

AI as a Game-Changer in Teacher Education: Paving the Way for Next-Generation Language Teaching

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Abstract

This mixed-methods study examines AI integration in Iranian language teacher education. Fifty-nine university professors completed surveys measuring AI effectiveness, ease of use, teaching efficacy, and student engagement; 15 were subsequently interviewed. Quantitative analyses revealed positive perceptions across all constructs, with student engagement rated highest ($M = 4.33$). Regression analysis identified ease of use as the strongest predictor of teaching efficacy ($\beta = .41, p < .001$), while both effectiveness and ease of use equally predicted student engagement ($\beta = .38$ each, $p < .001$). Experienced teachers reported significantly higher perceptions than novices across all measures. Thematic analysis generated five benefit themes—enhanced teaching efficacy, personalized learning, augmented student engagement, advanced data analytics, and continuous professional development—alongside challenges including technological barriers, financial constraints, digital divide, and resistance to change. Ethical concerns centered on data privacy, algorithmic bias, and maintaining human agency. Participants recommended integrating AI literacy across curricula, providing hands-on training, fostering interdisciplinary collaboration, and emphasizing ethical preparation. Findings highlight AI's transformative potential while underscoring the need for institutional readiness, infrastructure investment, and policy frameworks guiding responsible integration. Strengthening AI literacy among teacher educators is essential for sustainable, pedagogically sound implementation.

1. Introduction

Artificial intelligence (AI) is rapidly reshaping educational landscapes, with language teaching and teacher education standing at the forefront of this transformation (Chen et al., 2023; Cao & Hsu, 2023). AI technologies—including machine learning, natural language processing, and intelligent tutoring systems—are enabling personalized learning pathways, real-time feedback, and adaptive assessments that extend far beyond conventional pedagogical methods. As global demand for language learning intensifies, teacher education programs face mounting pressure to prepare instructors who can effectively leverage these tools. This imperative is particularly urgent in contexts like Iran, where AI is gradually entering university classrooms but its implications for teacher preparation remain largely unexplored. Despite AI's potential, integration into language teaching remains complex and challenging. Teacher education programs have traditionally emphasized pedagogy, linguistics, and language acquisition theories while overlooking competencies essential for implementing advanced technologies (Lin et al., 2024). Consequently, many language instructors lack the training and support needed to utilize AI tools effectively, missing opportunities to enhance student learning outcomes (Kim et al., 2024). This gap between technological advancement and teacher preparation represents a critical barrier to realizing AI's full potential in language education.

The significance of this study lies in its contribution to bridging this gap. As language learning becomes increasingly adaptive and technology-mediated, demand for instructors who can navigate AI-enhanced environments will continue to grow (Alam & Mohanty, 2023). Without systematic preparation, teachers may struggle to integrate AI meaningfully, potentially compromising the quality of language instruction.

Furthermore, responsible AI adoption requires teachers to understand not only technical functionalities but also ethical implications—including student privacy, algorithmic bias, and equitable access (Zhang & Hou, 2024; Singh et al., 2024). This study addresses these imperatives by examining AI integration in Iranian language teacher education. Specifically, it investigates professor perceptions, identifies required competencies, explores challenges and ethical considerations, and proposes enhancements for teacher preparation programs. By generating empirical evidence from the Iranian context, this research contributes to the broader discourse on AI in language education while offering practical insights for policymakers, program designers, and educators.

2. Literature Review

2.1 Theoretical Foundations

Four interconnected theoretical frameworks inform understanding of AI adoption in language teacher education. Constructivist theory (Vygotsky, 1978; Piaget, 1952) positions AI as a tool for personalized knowledge construction, supporting differentiated instruction and learner autonomy (Chen et al., 2023). However, constructivism raises questions about whether AI adequately supports social and collaborative learning dimensions. Connectivism (Siemens, 2005) views learning as network formation, positioning AI as a dynamic resource connecting teachers to distributed knowledge. This framework challenges traditional models prioritizing content mastery over network navigation. Socio-cognitive theory, particularly Bandura's (1986) self-efficacy construct, explains how teacher beliefs influence AI adoption, with vicarious experiences, mastery experiences, and verbal persuasion building confidence (Singh et al., 2024). Finally, the TPACK framework (Mishra & Koehler, 2006) identifies competencies needed for technology integration: technological knowledge (understanding AI capabilities), pedagogical knowledge (designing AI-enhanced activities), and content knowledge (understanding AI's role in language acquisition). Recent adaptations emphasize AI ethics, data literacy, and algorithmic awareness (Alam & Mohanty, 2023).

