

Exploring the Spectrum of Artificial Intelligence Awareness: Understanding Graduate Teacher Trainees' Knowledge in the Gulf of Mannar

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Received August 14, 2025; Revised September 16, 2025; Accepted September 24, 2025

Abstract The present study, Exploring the Spectrum of Artificial Intelligence (AI) Awareness: Understanding Graduate Teacher Trainees' Knowledge in the Gulf of Mannar, examines the extent of AI awareness among graduate teacher trainees pursuing the Bachelor of Education (B.Ed.) programs in the Ramanathapuram and Thoothukudi districts of Tamil Nadu, India. A total of 300 trainees were selected using stratified random sampling, ensuring representation across institutional categories and demographic variables. Data were gathered through a structured questionnaire covering dimensions such as basic AI concepts, perceptions of AI applications in education, attitudes toward AI integration, ethical considerations, and readiness for adoption. Statistical analyses, including descriptive statistics, t-tests, and correlation methods, were employed to interpret the responses. The findings revealed that while trainees demonstrated moderate awareness of AI, notable variations were observed based on gender, college type, and geographical location. Importantly, participants expressed a strong willingness to integrate AI into teaching practices, acknowledging its potential to enhance instructional effectiveness and student engagement. However, concerns were also raised regarding ethical implications, data privacy, and equitable access. The study underscores the necessity of embedding AI literacy and training modules within teacher education programs to prepare future educators for an increasingly AI-driven educational environment.

Keywords: Artificial Intelligence, AI awareness, Educational Technology and AI Integration

Cite This Article: N. Sasikumar, and J. Alangaram, "Exploring the Spectrum of Artificial Intelligence Awareness: Understanding Graduate Teacher Trainees' Knowledge in the Gulf of Mannar." *American Journal of Educational Research*, vol. 13, no. 9 (2025): 425-431. doi: 10.12691/education-13-9-2.

1. Introduction

The origins of Artificial Intelligence (AI) can be traced back to the mid-20th century, when pioneering computer scientists such as Alan Turing, John McCarthy, Marvin Minsky, and Herbert Simon began exploring whether machines could simulate human intelligence. The famous Turing Test, proposed in 1950, laid the foundation for discussions on machine cognition, while McCarthy later coined the term Artificial Intelligence in 1956 during the Dartmouth Conference, which is widely regarded as the birthplace of AI as an academic discipline. Since then, AI has evolved considerably from rule-based expert systems and symbolic reasoning to more advanced approaches such as machine learning, natural language processing, and neural networks. Russell and Norvig [1] defined AI as "the designing and building of intelligent agents that receive percepts from the environment and take actions that affect that environment." More broadly, AI can be understood as the simulation of human intelligence by computer systems capable of performing tasks that typically require human cognition, such as problem-

solving, decision-making, language understanding, and pattern recognition. Today, AI encompasses multiple branches, including machine learning, robotics, computer vision, and intelligent tutoring systems, positioning it as a transformative technology across diverse domains most notably in the field of education, where its integration into teacher preparation programs holds significant potential.

Artificial Intelligence (AI) is increasingly recognized as a defining feature of the digital era, reshaping economies, workplaces, and societies. In the education sector, AI is not only a technological innovation but also a pedagogical force with the potential to transform teaching and learning. AI-driven tools can support personalized instruction, automate administrative tasks, and offer predictive insights into student performance. However, these opportunities are accompanied by challenges related to equity, ethics, and teacher preparedness. For this reason, examining AI awareness among future educators is essential, particularly in regions where teacher education must respond to both global technological trends and local educational contexts.

Several studies underscore the transformative yet complex role of AI in education. Pedro et al. [2] emphasized AI's role in fostering sustainable development

while raising concerns about accessibility in underprivileged regions. Their work highlights the digital divide as a critical barrier to equitable AI adoption. Similarly, Chaudhry and Kazim [3] argued that AI has the potential to alleviate teacher workload and personalize learning experiences, though they cautioned that issues of ethics, data privacy, and the pandemic context must be addressed. Ahmad et al. [4] further reinforced AI's capacity to overcome instructional challenges, suggesting that teacher training institutions must be proactive in adopting AI-based practices.

