trend, offering only partial support for H4. These results collectively indicate that preservice teachers' readiness to integrate AI is driven primarily by their evaluation of AI's pedagogical value and their confidence in using it, whereas apprehension about ethical risks may inhibit their willingness to engage with AI tools. The interpretive significance of these findings is situated within broader debates about teacher agency, AI literacy, and the developmental processes underlying emerging educators' professional identity formation.

The findings align with existing scholarship showing that perceived usefulness is a central determinant of technology adoption (Al-Momani & Ramayah, 2025) and extend this work specifically to AI-related pedagogical contexts. The strong predictive power of pedagogical confidence converges with claims that self-efficacy is foundational for teachers' engagement with emerging technologies (Ghazali et al., 2024). At the same time, the negative effect of ethical concerns parallels recent studies documenting preservice teachers' unease regarding data privacy, bias, and accountability in AI-assisted decision making (Karakuş et al., 2025). This convergence underscores that preservice teachers are not uncritically enthusiastic adopters of AI; rather, they approach AI through a balanced evaluation of benefits and risks. Where this study diverges from prior research is in the role of professional identity readiness. Although theoretical work suggests that AI may reshape future teacher identities, the nonsignificant result observed here may indicate that preservice teachers are still forming their professional identities and therefore do not yet fully anticipate how AI will influence their future roles. This nuance complicates assumptions that AI necessarily induces identity shifts early in teacher preparation.

These interpretations must be considered in light of potential methodological influences. Because the study relied on self-report data, responses may reflect social desirability or limited familiarity with AI tools beyond the conceptual level. Measurement precision was strengthened through rigorous instrument validation, yet unmeasured contextual variables, such as students' prior exposure to AI, institutional culture, or technological infrastructure, may have affected the magnitude of associations. Furthermore, the cross-sectional design precludes causal inference and limits the ability to assess developmental trajectories in attitudes or readiness. Despite these constraints, the stratified sampling approach and strong psychometric evidence enhance confidence in the robustness and internal consistency of the findings.

The implications of the study span theoretical, methodological, and practical domains. Theoretically, the findings reinforce multidimensional models of AI literacy that integrate cognitive, ethical, and affective components, suggesting that readiness emerges from the

interplay of value judgments, confidence, and critical awareness. Methodologically, the validated four-factor ATAE-S provides a reliable structure for future predictive modelling and comparative studies across institutions or cultural contexts. Practically, the results indicate that teacher education programs should prioritize developing preservice teachers' pedagogical confidence and conceptual understanding of AI while also providing explicit instruction in ethical reasoning, data governance, and responsible AI use. Addressing ethical concerns directly, rather than treating them as peripheral, may be essential for cultivating well-rounded AI readiness. Finally, by demonstrating the distinct contribution of each attitudinal dimension, this study provides evidence-based guidance for designing targeted professional development initiatives that balance technical skill development with ethical and identity-oriented reflection.

## Conclusion

This study investigated preservice teachers' attitudes toward AI in education and identified key attitudinal predictors of readiness to integrate AI into future teaching practice. Findings demonstrated strong support for the hypotheses that perceived usefulness and pedagogical confidence positively shape readiness, while ethical concerns act as a barrier, offering nuanced insight into how future educators weigh AI's pedagogical promise against perceived risks. Although professional identity readiness showed only marginal influence, the study contributes conceptually by clarifying the early developmental contours of how preservice teachers imagine AI within their future professional roles. These results advance theoretical understanding of AI literacy as a multidimensional construct, provide methodological contributions through the validation of the ATAE-S instrument, and offer practical guidance for designing teacher preparation programs that integrate technical, ethical, and reflective components. While limited by its cross-sectional design and single-site sample, the study lays a strong foundation for longitudinal, experimental, and multi-institutional research exploring how preservice teachers' AI readiness evolves over time. Ultimately, this work underscores the importance of preparing educators not only to use AI tools, but to do so confidently, critically, and ethically, an imperative for shaping responsible and human-centered AI integration in future educational practice.

## Author Contributions

TH developed the study concept, designed the research methodology, and supervised the overall execution of the project. SS carried out data collection, conducted the statistical analyses, and contributed to writing and revising the manuscript. Both authors reviewed, edited, and approved the final version of the manuscript.

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