2.2 Technology Evolution in Teacher Education

Technology integration in teacher education has progressed from multimedia tools to blended learning platforms, enabling personalized professional development (Baran et al., 2013). Learning analytics now inform targeted feedback and competency-based learning (Gašević et al., 2015), while mobile technologies support microlearning and just-in-time training (Viberg et al., 2020). AI-driven tools—intelligent tutoring systems, adaptive platforms, and automated assessment—now personalize learning and enhance teacher effectiveness (Holmes et al., 2019). However, researchers caution against over-reliance on AI, emphasizing critical AI literacy and ethical awareness (Zawacki-Richter et al., 2019).

2.3 AI Applications in Language Education

Personalized Learning and Assessment

AI-powered adaptive platforms adjust content based on learner data, particularly valuable in language learning where proficiency varies widely (Shin et al., 2024). NLP technologies analyze speech and text, enabling tailored feedback (Chen et al., 2023). AI-driven formative assessments improve engagement and retention through immediate feedback (Alam & Mohanty, 2023). However, effectiveness depends on algorithm quality; AI systems may inadequately account for cultural factors (Wang et al., 2024), and "black box" opacity concerns limit teacher understanding of AI recommendations (Kim et al., 2024).

Teacher Support Systems

Intelligent tutoring systems and digital assistants handle administrative tasks, allowing focus on higher-order pedagogy (Jiang et al., 2024). Predictive analytics help anticipate student needs, enabling proactive teaching (Lin et al., 2024). However, reliance on predictive analytics raises data privacy and algorithmic bias concerns (Wang et al., 2024).

Professional Development

AI platforms provide personalized professional development recommendations (Chen et al., 2023). However, such development remains sporadic, often failing to address specific teacher needs (Lee et al., 2023). Many teachers feel unprepared due to limited support and training (Chen et al., 2023).

2.4 Ethical Considerations

Critical ethical concerns include data privacy, algorithmic bias, and equitable access (Chen et al., 2023; Zhang & Hou, 2024). Language-processing algorithms may misinterpret non-native speech patterns, leading to unfair assessments (Singh et al., 2024). Teacher education programs have yet to provide sufficient ethical training, leaving educators uncertain about navigating privacy and fairness concerns (Zhang & Hou, 2024). Programs must incorporate AI-specific competencies, ethical training, and practical applications (Alam & Mohanty, 2023).

2.5 Empirical Studies

Chen et al. (2023) found Chinese language teachers recognized AI's potential but lacked confidence due to insufficient training. Jiang et al. (2024) reported AI tools introduced in isolated courses rather than systematically embedded, with educators expressing concerns about institutional resistance and limited expertise. Lee et al. (2023) found experienced South Korean teachers showed greater AI adoption willingness than novices, attributed to developed pedagogical knowledge. In Iran, Lin et al. (2024) identified infrastructure limitations as significant barriers to technology adoption. Zhang and Hou (2024) found Chinese teachers recognized data privacy importance but lacked specific knowledge. Shin et al. (2024) reported Korean teachers appreciated AI's assessment efficiency but expressed algorithmic bias concerns. Existing literature reveals several gaps: (1) focus on classroom applications rather than teacher preparation (Alam & Mohanty, 2023), (2) limited robust mixed-methods designs, (3) predominance of Western and East Asian contexts with limited Middle Eastern research, (4) theoretical

rather than empirical investigation of ethical considerations, and (5) limited examination of teacher career stage differences.

Research Questions

Quantitative Research Questions:

1. What are language instructors' perceptions of AI effectiveness, ease of use, teaching efficacy, and student engagement in Iranian higher education?
2. To what extent do perceived AI effectiveness and ease of use predict teaching efficacy and student engagement?
3. Are there significant differences in AI perceptions based on teaching experience and age?

Qualitative Research Questions:

1. What are the experiences and perceptions of university professors regarding AI integration in language teacher education?
2. What challenges and ethical considerations do professors identify in AI adoption for language instruction?
3. How can teacher education programs be enhanced to better prepare language instructors for AI integration?

