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Teacher Education in the Age of Artificial Intelligence: Preparing Pre-Service English Teachers for Generation Z at Farhangian University

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Abstract: The rapid expansion of artificial intelligence (AI) is transforming education and challenging teacher education systems to address emerging technological, pedagogical, and ethical demands. This study investigates how Farhangian University, Iran's primary teacher education institution, prepares pre-service English teachers for AI integration, particularly in relation to the expectations and learning preferences of Generation Z. Using a mixed-methods design, data were collected from 150 pre-service teachers through questionnaires, semi-structured interviews, and focus group discussions. The study extends recent Iranian scholarship by integrating the TPACK and SAMR frameworks with critical pedagogy to examine AI readiness within a centralized teacher education context. Findings indicate moderate levels of AI literacy and preparedness, alongside considerable variation in practical competencies across participants and academic levels. While respondents recognized AI's potential to support personalized learning, adaptive feedback, and reduced administrative workload, qualitative data revealed persistent ethical concerns, contextual constraints, limited institutional support, and the need for stronger pedagogical agency. The analysis also identified shortcomings in technical proficiency, hands-on experience, and the effective integration of technological and pedagogical knowledge. The study recommends curriculum redesign, explicit ethical instruction, and context-specific professional development to promote ethically informed, practice-oriented AI training and better prepare Generation Z teachers for responsible AI use.

Keywords: AI integration in teacher education, ethical pedagogy, pre-service English teachers, TPACK framework

Introduction

Artificial intelligence (AI) is rapidly reshaping the educational landscape, fundamentally altering how teaching and learning are conceptualized and enacted. Contemporary AI applications enable personalized learning trajectories, alleviate routine administrative burdens, and inform pedagogical decision-making through systematic data insights (Holmes, Bialik, & Fadel, 2019; Luckin, 2018). However, alongside

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these benefits, AI introduces complex questions regarding educational philosophy, professional ethics, and the evolving role of teachers. Accordingly, modern teacher preparation programs are tasked not only with fostering technological competence but also with developing critical awareness of AI's pedagogical relevance, ethical implications, and socio-cultural alignment (Selwyn, 2020; Williamson et al., 2023).

This challenge is particularly pronounced for Generation Z pre-service teachers. While this cohort often demonstrates advanced digital fluency and a preference for interactive, technology-mediated environments, their readiness to integrate AI in formal classroom settings remains uneven (Ashoori Tootkaboni & Maghsoudi, 2025). Emerging evidence from the Iranian context underscores that while pre-service EFL teachers at institutions such as Farhangian University recognize the potential benefits of AI, they often lack the structured pedagogical frameworks required for meaningful implementation (Tusi Nasrabadi et al., 2025). Consequently, teacher education must transcend basic digital training and instead integrate AI literacy with robust pedagogical strategies. Pre-service teachers must acquire the capacity to implement AI tools thoughtfully while critically evaluating their educational value and ethical consequences.

Despite the global surge in AI-related educational research, much of the scholarship remains concentrated in Western and East Asian contexts (Zawacki-Richter et al., 2019). Less is known about how centralized, policy-driven teacher education systems, such as Iran's, prepare graduates for AI-mediated instructional environments. Within this context, Farhangian University serves as a pivotal site for examining the interplay of AI competence, ethical sensitivity, and professional readiness.

This study investigates the strategies employed by Farhangian University to prepare pre-service English teachers for AI integration in alignment with Generation Z learning preferences. Through a mixed-methods design, it evaluates participants' AI literacy, perceptions of benefits and limitations, readiness for classroom application, and awareness of ethical and cultural considerations. By synthesizing quantitative and qualitative insights, the research illuminates the pathways for designing teacher education programs that cultivate AI proficiency that is contextually grounded, ethically informed, and pedagogically effective—contributing to global discourse on AI in teacher development

Literature Review

Artificial Intelligence in Education: Potentials and Tensions

Artificial Intelligence (AI) has emerged as a disruptive force in contemporary education, facilitating dynamic assessment, personalized learning pathways, and the automation of administrative tasks (Luckin et al., 2016; Holmes et al., 2019; Singh & Ram, 2024). Through intelligent tutoring and predictive analytics, AI enables a shift toward differentiated instruction that aligns with the immediate, interactive, and customizable preferences of Generation Z (Zawacki-Richter et al., 2019).

However, this rapid adoption introduces significant socio-pedagogical tensions. Critics argue that uncritical integration risks reinforcing existing inequities, particularly when algorithmic systems mirror societal biases or when educators lack the competence to engage with these tools reflectively (Selwyn, 2020; Williamson et al., 2023). Much of the existing literature treats AI as a technical innovation, often sidelining the ethical dimensions and the impact on teacher-student relationships. Consequently, preparing educators requires moving beyond technical affordances toward a critical understanding of equity, algorithmic transparency, and the evolution of professional identity.

Generation Z as Learners and Emerging Educators

Born between 1997 and 2012, Generation Z represents the first cohort to develop within fully digitized, multimodal communication environments (Seemiller & Grace, 2016). While their learning preferences—characterized by a demand for immediacy and interactivity—align with AI-driven platforms, their role as *future educators* is more complex. Recent discourse suggests that personal digital fluency is not synonymous with professional AI literacy, which necessitates deliberate ethical judgment, pedagogical design, and cultural sensitivity (Meylani, 2024; Billings, 2024). Preparing this generation requires cultivating a "critical technological mindset" that moves beyond intuitive use to informed, pedagogical application.