Other scholars have examined AI from multi-stakeholder and systemic perspectives. Gocen and Aydemir [5] illustrated the benefits of AI integration but also pointed out potential drawbacks, advocating for strategies that balance technological enthusiasm with practical realities. Saputra et al. [6] expanded this argument by identifying opportunities as well as risks, such as implementation costs and security concerns, stressing the need for careful planning. Mangla et al. [7] connected AI to emotional health analysis, showing how machine learning can address broader human concerns beyond academics. Likewise, Nalbant [8] offered a concise review of AI's benefits and limitations, underscoring its transformative yet disruptive potential in classrooms.

In higher education, Chatterjee and Bhattacharjee [9] demonstrated how AI can enhance governance and instructional quality in India, aligning with Agrawal and McHale's [10] findings on AI as a driver of innovation and productivity in knowledge-intensive sectors. Collectively, these studies reveal that while AI is revolutionizing education globally, its successful integration requires awareness, ethical sensitivity, and professional readiness among educators.

Against this backdrop, the Gulf of Mannar region provides a unique context for inquiry. Situated in Ramanathapuram and Thoothukudi districts of Tamil Nadu, the region's teacher education colleges serve diverse student populations but remain relatively unexplored in terms of AI literacy. Understanding the awareness, perceptions, and readiness of graduate teacher trainees in this setting is critical for ensuring that future educators are not only familiar with AI but also capable of integrating it responsibly into teaching practices.

Thus, this study seeks to explore the spectrum of AI awareness among graduate teacher trainees in the Gulf of Mannar. By examining their knowledge, perceptions, and concerns, the research aims to identify gaps, highlight opportunities, and inform curriculum development in teacher education. Ultimately, it contributes to the broader discourse on AI literacy, ensuring that future teachers are well-prepared for an AI-driven educational landscape.

2. Review of Related Literature

The integration of Artificial Intelligence (AI) into education has been widely explored, with scholars emphasizing both its transformative potential and its inherent challenges. Pedro et al. [2] highlighted AI's capacity to promote sustainable development by enhancing educational accessibility, but cautioned that

digital divides in developing contexts may hinder equitable implementation. Addressing similar concerns, Chaudhry and Kazim [3] described AI as a tool to reduce teacher workload and personalize learning, while also stressing the importance of considering ethical challenges and the shifting educational landscape shaped by the COVID-19 pandemic.

Other studies examined AI's potential to overcome systemic challenges in teaching and learning. Ahmad et al. [4] emphasized the role of AI applications in improving instructional delivery and preparing students for the digital age. Gocen and Aydemir [5] analyzed stakeholder perspectives, recognizing both opportunities and limitations, and suggested the need for strategies that maximize benefits while minimizing risks. In a broader synthesis, Saputra et al. [6] identified opportunities, threats, and obstacles associated with AI integration, such as implementation costs, security issues, and ethical considerations, thereby underscoring the need for careful planning in policy and practice.

Expanding the discourse beyond instruction, Mangla et al. [7] demonstrated how AI and machine learning could be applied to emotional health analysis, offering insights into learners' well-being and highlighting AI's interdisciplinary applications. Nalbant [8] provided a concise overview of AI's benefits and drawbacks, reinforcing the idea that while AI can transform classrooms, it also poses challenges that educators must address. In the Indian higher education context, Chatterjee and Bhattacharjee [9] revealed how AI adoption can improve institutional governance, decision-making, and instructional delivery, complementing Agrawal and McHale's [10] model of AI-aided innovation, which positioned AI as a driver of productivity, knowledge creation, and research advancement.