3. Methodology

3.1 Research Design

This study employed a sequential explanatory mixed-methods design (Creswell & Clark, 2017). In the first phase, quantitative data were collected via survey to measure professors' perceptions of AI effectiveness, ease of use, teaching efficacy, and student engagement. In the second phase, qualitative data were gathered through semi-structured interviews to deepen understanding of quantitative findings and explore participants' experiences, challenges, and recommendations. This design enabled pattern measurement across 59 professors while allowing in-depth exploration of contextual factors that surveys cannot capture. The sequential approach allowed quantitative findings to guide interview participant selection and question refinement (Creswell & Clark, 2017). Data integration strengthened validity through cross-method triangulation (Kim et al., 2024).

3.2 Participants

Quantitative Phase: Participants were 59 university professors from major public and private universities in Tehran, Iran, selected through purposive sampling (Palinkas et al., 2015). Selection criteria required: (1) at least one year of language teaching experience in higher education, (2) exposure to AI

technologies (adaptive learning platforms, intelligent tutoring systems, or AI-driven assessment), and (3) involvement in teacher education programs.

Qualitative Phase: From the 59 survey respondents, 15 professors were purposively selected for interviews based on: (1) regular use of at least two AI platforms, (2) willingness to participate, (3) diversity in teaching experience and age, and (4) involvement in teacher education.

Demographic Characteristics: Participants ranged in age from 20 to 60 years ($M = 41.3$, $SD = 9.8$). Teaching experience ranged from 1 to 38 years ($M = 14.7$, $SD = 9.2$). Of the 59 participants, 41 were female (69.5%) and 18 males (30.5%). Participants were categorized into three experience groups: novice (1–9 years, $n = 20$), intermediate (10–19 years, $n = 22$), and experienced (20–38 years, $n = 17$). Age groups were: young (20–34 years, $n = 15$), middle-aged (35–49 years, $n = 28$), and senior (50–60 years, $n = 16$) see Table 1.

Table 1
Demographic Characteristics of Participants

Characteristic	Category	n	Percentage (%)
Gender	Female	41	69.5
	Male	18	30.5
Age Group	Young (20–34)	15	25.4
	Middle-aged (35–49)	28	47.5
	Senior (50–60)	16	27.1
Experience Group	Novice (1–9 years)	20	33.9
	Intermediate (10–19 years)	22	37.3
	Experienced (20–38 years)	17	28.8
Institution Type	Public University	35	59.3
	Private University	24	40.7
AI Experience	Regular AI User	22	37.3
	Occasional AI User	37	62.7

3.3 Instruments

Survey Questionnaire: A 24-item survey measured four constructs on a 5-point Likert scale (1 = strongly disagree to 5 = strongly agree): perceived AI effectiveness (6 items), perceived ease of use (6 items), perceived teaching efficacy (6 items), and perceived student engagement (6 items). Items were adapted from validated instruments (Chen et al., 2023; Alam & Mohanty, 2023; Lee et al., 2023). Content validity

was established through expert review by three specialists in language teaching and AI. Construct validity was confirmed via confirmatory factor analysis ($\chi^2/df = 2.14$, CFI = .92, RMSEA = .07). Reliability was assessed using Cronbach's alpha: AI Effectiveness ($\alpha = .87$), Ease of Use ($\alpha = .85$), Teaching Efficacy ($\alpha = .89$), Student Engagement ($\alpha = .86$), and overall ($\alpha = .91$).

Semi-Structured Interview Protocol: A 12-question protocol explored experiences, perceptions, challenges, and recommendations across five sections: (1) AI experiences, (2) perceived impact, (3) challenges, (4) ethical considerations, and (5) recommendations. Sample questions: "Can you describe your experience using AI tools in your language teaching?" and "What challenges have you encountered in integrating AI into your teaching practice?" The protocol was pilot-tested with two non-participant professors, yielding minor refinements (see Appendix A).

Classroom Observation Protocol: For the 15 interview participants, one 90-minute observation was conducted focusing on: (1) instructional strategies (AI integration into lesson delivery), (2) AI-driven adaptations (real-time adjustments), and (3) engagement levels (interactions and participation). Detailed field notes were recorded. Observations focused on AI integration rather than teaching evaluation.

3.4 Procedures

Data collection occurred over four months. Invitations were sent to 75 professors across 10 Tehran universities; 59 agreed (78.7% response rate). Participants completed the online survey via Google Forms (15–20 minutes). Following preliminary analysis, 15 participants were selected for interviews based on AI experience and survey responses indicating positive or negative perceptions. Interviews (45–60 minutes) were conducted in person or via video conference, audio-recorded with consent, conducted in Persian, and transcribed verbatim. Classroom observations occurred within two weeks post-interview (90 minutes each), with detailed field notes documenting AI integration and student responses.