AI Literacy in Teacher Education: A Critical Framework

AI literacy is a multidimensional construct encompassing the knowledge, skills, and attitudes required to navigate AI within educational ecosystems. It demands an integration of technological knowledge with pedagogical reasoning and ethical sensitivity (Selwyn, 2020). Despite the call for such literacy, many teacher education programs remain overly focused on operational or functional skills (Ofem & Chukwujama, 2024).

Current training often fails to engage with the deeper implications of data privacy, algorithmic bias, or the shifting role of the teacher (Rezai et al., 2024; Su et al., 2023). This gap highlights the need for a framework that elevates AI use from mere automation to critical pedagogical practice. A key instrument for such an evolution is the SAMR model (Substitution, Augmentation, Modification, Redefinition), which provides a metric for assessing whether AI is being used merely to substitute traditional tasks or to fundamentally redefine learning experiences.

Barriers to AI Integration in Teacher Education

AI integration faces multifaceted barriers, including rigid curricular structures, inadequate infrastructure, and institutional resistance (Selwyn, 2020; Wang, 2021). In centralized systems, such as in Iran, these barriers are compounded by top-down regulatory frameworks that limit the autonomy required for localized experimentation. Unlike decentralized systems where universities have the flexibility to pilot AI initiatives, centralized systems often struggle with a disconnect between national mandates and classroom-level readiness. Thus, AI readiness in this context is as much a function of policy support and institutional vision as it is an individual teacher's competence.

Recent Empirical Studies on AI in EFL Teacher Education

The discourse on AI in TESOL has recently shifted toward the necessity of critical integration. Kohnke and Zou (2025) advocate for utilizing the TPACK (Technological Pedagogical Content Knowledge) and SAMR (Substitution, Augmentation, Modification, Redefinition) frameworks to guide pre-service teachers, arguing that without these theoretical lenses, AI integration remains superficial. Specifically, TPACK provides a framework for teachers to negotiate the complex intersection of English language content, language pedagogy, and emerging AI technologies, ensuring that AI is not used in a vacuum but is intentionally aligned with language learning objectives. Meanwhile, the SAMR model offers a developmental pathway, helping teachers move beyond merely using AI as a basic substitute for traditional tools (e.g., using an AI chatbot as a simple bilingual dictionary) and toward modifying or redefining tasks (e.g., leveraging AI for personalized, interactive conversational practice or real-time socio-pragmatic feedback). Supporting this, Karaduman (2025) demonstrates that pre-service teachers'

perceived AI literacy is often inflated by their daily consumption of social technology, masking a lack of genuine pedagogical expertise. This disconnect underscores the need for structured frameworks like TPACK and SAMR to bridge the gap between casual digital literacy and purposeful, pedagogically-sound AI implementation.

In the Iranian context, Aghaei et al. (2022) reported that online synchronous educational software can facilitate language development and support more interactive forms of corrective feedback in ESP settings. Similarly, Kheiri et al. (2019) found that web-integrated instruction contributes positively to learners' self-regulated learning. Although these studies predate the widespread adoption of generative AI, they collectively highlight an important principle: the educational value of emerging technologies depends less on the technology itself than on teachers' ability to align digital tools with pedagogical objectives. This observation is particularly relevant in the context of AI integration, where effective implementation requires not only technical familiarity but also pedagogical competence and ethical awareness. Consequently, the preparation of pre-service English teachers must extend beyond technological training to include critical evaluation, adaptation, and responsible use of AI-driven tools in language education.

Recent studies focusing specifically on AI have reinforced this need. Ashoori Tootkaboni and Maghsoudi (2025) and Nasrabadi et al. (2025) have provided foundational insights into the anxieties and structural challenges faced by Farhangian University students. These studies indicate that, despite a generally positive disposition toward AI, institutional support and explicit pedagogical training remain limited. Building on this emerging body of research, the present study adopts a mixed-methods approach to examine not only what levels of AI literacy pre-service teachers possess, but also how and why they perceive AI as relevant to their future professional practice. By mapping Generation Z pre-service teachers' perceptions against the SAMR framework and examining issues of ethical awareness, AI-integrated lesson design, and policy constraints, this study offers a more comprehensive roadmap for sustainable and contextually appropriate AI integration in teacher education.

Farhangian University and the Iranian Context

Farhangian University offers a compelling site for investigating AI integration in teacher education. As Iran's central institution responsible for preparing the national teaching workforce, it plays a decisive role in shaping pedagogical reform and technological innovation. Its graduates, primarily members of Generation Z, will soon enter classrooms increasingly influenced by AI-driven tools and analytics. Yet empirical evidence concerning their AI literacy, readiness, and ethical awareness remains scarce.

Given Iran's centralised educational governance, Farhangian University's role extends beyond training to include policy enactment and professional socialisation. Understanding how it addresses AI integration thus provides insight into the broader dynamics of educational change in constrained policy contexts. Accordingly, this study aims to explore the following research questions:

Research Question One: What is the level of AI literacy among pre-service teachers at Farhangian University?

Research Question Two: How do pre-service teachers perceive the benefits and challenges of AI in education?

Research Question Three: To what extent do they feel prepared to incorporate AI into their future teaching practice?

Research Question Four: What barriers do they identify in implementing AI within teacher education?

Research Question Five: What strategies do they propose to promote effective and ethical AI integration?

Examining these dimensions allows the study to illuminate how pre-service teachers situated within a centrally regulated education system make sense of artificial intelligence, interact with it during their preparation, and project its significance for their prospective teaching roles.