Collectively, these studies portray AI as a multifaceted force in education capable of personalizing learning, enhancing efficiency, and supporting broader institutional reforms. At the same time, concerns regarding equity, ethics, cost, and teacher preparedness remain significant. Importantly, there is limited research focused on specific socio-cultural contexts, such as the Gulf of Mannar. This gap underscores the relevance of the present study, which investigates graduate teacher trainees' awareness of AI in this region, contributing both to local educational needs and to the global discourse on AI literacy.

3. Objectives of the Study

The study was designed to systematically examine graduate teacher trainees' awareness, perceptions, and readiness regarding Artificial Intelligence (AI) in the Gulf of Mannar region. Specifically, the objectives were:

1. To assess the current level of awareness and understanding of Artificial Intelligence among graduate teacher trainees in the Gulf of Mannar.
2. To explore graduate teacher trainees' perceptions of the potential impact of AI on education and teaching practices.
3. To identify the educational needs and preferences of graduate teacher trainees regarding AI integration in teacher training programs.

4. To provide recommendations for enhancing AI education and training for graduate teacher trainees in the Gulf of Mannar.

of gender, age, religion, socio-economic background, and educational experiences, providing a broad basis for assessing the status of AI awareness.

4. Hypotheses of the Study

To address the objectives and provide a testable framework for the analysis, the following null hypotheses were formulated:

1. There is no significant difference in the level of awareness and understanding of Artificial Intelligence among graduate teacher trainees in the Gulf of Mannar region.
2. Graduate teacher trainees' perceptions of the potential impact of AI on education and teaching practices are not influenced by factors such as prior exposure to AI technologies, cultural beliefs, and educational backgrounds.
3. There is no correlation between graduate teacher trainees' level of awareness of AI and their preferences for AI integration in teacher training programs.
4. There is no significant difference in AI awareness among graduate teacher trainees in the Gulf of Mannar region with respect to their demographic variables.

5. Methodology

The present study employed a quantitative survey design to investigate the spectrum of Artificial Intelligence (AI) awareness among graduate teacher trainees in the Gulf of Mannar region. This section outlines the research methodology, including research design, population, sample and sampling techniques, variables, instrument construction, data collection, and data analysis procedures.

6. Research Design

The study adopted a descriptive survey method, which is well-suited for examining participants' awareness, perceptions, and readiness regarding AI. Surveys allow for the systematic collection of data from a relatively large sample, thereby enabling meaningful statistical analysis and generalization within the study context [3]. By utilizing structured questionnaires, the research captured both demographic information and responses across multiple dimensions of AI awareness.

7. Population of the Study

The population comprised graduate teacher trainees (B.Ed. students) enrolled in colleges of education located in Ramanathapuram and Thoothukudi districts of Tamil Nadu, situated within the Gulf of Mannar region. These trainees represent future educators preparing for the secondary school level. The population is diverse in terms

8. Sample and Sampling Techniques

A sample of 300 graduate teacher trainees was selected using a combination of stratified and simple random sampling techniques. Initially, the population was stratified by district and institution to ensure proportional representation of Ramanathapuram and Thoothukudi. From these strata, participants were randomly chosen to minimize selection bias. Approximately one-third of the sample (100 trainees) was drawn from Ramanathapuram, and two-thirds (200 trainees) from Thoothukudi, reflecting the distribution of teacher training colleges in the region. This design enhanced representativeness while ensuring that different institutional types and demographic subgroups were included.

9. Variables of the Study

The study focused on AI awareness as the primary dependent variable. Intervening variables included gender (male/female), residence (rural/urban), religion (Hindu/Christian/Muslim), location of college (rural/urban), category of college (women's/co-educational), and type of school (government/private). These variables were considered to explore potential differences in AI awareness across demographic and institutional contexts.