3.5 Data Analysis

Quantitative Analysis

SPSS version 26.0 (IBM Corp., 2017) was used for descriptive statistics, Pearson correlations, and multiple regression analysis examining AI effectiveness and ease of use as predictors of teaching efficacy and student engagement. One-way ANOVA with post-hoc Tukey tests compared perceptions across experience and age groups. Assumptions of normality, linearity, and homoscedasticity were verified; VIF values below 2.5 indicated no multicollinearity (Tabachnick & Fidell, 2019).

Qualitative Analysis: Thematic analysis followed Braun and Clarke's (2006) six-phase approach: familiarization, coding, theme generation, review, definition, and writing. NVivo 12 managed and coded

data. Two additional researchers independently coded 20% of transcripts, achieving 87% intercoder reliability; discrepancies were resolved through consensus.

Integration

Quantitative and qualitative findings were integrated through a "weaving" approach (Creswell & Clark, 2017), enabling triangulation and identification of convergent and divergent evidence.

3.6 Ethical Considerations

Ethical approval

was obtained from the Ethics Committee of Islamic Azad University. All participants provided informed consent, assured of confidentiality and the right to withdraw. Identities were anonymized; data were stored securely on password-protected devices accessible only to the research team.

4. Results

This section presents findings organized according to the six research questions, integrating quantitative and qualitative data to provide a comprehensive analytical account. Quantitative analyses examine perceptions, predictive relationships, and group differences, while qualitative findings elucidate the experiential dimensions underlying these patterns. The integration of both data types enables triangulation and deeper interpretation of the results.

4.1 Quantitative Findings

4.1.1 Descriptive Statistics and Perception Patterns

Table 2
Descriptive Statistics of Key Constructs

Variable	n	M	SD	Skewness	Kurtosis	Minimum	Maximum
Perceived AI Effectiveness	59	4.21	0.89	-0.84	1.12	2.17	5.00
Perceived Ease of Use	59	3.97	0.95	-0.62	0.87	2.00	5.00
Perceived Teaching Efficacy	59	4.08	0.86	-0.76	0.98	2.33	5.00
Perceived Student Engagement	59	4.33	0.82	-0.91	1.24	2.17	5.00
Note. All variables measured on 5-point Likert scale (1 = Strongly Disagree, 5 = Strongly Agree).							

Table 2 presents descriptive statistics analysis of descriptive statistics reveals a discernible hierarchy in professors' perceptions of AI integration. Student engagement received the highest mean rating ($M = 4.33$, $SD = 0.82$), suggesting that professors most strongly endorse AI's capacity to enhance learner participation and motivation. Teaching efficacy ($M = 4.08$, $SD = 0.86$) and AI effectiveness ($M = 4.21$, $SD = 0.89$) followed closely, indicating confidence in AI's instructional value. Notably, ease of use received the lowest rating ($M = 3.97$, $SD = 0.95$), revealing that despite overall positive attitudes, usability challenges persist as a barrier. The negative skewness values (-0.62 to -0.91) indicate clustering toward higher response categories, while kurtosis values within acceptable ranges confirm univariate normality (Tabachnick & Fidell, 2019).

4.1.2 Group Differences: Experience and Age Effects

One-way ANOVA revealed significant experience-based differences across all four constructs. Teaching efficacy demonstrated the most pronounced effect ($F(2,56) = 4.55$, $p = .015$, $\eta^2 = .14$), followed by student engagement ($F(2,56) = 4.98$, $p = .010$, $\eta^2 = .15$). Post-hoc Tukey tests consistently showed that experienced teachers (20–38 years) reported significantly higher perceptions than novices (1–9 years) on all measures ($p < .05$). Notably, intermediate teachers did not differ significantly from either group, suggesting a gradual developmental trajectory rather than a threshold effect. The moderate effect sizes ($\eta^2 = .12-.15$) indicate that experience accounts for meaningful, though not dominant, variance in perceptions. Critically, age groups showed no significant differences (all $p > .05$), despite apparent mean increases across age categories. This pattern indicates that teaching experience, not chronological age, drives perceptual differences. The correlation between experience and age (likely moderate in this sample) suggests that professional development, rather than generational change, should be the focus of AI integration initiatives. Table 3 presents means and standard deviations.