Method

Research Design

The study adopted a convergent parallel mixed-methods design (Creswell & Plano Clark, 2018), in which quantitative and qualitative data were collected and analyzed concurrently to develop a comprehensive account of pre-service teachers' AI literacy, perceptions, and levels of preparedness. This methodological choice was guided by the need to capture both broadly generalizable patterns and in-depth, context-sensitive perspectives. Quantitative analyses identified the distribution and trends of AI-related skills and attitudes, whereas qualitative data provided deeper insight into the ethical, pedagogical, and contextual factors shaping those trends.

Consistent with the principle of methodological complementarity, the two strands of data were treated with equal priority and brought together during the interpretive phase through a side-by-side comparison strategy. In this joint display process, results from the quantitative and qualitative analyses were systematically juxtaposed to examine areas of convergence, divergence, and elaboration. This integrative approach strengthened triangulation and enabled a more holistic understanding of pre-service teachers' readiness to engage with artificial intelligence in educational contexts.

Participants

The research was conducted with a cohort of 150 pre-service English teachers enrolled at Farhangian University, Zanjan campus, in Iran. To achieve balanced representation, participants were recruited using a stratified random sampling procedure based on three key variables: year of study (from first year to final year), gender, and teacher education track (primary education, secondary education, and special education). This approach ensured proportional inclusion of participants across institutional subgroups.

The final sample consisted of 87 female participants (58%) and 63 male participants (42%), a distribution closely aligned with the overall gender composition of the university. Participants ranged in age from 18 to 25 years, with a mean age of 21.6 years (SD = 1.9). Representation across academic levels was relatively even, with first-year students accounting for 25% of the sample, second-year students 28%, third-year students 22%, and final-year students 25%.

From a methodological standpoint, a sample size of 150 was considered adequate to support both representational validity and statistical robustness, particularly for non-parametric analyses. Based on Cohen's (1992) power analysis criteria for identifying medium effect sizes ($f = 0.25$, $\alpha = 0.05$, power = 0.80), at least 128 participants are required to conduct reliable comparisons between groups. The selected sample therefore exceeded this threshold, allowing for dependable quantitative analysis while simultaneously accommodating the collection of diverse and meaningful qualitative insights. Because the study was conducted at a single campus, findings are analytically rather than statistically generalizable—that is, they provide transferable insights applicable to similar centralized teacher education contexts.

Instruments

Researcher-Developed Questionnaire (Quantitative Component)

A structured questionnaire was developed to measure participants' AI literacy, perceived benefits and challenges, self-reported preparedness, and perceived barriers to AI integration.

The instrument consisted of five subscales:

1. AI Literacy (5 items; e.g., "I can identify AI tools relevant to my teaching field");
2. Perceived Benefits (6 items);
3. Perceived Challenges (6 items);
4. Preparedness for AI Integration (4 items);
5. Perceived Barriers and Suggested Strategies (5 open-ended items).

Participant responses were captured using a five-level response format designed to reflect degrees of attitudinal alignment, ranging from complete disagreement at the lowest point of the scale (1) to full agreement at the highest point (5). To support the instrument's content relevance, the initial pool of items underwent an external evaluation process involving five subject-matter experts: three specialists in educational technology and two faculty members in applied linguistics. Their feedback was used to verify conceptual coverage and disciplinary appropriateness. Evidence for construct validity was subsequently examined through an exploratory factor analytic procedure, which indicated satisfactory alignment between individual items and their intended latent dimensions, with all factor loadings exceeding the acceptable threshold of 0.60. Internal consistency estimates demonstrated a high level of measurement reliability. The overall scale yielded a Cronbach's alpha coefficient of 0.86, while coefficients for individual subcomponents fell within a range of 0.78 to 0.89, indicating stable performance across dimensions.

Semi-Structured Interviews and Focus Groups (Qualitative Component)

In order to extend and contextualize the survey findings, a qualitative strand was implemented involving a purposively selected subgroup of 20 participants. Selection was guided by deliberate variation across academic level, gender, and self-reported familiarity with artificial intelligence, with the aim of capturing a wide spectrum of viewpoints rather than statistical representativeness.

Qualitative data were generated through two complementary formats. First, four focus group sessions, each consisting of five participants, were organized to facilitate interactive discussion around shared experiences. These group conversations addressed perceived opportunities and challenges associated with AI use in education, ethical implications, and participants' suggestions for meaningful integration within teacher education programs. Second, individual semi-structured interviews were conducted to allow for more detailed examination of personal experiences, beliefs, and critical reflections that might not surface in group settings.

The interview and discussion protocols were reviewed and refined by two specialists in qualitative research to ensure conceptual relevance, linguistic precision, and cultural suitability. All sessions were conducted over a period of 45 to 60 minutes. With informed consent, interactions were audio recorded and subsequently transcribed verbatim in Persian. For the purposes of analysis and reporting, the transcripts were then translated into English.

Data Collection Procedures

Data were gathered in three sequential but partially overlapping stages:

1. **Quantitative Stage:** After obtaining informed consent, the structured questionnaire was administered to the full sample of 150 participants. Participation was entirely voluntary, and responses were collected anonymously.
2. **Qualitative Stage:** Based on the outcomes of the survey, a subset of 20 participants was purposefully selected to take part in semi-structured interviews and focus group discussions. This approach ensured diverse representation across different levels of AI literacy and academic standing.
3. **Integration Stage:** Initial quantitative results guided the refinement of qualitative themes. These themes were then compared during analysis to enhance the validity and coherence of interpretations.

Data Analysis

Quantitative Analysis

All quantitative analyses were performed using IBM SPSS Statistics (Version 28). To obtain an initial profile of participants' levels of AI literacy, attitudes toward artificial intelligence, and perceived readiness for classroom use, summary indicators such as means, medians, and standard deviations were computed. These descriptive measures were used to capture central tendencies and dispersion patterns across the dataset.