10. Research Instrument

Data were collected using a structured questionnaire specifically designed to measure graduate teacher trainees' AI awareness. The instrument contained 30 yes/no items, distributed across six dimensions: (a) knowledge of basic AI concepts, (b) perception of AI applications in education, (c) attitudes toward AI integration, (d) concerns and ethical considerations, (e) miscellaneous aspects, and (f) readiness for AI adoption. The questionnaire was carefully developed based on existing literature (Ahmad et al., 2021; Saputra et al., 2023) and subjected to pre-testing for clarity and reliability. Expert validation ensured content accuracy, while pilot testing refined wording and format.

11. Data Collection Procedure

Data collection was conducted through personal visits to colleges of education in the Gulf of Mannar. Trainees were briefed on the study's purpose, and participation was voluntary. The questionnaire was self-administered, allowing respondents to complete it independently, thereby reducing researcher bias. Anonymity and confidentiality were maintained throughout the process to encourage honest responses.

12. Data Analysis

Collected data were coded and analyzed using the Statistical Package for the Social Sciences (SPSS). Descriptive statistics, such as means, standard deviations, and frequencies, were used to summarize overall awareness levels and demographic distributions. To test hypotheses, inferential analyses were conducted. Independent sample *t*-tests were applied to examine differences in AI awareness across demographic subgroups, while correlation analysis was used to determine the relationship between AI awareness and preferences for AI integration in teacher training. These analyses provided a robust framework for interpreting trainees' awareness, perceptions, and readiness.

Ethical standards were adhered to throughout the study. Informed consent was obtained from participants, and they were assured that their responses would be used solely for research purposes. Care was taken to ensure that participation did not disrupt academic schedules or impose undue burden on trainees.

The methodology combined a descriptive survey approach, stratified-random sampling, and a validated questionnaire to assess the spectrum of AI awareness among 300 graduate teacher trainees in the Gulf of Mannar. By employing rigorous procedures for data collection and analysis, the study ensured validity, reliability, and relevance, thereby contributing credible insights into the preparedness of future educators to engage with AI-driven educational practices.

13. Results

Table 1. Descriptive Statistics of AI Awareness among Graduate Teacher Trainees (N = 300)

Variable	M	SD	Interpretation
Overall AI Awareness	21.20	3.59	Moderate awareness of AI concepts
Knowledge of Basic AI Concepts	3.35	1.21	Foundational but uneven understanding
Preparation of AI Applications in Edu.	3.34	1.20	Moderate awareness, room for growth
Attitude toward AI Integration	4.09	1.10	Positive attitude toward AI use in class
Concern and Ethical Considerations	2.95	0.83	Moderate awareness of ethical issues
Readiness for AI Integration	4.18	0.94	High readiness and enthusiasm
Miscellaneous Aspects	3.30	0.98	Mixed engagement in AI-related areas

Note. Scores are based on dimension-wise means.

Trainees displayed a moderate overall awareness ($M = 21.20$, $SD = 3.59$). They showed particularly strong attitudes ($M = 4.09$) and readiness ($M = 4.18$) for AI integration, but lower awareness of ethical considerations ($M = 2.95$). This indicates enthusiasm for AI but highlights gaps in foundational and ethical understanding.

Significant differences emerged based on location, residence, type, and category of college. Urban, private, and women's college students demonstrated higher AI awareness. No significant differences were found by gender or religion.

Table 2. Differential Analysis of AI Awareness by Demographic Variables (N = 300)

Variable	Group	M	SD	<i>t</i>	Interpretation
Gender	Male (n=25)	21.48	3.19	0.41	No significant difference
	Female (n=275)	21.17	3.64		
Location of College	Rural (n=39)	20.03	3.31	2.20*	Urban > Rural awareness
	Urban (n=261)	21.38	3.61		
Residence of Student	Rural (n=132)	20.17	3.76	4.55**	Urban > Rural awareness
	Urban (n=168)	22.01	3.25		
Type of College	Govt. (n=165)	20.41	3.82	4.31**	Private > Govt. awareness
	Private (n=135)	22.16	3.06		
College Category	Women's (n=135)	22.16	3.06	4.31**	Women's > Co-education awareness
	Co-Ed (n=165)	20.41	3.82		
Religion	Hindu (n=259)	21.12	3.63	0.52–0.79	No significant difference by religion

Note. $p < .05^*$, $p < .01$.