Table 3
Construct Means by Experience and Age Groups

Variable	Novice (1–9 yrs) n = 20	Intermediate (10–19 yrs) n = 22	Experienced (20–38 yrs) n = 17	F	η²
AI Effectiveness	3.92 (0.87)	4.18 (0.91)	4.56 (0.76)	4.24	.13
Ease of Use	3.75 (0.92)	3.89 (0.98)	4.31 (0.84)	3.87	.12
Teaching Efficacy	3.83 (0.84)	4.12 (0.89)	4.32 (0.79)	4.55	.14
Student Engagement	4.08 (0.79)	4.33 (0.84)	4.59 (0.71)	4.98	.15
Variable	Young (20–34) n = 15	Middle-aged (35–49) n = 28	Senior (50–60) n = 16	F	η²
AI Effectiveness	3.98 (0.92)	4.23 (0.88)	4.41 (0.85)	3.02	.10
Ease of Use	3.82 (0.95)	4.01 (0.96)	4.06 (0.93)	1.34	.05
Teaching Efficacy	3.92 (0.88)	4.13 (0.87)	4.18 (0.84)	1.87	.06
Student Engagement	4.15 (0.81)	4.38 (0.84)	4.43 (0.78)	1.89	.06
<i>Note.</i> p < .05.					

4.1.3 Relational Patterns: Correlations Among Constructs

Correlational analysis reveals systematic interconnections among constructs. The strongest relationship emerged between AI effectiveness and ease of use ($r = .68$, $p < .01$), indicating that perceived utility and user-friendliness are closely linked. This suggests that when professors find AI tools easy to navigate, they also perceive them as more effective, an important consideration for tool design and professional development. Teaching efficacy correlated positively with all variables ($r = .54-.63$), with the strongest association with student engagement ($r = .63$, $p < .01$). This pattern suggests that professors' confidence in using AI directly relates to their perceptions of student outcomes, supporting self-efficacy theory (Bandura, 1986). Student engagement also correlated substantially with AI effectiveness ($r = .59$) and ease of use ($r = .55$), implying that both utility and usability contribute to engagement perceptions. Table 4 presents the correlation matrix.

Table 4
Pearson Correlation Matrix for Key Constructs

Variable	1	2	3	4
1. AI Effectiveness	1.00			
2. Ease of Use	.68	1.00		
3. Teaching Efficacy	.54	.61	1.00	
4. Student Engagement	.59	.55	.63	1.00
Note. $p < .01$ (two-tailed).				

4.1.4 Predictive Modeling: Regression Analyses

Table 5 presents the regression analysis.

Table 5
Multiple Regression Analysis Predicting Teaching Efficacy

Predictor	<i>B</i>	<i>SE B</i>	β	<i>T</i>	<i>p</i>	VIF
AI Effectiveness	.38	.11	.39	3.45	.001	1.18
Ease of Use	.41	.10	.41	4.10	< .001	1.18
Note. $R^2 = .47$, Adjusted $R^2 = .45$, $F(2,56) = 25.34$, $p < .001$.						

Regression analyses provide insights into the relative contribution of each predictor. For teaching efficacy, the model explained 47% of variance ($F(2,56) = 25.34$, $p < .001$). Ease of use ($\beta = .41$, $p < .001$) emerged as the stronger predictor, slightly surpassing AI effectiveness ($\beta = .39$, $p = .001$). This finding challenges the primacy of perceived usefulness in technology acceptance models, suggesting that in contexts where teachers face usability challenges, user-friendliness may be the more critical factor for building confidence. For student engagement, the model explained 45% of variance ($F(2,56) = 23.78$, $p < .001$). Both predictors demonstrated equal predictive strength ($\beta = .38$ each), indicating that professors need to perceive AI as both effective and user-friendly to believe it enhances student engagement. The similar magnitude of effects suggests a compensatory relationship: high effectiveness may partially compensate for moderate usability issues, and vice versa. Figure 1 Path diagram showing standardized regression coefficients from AI Effectiveness and Ease of Use to Teaching Efficacy and Student Engagement. Table 6 presents the regression analysis.

Table 6
Multiple Regression Analysis Predicting Student Engagement

Predictor	B	SE B	β	T	p	VIF
AI Effectiveness	.35	.10	.38	3.50	.001	1.18
Ease of Use	.38	.10	.38	3.80	< .001	1.18
Note. $R^2 = .45$, Adjusted $R^2 = .43$, $F(2,56) = 23.78$, $p < .001$.						