Given the ordinal nature of responses generated through the Likert-type measurement format, inferential procedures were selected from the family of non-parametric statistics. Differences between two independent groups were examined using the Mann–Whitney U test, whereas comparisons involving more than two groups were conducted via the Kruskal–Wallis H test. In addition, relationships among categorical variables were evaluated using Chi-square tests of association. To move beyond statistical significance and assess the magnitude of observed differences, effect sizes were calculated and interpreted in line with the benchmarks proposed by Cohen (1988). This approach allowed for a more meaningful interpretation of results by emphasizing practical relevance alongside inferential outcomes.

Qualitative Analysis

Qualitative materials obtained from interviews and focus group discussions were examined using a thematic analysis approach grounded in the six-stage analytic model proposed by Braun and Clarke (2006). To support systematic data management and organization, NVivo software (version 12) was employed throughout the analytic process. Rather than applying predefined categories, the analysis followed an inductive logic, allowing recurring patterns and meanings to emerge directly from participants' narratives.

To enhance analytic rigor, a subset of the dataset—approximately 20% of the transcripts—was independently coded by two researchers. The level of agreement between coders reached 0.87, indicating a high degree of coding consistency. Instances of divergence were addressed through reflective discussion until mutual agreement was achieved. This collaborative procedure contributed to the credibility and dependability of the qualitative findings, while ensuring that theme development remained closely grounded in the original data. Emerging themes were iteratively reviewed and organised into higher-order

categories, reflecting participants' experiences, perspectives, and ethical considerations regarding AI integration.

Integration of Quantitative and Qualitative Findings

Integration was carried out at the interpretation stage through joint display analysis, comparing quantitative trends (e.g., moderate AI literacy) with qualitative insights (e.g., conceptual but not practical exposure). Convergence and divergence were identified to explain inconsistencies and expand interpretation. This process enhanced meta-inference validity, ensuring that conclusions reflected both statistical evidence and experiential perspectives.

Results

Quantitative Findings

AI Literacy

Considering the ordinal nature of the Likert-scale responses, non-parametric descriptive analyses were employed to accurately represent trends. Tables 1 and 3 provide a detailed distribution of participants' AI literacy and readiness levels, capturing patterns without invoking inappropriate parametric assumptions.

Participants demonstrated moderate AI literacy, with an average score of 2.8 out of 5 (SD = 0.9). First-year students scored significantly lower than their final-year counterparts (Mann-Whitney U= 412, $p < 0.01$), suggesting that knowledge and confidence in AI increase progressively throughout the teacher education program.

Table 1

AI Literacy Levels

Literacy Level	Frequency	Percentage (%)
Not familiar at all	40	26.7
Slightly familiar	50	33.3
Moderately familiar	40	26.7
Very familiar	20	13.3

Qualitative interviews revealed that although AI was discussed in theory-based coursework, students had limited hands-on experience. One first-year student remarked, "AI is mentioned in lectures, but we never actually apply it in class." A final-year student added, "I understand the theory, but I don't know which tools are effective or how to use them with students." These comments indicate that AI exposure remains primarily conceptual rather than practical.

Perceived Benefits and Challenges

Survey results indicated that most participants **acknowledged the advantages of AI**. Around 70% agreed that AI can support personalized learning, while 65% highlighted its potential to reduce administrative workload.

Table 2

Participants' Perceptions of AI Benefits and Challenges

Aspect	Agree (%)	Strongly Agree (%)	Neutral (%)	Disagree (%)	Strongly Disagree (%)
Supports personalized learning	46.7	23.3	16.7	6.7	6.6
Reduces administrative workload	40.0	25.0	20.0	10.0	5.0
Ethical concerns (privacy, bias)	33.3	16.7	26.7	20.0	3.3

Qualitative feedback expanded on these perceptions. Students appreciated AI's potential for adaptive assessments, individualized feedback, and engagement. One participant explained, "AI can track each student's progress and tailor exercises to their level, something impossible to do manually." However, participants also expressed concerns regarding bias, fairness, and over-reliance. A student noted, "If the algorithms are biased or data is incomplete, AI could give some students an unfair advantage."

AI Readiness

Participants reported moderate readiness to integrate AI into their teaching (M = 2.7/5, SD = 1.0), with first-year students scoring lower than final-year students (Mann-Whitney U=398, $p < 0.01$).

Table 3

Self-Reported Readiness for AI Integration

Preparedness Level	Frequency	Percentage (%)
Not prepared at all	25	16.7
Slightly prepared	45	30.0
Moderately prepared	50	33.3
Very prepared	30	20.0

Interviewees emphasized the need for practical, context-specific training. One final-year student said, "I feel somewhat prepared theoretically, but I need workshops to practice AI with real lesson plans." Focus groups reinforced that readiness depends on both exposure and hands-on opportunities within local curricula.

Barriers to AI Adoption

Several obstacles were identified. The most frequently reported barrier was insufficient training (80%), followed by limited access to AI tools (65%) and ethical concerns (50%).

Table 4

Perceived Barriers to AI Integration

Barrier	Frequency	Percentage (%)
Lack of training	120	80
Limited access to AI tools	98	65
Ethical concerns (privacy, bias)	75	50

Participants highlighted systemic issues such as inadequate guidance and resources. One explained, "Even if we want to use AI, the university doesn't provide tools or clear instructions for implementation."

Suggested Strategies for AI Integration

Students recommended strategies to improve AI adoption. Workshops and hands-on training tailored to the local curriculum were emphasized, along with collaboration with AI developers and integration of case studies.