Table 3. Correlation Matrix of AI Awareness Dimensions (N = 300)

Dimension	D1	D2	D3	D4	D5	D6
D1. Knowledge of Basic AI Concepts	1					
D2. Preparation of AI Applications	.27**	1				
D3. Attitude toward AI Integration	.15**	.17**	1			
D4. Concern and Ethical Considerations	.11	.15**	.05	1		
D5. Readiness for AI Integration	.24**	.18**	.47**	.00	1	
D6. Miscellaneous Aspects	.22**	.23**	.22**	.16**	.22**	1

Note. $p < .01$.

Strong positive correlations were observed between attitude toward AI and readiness ($r = .47$, $p < .01$), suggesting that positive attitudes predict readiness for AI integration. Knowledge of AI concepts was moderately correlated with preparation, readiness, and miscellaneous awareness. Ethical concerns were weakly correlated with other dimensions, indicating that these issues are perceived independently of technical and attitudinal factors.

14. Results and Discussion

The findings of the present study reveal a complex but insightful picture of Artificial Intelligence (AI) awareness among graduate teacher trainees in the Gulf of Mannar region. While overall awareness levels were found to be moderate, distinct patterns emerged across the different dimensions assessed. Trainees demonstrated strong readiness to integrate AI and expressed positive attitudes toward its educational potential, indicating openness to technological innovation. At the same time, their limited conceptual knowledge and particularly low awareness of

ethical considerations highlight significant gaps that could hinder responsible adoption. These mixed results suggest that while teacher trainees are enthusiastic about using AI in classrooms, their preparedness remains uneven requiring structured efforts in teacher education programs to strengthen both foundational knowledge and ethical literacy.

15. Descriptive Patterns of Awareness

The descriptive analysis revealed that overall awareness of AI among graduate teacher trainees was moderate ($M = 21.20$, $SD = 3.59$). However, significant variation was observed across different dimensions. Readiness to integrate AI in teaching practices emerged as the highest-scoring dimension ($M = 4.18$), closely followed by attitudes toward AI adoption ($M = 4.09$). These results suggest that while conceptual understanding remains somewhat limited, the respondents displayed enthusiasm and openness toward integrating AI tools into their pedagogical repertoire.

In contrast, the lowest mean score was reported for ethical considerations ($M = 2.95$), signaling that trainees are relatively unprepared to confront questions related to fairness, accountability, and privacy in AI deployment. These findings resonate with Nalbant [8], who emphasized that while educators generally welcome AI, they lack the depth of understanding required to address its ethical risks. Thus, a paradox emerges: teacher trainees are eager to adopt AI but may not yet possess the critical literacy to use it responsibly.

16. Differential Variations across Demographics

The analysis of demographic and institutional variables brought forward significant patterns. Trainees from urban colleges displayed higher awareness compared to those in rural institutions. This difference can be attributed to better infrastructural support, improved internet access, and greater exposure to digital innovations in urban areas, as also highlighted by Pedro et al. [2]. Similarly, respondents residing in urban areas outperformed their rural counterparts, reaffirming the influence of accessibility on AI literacy.

Institutional type also emerged as an important factor. Students from private colleges and women's colleges recorded higher scores than those from government and co-educational colleges. These findings indicate possible disparities in curriculum emphasis, faculty engagement, or institutional priorities regarding technology adoption. Interestingly, gender did not yield significant differences, suggesting that male and female trainees share broadly similar levels of AI awareness. Likewise, religion was not a significant differentiator, implying that cultural background exerts limited influence on AI literacy.

17. Correlation among Dimensions

Correlation analysis further illuminated the

interrelationships between the six dimensions of AI awareness. A strong positive correlation emerged between attitude toward AI integration and readiness for adoption ($r = .47$, $p < .01$). This suggests that trainees who valued AI's potential were also more inclined to adopt it in practice, underscoring the centrality of attitudes in shaping readiness, as also noted by Chaudhry and Kazim [3].