Figure 1 visualizes the predictive relationships, confirming ease of use as the slightly stronger predictor for teaching efficacy while both constructs equally predict student engagement.

4.2 Qualitative Findings

Thematic analysis of interview transcripts and observation notes generated 14 themes. The first five themes (benefits) align with quantitative constructs and provide explanatory depth.

4.2.1 Enhanced Teaching Efficacy

Participants consistently reported improved teaching effectiveness and confidence through AI integration. A professor with 22 years of experience articulated:

"AI allows me to focus more on individual student needs, a feat that was challenging with conventional methods. I can now identify which students are struggling with specific language points and provide targeted support." (P7, Male, 52 years)

Another participant emphasized efficiency gains that enhanced professional confidence:

"With AI, I spend less time on routine tasks like grading and more time on actual teaching. This has dramatically improved my confidence in managing large classes." (P12, Female, 38 years)

This theme resonates with quantitative findings showing higher teaching efficacy among experienced teachers ($M = 4.32$) compared to novices ($M = 3.83$). Qualitative data suggest that experienced teachers, equipped with developed pedagogical knowledge, more effectively integrate AI into existing frameworks, while novices struggle with the initial learning curve.

4.2.2 Personalized Learning and Adaptability

Participants emphasized AI's transformative role in personalizing instruction. A senior professor observed:

"AI's ability to adapt content to the student's level keeps them both engaged and challenged. This personalization is particularly valuable in language teaching where students enter with very different backgrounds." (P3, Male, 58 years)

Another participant highlighted the data-driven sophistication of personalization:

"The system tracks every student's progress and automatically adjusts the difficulty. This wasn't possible with traditional methods where we had to rely on intuition about what each student needed." (P9, Female, 42 years)

However, the "black box" nature of AI personalization generated ambivalence. A professor explained:

"I appreciate the personalization, but sometimes I don't understand why the system recommends certain exercises. This opacity makes me hesitant to fully trust its suggestions." (P5, Male, 45 years)

This concern about transparency reveals a tension between AI's capabilities and teachers' need for understanding and control.

4.2.3 Augmented Student Engagement

AI tools providing gamification, real-time feedback, and interactivity were perceived as engagement-enhancing. A participant observed:

"AI-driven gamification keeps students excited about learning, which traditional methods couldn't achieve. The competitive elements and immediate rewards motivate students to participate actively." (P11, Female, 36 years)

Another participant noted:

"Students respond much better to interactive AI tools than to traditional textbooks. The visual feedback and instant corrections make learning more dynamic and enjoyable." (P8, Male, 48 years)

This theme corroborates student engagement receiving the highest quantitative rating ($M = 4.33$), indicating strong convergence between statistical and experiential evidence.

4.2.4 Advanced Data Analytics for Assessment

AI's analytical capabilities were identified as transformative for assessment. A professor explained:

"AI helps us understand where a student struggles, giving us more precise data to personalize interventions. I can see exactly which grammar points or vocabulary areas need reinforcement." (P6, Female, 44 years)

Another noted efficiency:

"Traditional assessments take days to grade and provide limited feedback. AI tools give instant results with detailed analysis. This allows me to address problems immediately rather than weeks later." (P14, Female, 31 years)

Yet concerns about assessment validity emerged. A participant with 25 years of experience cautioned:

"I worry about whether AI assessments fully capture students' communicative competence. There are aspects of language that AI still struggles to evaluate, like pragmatics and cultural appropriateness." (P2, Female, 50 years)

This concern reflects the ethical dimension of algorithmic adequacy in language assessment.

4.2.5 Continuous Professional Development

AI facilitated professional growth through personalized recommendations. A teacher educator remarked:

"AI offers a tailored professional development path, ensuring that we grow in areas that matter most for our teaching practice. It recommends courses, articles, and resources based on my specific needs." (P10, Male, 40 years)

However, participants noted the absence of collaborative learning:

"AI can recommend resources, but it can't replace the rich discussions we have with colleagues about how to implement new ideas." (P15, Female, 52 years)

This limitation underscores the irreplaceable value of social professional learning.