Table 5

Suggested Strategies for AI Integration

Strategy	Mentioned by Participants (%)
Context-specific workshops	90
Collaboration with AI developers	75
Case studies and practical examples	80

A participant summarized, "We need examples and guided practice relevant to our students and curriculum, not generic AI demonstrations."

Qualitative Insights

Thematic analysis of interviews and focus group discussions revealed five interrelated dimensions of pre-service teachers' experiences and perceptions regarding AI integration:

1. **Limited Practical Engagement and the Need for Contextualized Training:** Participants consistently reported that their exposure to AI remained largely conceptual, with a recognized deficit in hands-on application during their training. A first-year student lamented, "AI is introduced in a single lecture, but practical applications are rarely explored." This highlights a broader need for training that is not only practical but also tailored to local curricular and cultural contexts. Respondents emphasized that AI tools must align with their specific teaching environment and student characteristics, advocating for practical applications in areas like classroom management, personalized learning platforms, and formative assessment. As one focus group member explained, "AI tools designed for international contexts may not align with our curriculum or student characteristics. Therefore, localized, context-specific training is essential for effective pedagogical integration." A related practical limitation was participants' perceived lack of ELT-specific exposure to how AI can support teaching and learning; as one participant noted, "We need examples of how AI can help us teach English," especially in areas such as language assessment, instant feedback, materials development, and chatbot-based learner support.
2. **Ethical, Data Privacy, and Academic Integrity Concerns:** A significant cluster of concerns revolved around the ethical implications of AI, particularly regarding student data and academic honesty. Participants expressed apprehension about the lack of transparency in how AI systems process and utilize student data, raising fears about potential misuse or unauthorized sharing of sensitive information. One participant articulated this worry: "AI can support teaching, but mishandling student data, such as its use in training algorithms without clear consent, could lead to significant harm or systemic inequity." Furthermore, participants recognized the growing challenge of maintaining academic integrity in the face of AI-generated content. They worried about their future ability to distinguish authentic student work from AI outputs, acknowledging that "the rise of generative AI tools necessitates new approaches to assessment that value critical thinking and originality over easily automated tasks."
3. **AI as a Complementary Resource for Both Teachers and Learners:** Participants generally viewed AI tools as valuable complements rather than replacements for human educators. There was a strong

preference for AI to support administrative tasks, student assessment, and personalized learning. Crucially, participants began to articulate the distinct benefits AI could offer to different stakeholders. For teachers, AI was seen as a potential aid for tasks such as curriculum planning, generating diverse teaching materials, and automating grading. For learners, AI held promise for personalized practice, instant feedback, and support in their language learning journey. As one participant stated, "AI can free up our time from administrative burdens, allowing us to focus more on direct student interaction and pedagogical strategy, while learners can benefit from immediate practice opportunities."

4. **Emphasis on Professional Development and Collaborative Strategies**: Participants underscored the value of ongoing professional development, including hands-on workshops and practical exercises. They also highlighted the importance of "stronger partnerships between educators and AI developers to ensure that AI tools are pedagogically sound, ethically designed, and contextually relevant." Moreover, participants recognized the critical role of training learners in effective and ethical AI use, suggesting the need for explicit instruction on learning strategies related to AI, including critical evaluation of AI outputs and responsible usage.

Integrated Interpretation of Findings

Integrating evidence from the quantitative and qualitative strands yielded a comprehensive picture of pre-service teachers' preparedness to incorporate artificial intelligence into instructional practice. Overall, participants demonstrated moderate levels of AI literacy and classroom readiness; however, substantial variation was observed in their practical ability to apply AI tools in pedagogically meaningful ways. Notably, only around one-fifth of respondents expressed strong confidence in using AI for instructional purposes, suggesting that readiness remains uneven and largely conceptual rather than operational.

Participants widely acknowledged the instructional potential of AI, particularly in relation to personalized learning experiences, adaptive feedback, and ongoing monitoring of learner progress. At the same time, both datasets revealed persistent ethical and pragmatic concerns, including issues related to data privacy, algorithmic bias, and excessive reliance on automated systems. These apprehensions point to the necessity of embedding ethical deliberation and critical engagement with AI technologies within teacher education curricula.