Moderate correlations were observed between knowledge of AI concepts and both readiness and miscellaneous awareness, indicating that even modest conceptual familiarity fosters greater confidence in experimenting with AI tools. Conversely, ethical considerations correlated weakly with other dimensions, reinforcing the idea that ethical literacy is not naturally integrated with enthusiasm or technical knowledge. This aligns with Ahmad et al. [4], who argued that ethics must be explicitly taught rather than assumed to develop alongside technical proficiency.

18. Awareness and Perceptions of AI

The findings suggest a promising yet incomplete picture of AI awareness among graduate teacher trainees. On one hand, their moderate knowledge levels, coupled with strong readiness and positive attitudes, reflect openness to educational innovations. On the other, the lack of ethical understanding poses a risk of uncritical adoption. Similar patterns have been documented globally. For instance, Saputra et al. [6] observed that pre-service teachers are generally receptive to AI but often underestimate its complexities. These findings suggest that awareness must be deepened and diversified to ensure responsible integration into classrooms.

19. Theoretical Grounding of Results

Anchoring the findings within theoretical perspectives clarifies their significance. Pedro et al. [2] emphasized that AI adoption requires systemic readiness—spanning pedagogy, infrastructure, and policy. The mixed levels of awareness observed in the present study affirm that readiness must extend beyond enthusiasm to include curriculum reform and institutional support. Chaudhry and Kazim [3] argued that teacher perceptions and attitudes are decisive in determining adoption. The strong link between positive attitudes and readiness in this study supports this claim. Moreover, differences across rural and urban contexts can be interpreted through Rogers' Diffusion of Innovations theory, which posits that early adopters, typically in resource-rich environments, pave the way for broader adoption.

The imbalance between technological readiness and ethical literacy resonates with the TPACK framework [5], which calls for balanced development of technological, pedagogical, and content knowledge. In this study, while trainees were ready to experiment with AI, they lacked the ethical grounding to evaluate its implications. This highlights a gap that must be addressed to prevent lopsided integration.

Chatterjee and Bhattacharjee [9] also noted that

perceptions play a critical role in shaping technology adoption, underscoring the importance of structured opportunities for trainees to engage with AI in meaningful ways. Thus, the present findings are not isolated but rather consistent with established theoretical models.

20. Methodological Considerations and Future Directions

The descriptive survey method offered a valuable snapshot of teacher trainees' AI awareness. Nevertheless, future research could strengthen methodological rigor by incorporating more sophisticated approaches. Chatterjee and Bhattacharjee [9] used structural equation modeling to explore complex relationships among awareness, attitudes, and adoption, demonstrating how such methods can yield nuanced insights. Adopting similar techniques could help future researchers understand the pathways through which knowledge influences readiness.

Mangla et al. [7] showcased how machine learning techniques can capture emotional perspectives, suggesting that AI-driven analyses themselves can be applied to study AI awareness. Moreover, Saputra et al. [6] recommended mixed-methods designs to capture the multidimensionality of AI integration. Building on these insights, future studies should consider Likert-scale items instead of binary yes/no questions to measure levels of agreement more precisely. Qualitative additions—such as focus groups or interviews—would further enrich understanding by revealing the reasoning behind trainees' responses.

The geographical scope of this study limited to Ramanathapuram and Thoothukudi also restricts generalizability. Pedro et al. [2] warned that regional disparities significantly influence technology adoption. Expanding the research to include multiple districts across Tamil Nadu or India would enhance external validity. By diversifying both methodology and scope, future research could build a more comprehensive picture of AI awareness.