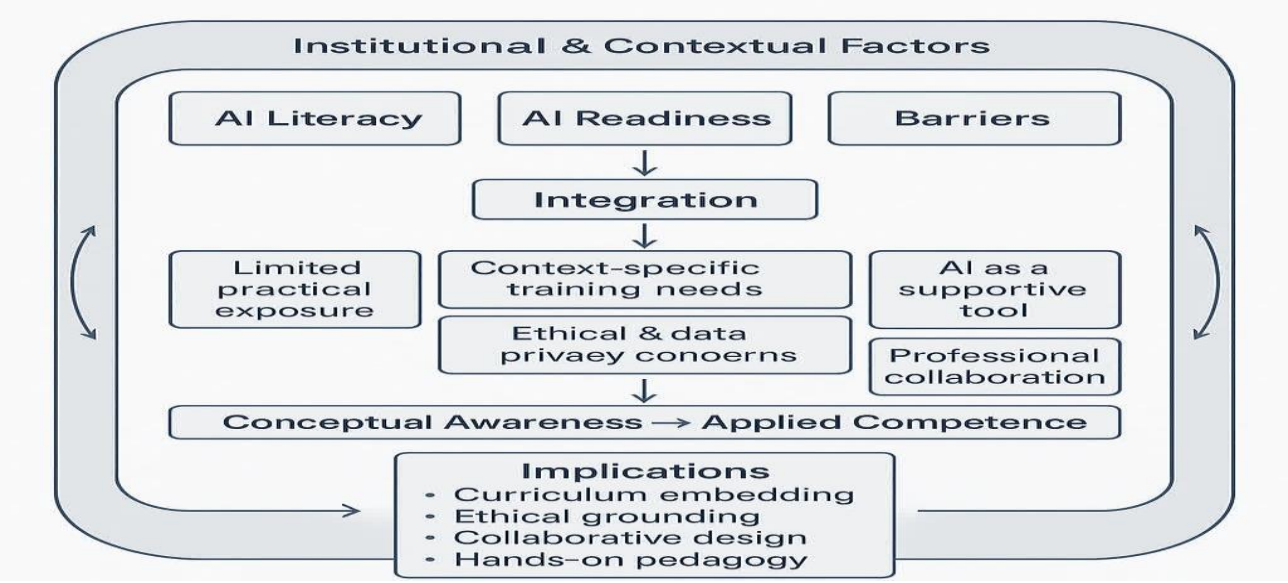
Across quantitative indicators and qualitative narratives, pre-service teachers consistently framed AI as an assistive component of teaching rather than a replacement for educators. Effective integration was understood to depend on preserving the teacher's core relational, emotional, and pedagogical responsibilities while selectively leveraging technological affordances. This perspective reinforces the view that human judgment and professional agency remain central in AI-enhanced educational environments.

Taken together, the findings suggest that teacher education programs—particularly within centralized systems such as Farhangian University—should systematically integrate AI literacy across the curriculum, expand opportunities for hands-on and context-specific practice, address ethical and data-related concerns explicitly, and position AI as an augmentative tool supporting professional practice. Such an approach can better equip future teachers to engage with AI in ways that are responsible, effective, and responsive to the learning preferences and expectations of Generation Z students.

Figure 1 synthesizes the mixed-methods results by illustrating how institutional and contextual conditions intersect with pre-service teachers' AI literacy, perceived barriers, and readiness for implementation. The model highlights a developmental trajectory from initial awareness to applied competence, underscoring the importance of institutional support, ethical grounding, and collaborative curriculum design in achieving sustainable AI integration.

Figure 1.

Institutional and Contextual Factors Intersecting with Pre-Service Teachers' AI Literacy, Perceived Barriers, and Readiness



Discussion and Conclusion

This research delved into how Iranian pre-service English teachers comprehend and approach artificial intelligence in the realm of language education, examining both their familiarity with AI tools and their readiness to integrate such technologies, as well as their personal attitudes toward its use in teaching.

The mixed-methods results revealed a complex and sometimes contradictory pattern: participants generally expressed optimism toward AI-supported instruction but demonstrated limited operational competence, insufficient institutional support, and uncertainty over ethical use. These findings align with international trends (e.g., Su et al., 2023; Alexandrowicz, 2024) while exposing contextual barriers specific to centralized educational systems such as Iran's.

Quantitative analyses showed that most participants had a conceptual understanding of AI applications—such as automated feedback, adaptive testing, and digital lesson design—but lacked confidence in applying them in practice. Qualitative data provided nuance, revealing that while trainees acknowledged AI's pedagogical potential, they rarely engaged with it in coursework due to restrictive policies and absent ethical frameworks. This persistent "knowledge–practice gap" suggests that teacher education must go beyond theoretical exposure and incorporate structured, hands-on learning that bridges understanding with authentic classroom application.

The present study explored how prospective English teachers combined technological, pedagogical, and content knowledge in their developing practice. While most participants showed familiarity with both technological tools and subject content, many displayed limited pedagogical fluency in orchestrating these resources for meaningful learning design. This pattern resonates with observations by Arvin et al. (2023), who noted that numerous teacher-education programs prioritize exposure to digital tools rather than cultivating pedagogically grounded design skills. The data further indicated that participants most frequently engaged with AI at the substitution and augmentation levels—using it for

efficiency purposes such as automated grammar correction, test generation, or administrative support—rather than leveraging it for substantial instructional transformation. Advancing toward higher stages of the SAMR continuum will therefore require nurturing design thinking, reflective pedagogical reasoning, and ethical sensitivity so that AI evolves from a mechanical aid into a genuine pedagogical collaborator.

A key contribution of the present study is its explicit attention to the ethical and -technical dimensions of artificial intelligence in educational contexts. Participants articulated significant concerns regarding the secure and ethical management of learner data, encompassing its collection, usage, and protection within AI-driven educational tools used for both research and direct language instruction. This includes anxieties about potential breaches, unauthorized access, and the use of data in ways that may not align with learner privacy rights or educational goals. There were also concerns about the presence of algorithmic bias, and the possibility that excessive reliance on AI could erode the humanistic foundations of teacher–student relationships. These concerns resonate with broader ethical discussions in AI in education, particularly the need for transparent, responsible, and privacy-conscious implementation of digital tools (Williamson & Eynon, 2020). From a critical pedagogy lens, such reflections signal an emerging critical consciousness among teachers who question how AI reshapes equity, access, and authority in classrooms. However, in the absence of structured coursework or institutional guidance, this awareness remains fragmented. Embedding ethics-focused digital pedagogy into teacher education could foster more coherent and critical engagement with AI technologies.

Moreover, globally, several education systems—such as those in Finland, Singapore, and South Korea—have integrated AI literacy through collaboration between education and computer science faculties (Ng et al., 2023; Alexandrowicz, 2024). Iran's centralized, exam-oriented structure limits similar innovation, yet its strong theoretical foundation in pedagogy provides fertile ground for meaningful adoption if complemented by experiential, context-sensitive training. These findings underscore that AI literacy is contextually constructed and must align with institutional capacity, teacher educators' modeling, and national education policy.

The study carries several implications for reforming teacher education. First, AI literacy should be systematically infused into pedagogy, assessment, and practicum courses rather than delivered as stand-alone workshops. Second, preservice teachers need scaffolded opportunities for supervised, ethical experimentation with AI tools. Third, faculty themselves require ongoing professional development to model reflective AI integration. Finally, universities should implement robust policy frameworks addressing privacy, academic integrity, and ethical AI use.

By positioning AI literacy at the convergence of the TPACK and SAMR frameworks and informed by principles of critical pedagogy, the present study frames it as a complex construct that integrates technical capability, pedagogical responsiveness, and ethical discernment. Analysis of participants' reported practices indicated that AI use was largely confined to lower levels of technological integration, most commonly corresponding to substitution and augmentation. This pattern highlights a limited progression toward more transformative applications of AI in teaching and learning.

These findings point to a pressing need for teacher education programs to move beyond surface-level exposure and foster deeper forms of engagement with AI technologies. Systematically embedding AI literacy across the curriculum can help narrow the gap between conceptual understanding and classroom application, while supporting the development of adaptive professional expertise. Such an approach also enables future educators to cultivate critical awareness alongside innovation, ensuring that AI integration is both pedagogically meaningful and ethically grounded.

Moreover, from a systemic perspective, the advancement of AI literacy requires its formal incorporation into national teacher education standards and accreditation frameworks. Higher education institutions should simultaneously invest in sustained professional development for teacher educators,

promote interdisciplinary collaboration with fields such as computer science and ethics, and establish clear institutional policies to regulate the responsible use of AI technologies. Robust governance mechanisms are essential to ensure transparency, accountability, and ethical oversight in AI-supported educational practices. Collectively, these measures can facilitate forms of AI integration that extend beyond instructional effectiveness to encompass ethical responsibility and sensitivity to cultural and contextual realities. Limitations and Future Research

Despite the contributions of this study, its focus on a single teacher education institution inevitably limits the extent to which the findings can be generalized to other contexts. To strengthen the evidentiary base, future investigations would benefit from incorporating multi-institutional or cross-contextual designs, as well as longitudinal approaches that follow the development of teachers' AI literacy and pedagogical practices over time. In addition, experimental and design-based research methodologies could offer deeper insight into how targeted professional learning interventions influence instructional innovation and ethically informed decision-making related to AI use in education. Furthermore, future studies could explore the specific challenges and successes of implementing AI ethics modules, examining how preservice teachers navigate real-world dilemmas concerning data privacy and algorithmic bias. Expanding comparative analyses to include regions with varying technological infrastructures and cultural approaches to AI would also enrich our understanding of context-specific needs and best practices.

In sum, findings highlight moderate literacy and positive attitudes but limited readiness for practical implementation, reflecting a widespread gap between conceptual awareness and applied capability. this study thus highlights that pre-service teacher perceive AI as both an instructional asset and an ethical challenge. Their cautious optimism captures the global tension between embracing technological innovation and upholding educational integrity. Developing a holistic AI literacy—integrating technical proficiency, pedagogical understanding, and ethical reflection—can equip future educators to use AI effectively while ensuring it serves human-centered and socially responsible educational practices.

References

Aghaei, K., Mousa Abad, M. A., & Mohammadi Sarab, M. (2022). Interplay between pronunciation-focused corrective feedback and online educational synchronic software in an ESP course. *Iranian Journal of English for Academic Purposes*, 11(3), 1–17. https://ijeap.cmu.ac.ir/article_157983.html

Alexandrowicz, V. (2024). Artificial intelligence integration in teacher education: Navigating benefits, challenges, and transformative pedagogy. *Journal of Education and Learning*, *13*(6), 346–360. https://doi.org/10.5539/jel.v13n6p346

Arvin, M., Chen, H., & Smith, J. (2023). Teacher collaboration with AI developers: Enhancing relevance and confidence in classroom AI integration. *Computers & Education,* 190, 104630. https://doi.org/10.1016/j.compedu.2023.104630

Ashoori Tootkaboni, A., & Maghsoudi, M. (2025). Exploring Pre-service EFL Teachers' Readiness to Integrate AI: A UTAUT2 Model Analysis. *Journal of Education*. https://doi.org/10.1177/00220574251379029

Billings, C. (2024). *Designing for Generation Z: Investigating the perceptions and experiences of Generation Z students with learning management systems* [Unpublished Doctoral dissertation, Concordia University, Chicago].

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology, 3*(2), 77–101. https://doi.org/10.1191/1478088706qp063oa

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). Lawrence Erlbaum.

Cohen, J. (1992). A power primer. *Psychological Bulletin, 112*(1), 155–159. https://doi.org/10.1037/0033-2909.112.1.155

Creswell, J. W., & Plano Clark, V. L. (2018). *Designing and conducting mixed methods research* (3rd ed.). Sage.

Ding, L., Zou, D., Kohnke, L. (2025). ChatGPT as an automated writing evaluation tool: how students perceive it and how it affects their writing. *Education and Information Technologies.* https://doi.org/10.1007/s10639-025-13775-3

Holmes, W., Bialik, M., & Fadel, C. (2019). *Artificial intelligence in education: Promises and implications for teaching and learning.* Center for Curriculum Redesign.