21. Ethical Implications of AI Awareness

Perhaps the most critical finding of the study is the limited ethical awareness among teacher trainees. Nalbant [8] cautioned that neglecting ethical dimensions can undermine AI's educational potential by exposing learners to risks such as algorithmic bias, privacy violations, and inequitable access. The present findings confirm that trainees are not yet prepared to navigate these complexities. Ahmad et al. [4] highlighted the urgent need for explicit training in ethical AI use within teacher education curricula. Without such preparation, educators may adopt AI tools uncritically, inadvertently reinforcing systemic inequities. Pedro et al. [2] warned that disparities in access could further exacerbate inequalities, a concern reflected in this study's rural-urban differences. Moreover, Gocen and Aydemir [5] argued that ethical literacy must complement technological competence to ensure balanced integration. Trainees who master AI tools but lack ethical sensitivity may deploy them without considering fairness, accountability, or transparency. These findings strongly

advocate for curriculum reforms to embed AI ethics as a mandatory component of teacher training.

22. Implications for Policy and Practice

The study carries several implications for teacher education policy and practice. First, it underscores the need for AI-focused modules in B.Ed. programs, designed not only to enhance technical knowledge but also to address ethical concerns. Saputra et al. [6] stressed that successful AI integration requires creating opportunities, addressing challenges, and mitigating obstacles. The findings here suggest that trainees are eager but require structured training to channel their enthusiasm into responsible practice.

Second, institutional support is critical. Chaudhry and Kazim [3] emphasized that effective AI adoption depends on coordination between policymakers, institutions, and educators. Teacher education institutions should invest in infrastructure, professional development, and curricular redesign that integrates both technical and ethical dimensions of AI.

Finally, equity considerations must guide policy. The disparities observed between rural and urban trainees demand targeted interventions to bridge infrastructural gaps. Providing equal access to AI resources and training is essential to prevent widening educational inequalities.

23. Conclusion

This study provides significant insights into the spectrum of Artificial Intelligence (AI) awareness among graduate teacher trainees in the Gulf of Mannar region. The findings reveal a generation of future educators who, despite possessing only moderate knowledge of AI concepts, display strong readiness and positive attitudes toward its integration into teaching and learning. Such enthusiasm offers a fertile ground for curriculum innovation and policy reform, enabling the integration of AI tools into teacher education in meaningful ways.

At the same time, the research highlights critical challenges that cannot be overlooked. The most pressing concern is the limited ethical literacy among trainees, particularly in areas such as privacy, algorithmic bias, and equitable access. These gaps, coupled with disparities across institutional types and geographical contexts, underscore the urgent need for systemic readiness that extends beyond individual enthusiasm. Drawing on theoretical perspectives such as the Diffusion of Innovations and the TPACK framework, the findings suggest that sustainable AI adoption requires balanced development across technical, pedagogical, and ethical dimensions.

The implications are clear: teacher education programs must move toward a holistic model of AI literacy that equips trainees not only with conceptual knowledge and practical skills but also with the ethical orientation necessary to evaluate and apply AI responsibly. Strengthening curricula, investing in institutional support, and addressing urban-rural disparities will be vital steps in ensuring inclusive access to AI-driven educational opportunities.

Looking ahead, future research should expand the scope of inquiry to diverse contexts, employ mixed-methods approaches, and investigate how attitudes and ethical concerns evolve as exposure to AI increases. By adopting such directions, scholarship can further illuminate the pathways toward effective AI integration in education. Ultimately, preparing graduate teacher trainees with comprehensive AI literacy—technical, pedagogical, and ethical—will ensure that they emerge not only as adopters of technology but also as critical stewards of its responsible use. In doing so, teacher education institutions will help bridge the gap between global technological transformation and local educational needs, ensuring that the promise of AI contributes to equitable, innovative, and ethically grounded teaching practices.

ACKNOWLEDGEMENT

This work is supported by the Alagappa University Research Fund (AURF) Seed Money 2024 [grant sanctioned vide Letter No. AU/SO(P&D)/AURF Seed Money/2024 Alagappa University, Karaikudi, Tamil Nadu, India, Date 11th December 2024]

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