Karaduman, I. (2025). Bridging the gap: Pre-service teachers' AI literacy and the illusion of digital fluency. *Journal of Educational Technology and Teacher Education, 14*(2), 112–129. https://doi.org/10.1016/j.jette.2024.101234

Kheiri, S., Soleimani, H., Jafarigohar, M., & Rostami Abu Saeedi, A. A. (2019). The effect ofweb-integrated instruction and feedback on self-regulated learning ability of Iranian EFL learners. *Iranian Journal of English for Academic Purposes, 8*(1), 35–57. https://doi.org/20.1001.1.24763187.2019.8.1.3.3

Luckin, R. (2018). *Enhancing learning and teaching with technology: What the research says.* UCL IOE Press.

Luckin, R., Holmes, W., Griffiths, M., & Forcier, L. B. (2016). *Intelligence unleashed: An argument for AI in education.* Pearson Education.

Meylani, R. (2024). Artificial intelligence in the education of teachers: A qualitative synthesis of the cutting-edge research literature. *Journal of Computer and Education Research, 12*(24), 600–637. https://doi.org/10.18009/jcer.1477709

Ng, D. T. K., Su, J., & Chu, S. K. W. (2023). Artificial intelligence (AI) literacy in early childhood education: The challenges and opportunities. *Computers and Education: Artificial Intelligence,* 4, 100124. https://doi.org/10.1016/j.caeai.2023.100124

Ofem, U. J., & Chukwujama, G. (2024). Sustainable artificial intelligence-driven classroom assessment in higher institutions: Lessons from Estonia, China, the USA, and Australia for Nigeria. *European Journal of Interactive Multimedia and Education, 5*(2), e02403. https://doi.org/10.30935/ejimed/15265

Rezai, A., Soyoof, A., & Reynolds, B. L. (2024). Ecological factors affecting students' use of informal digital learning of English: EFL teachers' perceptions. *Teaching and Teacher Education*, 145, 104629. https://doi.org/10.1016/j.tate.2024.104629

Seemiller, C., & Grace, M. (2016). *Generation Z goes to college.* John Wiley & Sons.

Selwyn, N. (2020). Taking a qualitative approach to technology and education. In N. Selwyn (Ed.), *Telling Tales on Technology* (pp. 7–20). Routledge.

Shorey, S., Chan, V., Rajendran, P., & Ang, E. (2021). Learning styles, preferences and needs of Generation Z healthcare students: Scoping review. *Nurse Education in Practice*, 57, 103247. https://doi.org/10.1016/j.nepr.2021.103247

Singh, V., & Ram, S. (2024). *Impact of artificial intelligence on teacher education*. https://doi.org/10.59231/sari7669

Su, J., & Yang, W. (2023). Unlocking the power of ChatGPT: A framework for applying generative AI in education. *ECNU Review of Education, 6*(3), 355–366. https://doi.org/10.1177/20965311231168423

Tusi Nasrabadi, M., Haji, S., & Afshari, S. (2025). Assessing AI literacy among Iranian pre-service EFL teachers: Levels, predictors, and challenges: A mixed methods design. *International Journal of Educational Research,* Hormozgan University. https://ijer.hormozgan.ac.ir/article-1-418-fa.html

Wang, Y. (2021). When artificial intelligence meets educational leaders' data-informed decision-making: A cautionary tale. *Studies in Educational Evaluation,* 69, 100872. https://doi.org/10.1016/j.stueduc.2021.100872

Williamson, B., & Eynon, R. (2020). Historical threads, missing links, and future directions in AI in education. *Learning, Media and Technology, 45*(3), 223–235. https://doi.org/10.1080/17439884.2020.1798995

Williamson, B., Eynon, R., Knox, J., & Davies, H. C. (2023). Critical perspectives on AI in education: Political economy, discrimination, commercialization, governance and ethics. In B. du Boulay, A. Mitrovic, & K. Yacef (Eds.), Handbook of Artificial Intelligence in Education (pp. 555-573). (Elgar Handbooks in Education). Edward Elgar Publishing. https://doi.org/10.4337/9781800375413.00037

Zawacki-Richter, O., Marín, V. I., Bond, M., & Gouverneur, F. (2019). Systematic review of research on artificial intelligence applications in higher education–Where are the educators? *International Journal of Educational Technology in Higher Education,* 16(1), 1–27. https://doi.org/10.1186/s41239-019-0171-0

Appendix A: Sample Semi-Structured Interview Questions

This interview guide was designed to explore pre-service English teachers' understanding, readiness, and ethical awareness regarding the use of artificial intelligence (AI) in education.

1. How familiar are you with AI technologies, and how have you used them in your studies or daily life?
2. What do you think are the main benefits and challenges of using AI in English language teaching?
3. How prepared do you feel to use AI in your future teaching?
4. How do you combine your technological, pedagogical, and subject knowledge (**TPACK**) when thinking about using AI in the classroom?
5. What ethical issues should teachers consider when using AI with students?
6. How can Farhangian University improve its courses or training to help pre-service teachers use AI more effectively and responsibly?
7. How do you imagine the role of teachers changing in the age of AI?

Appendix B: Sample Focus Group Discussion Guide

This focus group guide was used to gather group perspectives from pre-service English teachers on AI integration in education.

1. What kinds of AI tools have you experienced or learned about in your teacher education program?
2. How do you think AI can support or challenge English language teaching?
3. What skills or knowledge do teachers need to use AI confidently and responsibly?
4. How can teacher education programs help you connect technology, pedagogy, and content knowledge (TPACK)?
5. What ethical or social issues come to mind when teachers use AI in classrooms?
6. How do you think frameworks like SAMR or critical pedagogy can guide responsible and meaningful AI use?
7. What changes would you suggest to improve AI-related training at Farhangian University?