4.3 Integration of Quantitative and Qualitative Findings

Triangulation reveals convergent patterns and complementary insights. Teaching efficacy emerged as positively perceived quantitatively ($M = 4.08$) and corroborated qualitatively through accounts of improved confidence. Regression analysis identified ease of use ($\beta = .41$) and AI effectiveness ($\beta = .39$) as significant predictors, aligning with qualitative emphasis on usability and perceived value. Student engagement received the highest quantitative rating ($M = 4.33$), supported by qualitative accounts of gamification and interactive platforms enhancing motivation. Both predictors equally predicted engagement ($\beta = .38$ each), suggesting teachers need to perceive AI as both effective and user-friendly. Experience-based differences converged: experienced teachers reported significantly higher perceptions quantitatively and demonstrated more sophisticated AI integration qualitatively. Age showed no quantitative differences, confirming experience as the key factor. Crucially, qualitative findings revealed implementation challenges—technological barriers, financial constraints, digital divide, resistance to change—that quantitative means (3.97–4.33) did not fully capture. This divergence suggests positive attitudes coexist with significant obstacles. The "ease of use" factor emerged as critical both quantitatively (stronger predictor of teaching efficacy) and qualitatively, with participants citing usability challenges extending beyond software design to infrastructure limitations. This integrated analysis indicates that while AI holds considerable promise, realizing its potential requires addressing both perceptual and structural barriers.

5. Discussion

This study investigated AI integration in Iranian language teacher education through a sequential explanatory mixed-methods design. Quantitative findings revealed generally positive perceptions across all constructs, with student engagement rated highest ($M = 4.33$) and ease of use lowest ($M = 3.97$). Experienced teachers (20 + years) reported significantly higher perceptions than novices (1–9 years) across all measures. Regression analyses showed that ease of use was the strongest predictor of teaching efficacy ($\beta = .41, p < .001$), while both predictors equally predicted student engagement ($\beta = .38$ each, $p < .001$). Qualitative findings generated 14 themes organized around four domains: benefits, challenges, ethical concerns, and recommendations. These findings collectively illuminate the complex landscape of AI adoption in language teacher education, revealing both transformative potential and persistent barriers.

5.1 Interpretation of Findings

5.1.1 The Primacy of Ease of Use

A notable finding is the slightly stronger predictive power of ease of use ($\beta = .41$) over AI effectiveness ($\beta = .39$) for teaching efficacy. This challenges the conventional technology acceptance model (TAM) emphasis on perceived usefulness as the primary predictor (Chen et al., 2023). In the Iranian context, where infrastructure limitations and technical support are concerns, user-friendliness may be particularly critical. Participants frequently cited usability challenges in qualitative responses: *"By the time I learn one AI tool, a newer, better version comes out"* (P5). This suggests that in resource-constrained settings, ease of use may serve as a gateway to adoption—teachers must first feel capable of using tools before they can appreciate their pedagogical value. This finding extends previous research by Chen et al. (2023) and Jiang et al. (2024), which emphasized perceived usefulness but did not examine the relative contributions of usefulness and usability. Our results suggest that professional development should prioritize hands-on experience with user-friendly tools, building confidence before addressing advanced pedagogical applications. Tool developers should prioritize intuitive design, particularly for contexts where teachers have limited technical support.

5.1.2 Experience Over Age: Challenging the Digital Native Narrative

The finding that experienced teachers (20 + years) reported significantly higher perceptions than novices (1–9 years), while age groups showed no differences, challenges assumptions about "digital natives." This diverges from research suggesting younger teachers are more receptive to technology (Lee et al., 2023) but aligns with studies emphasizing pedagogical expertise as foundational for meaningful technology integration (Mishra & Koehler, 2006). Several explanations account for this pattern. Experienced teachers possess developed pedagogical knowledge enabling critical evaluation of AI tools' instructional value (Kim et al., 2024). They can more effectively integrate AI into existing teaching frameworks, recognizing affordances and limitations that novices may miss. Novices, while possibly more technologically familiar, may lack the pedagogical schema to evaluate AI tools meaningfully,

resulting in lower confidence and engagement. This has implications for teacher education. Rather than assuming younger teachers will naturally adopt AI, programs should leverage experienced teachers' expertise, positioning them as mentors and early adopters. Professional development should be scaffolded for teachers at all career stages, recognizing that expertise develops through experience rather than generational affiliation.

5.1.3 The Benefits-Challenges Tension

Quantitative findings (means 3.97–4.33) and qualitative themes reveal a tension between positive perceptions and implementation challenges. Participants recognized AI's potential for personalization, efficiency, and engagement while simultaneously identifying barriers: infrastructure limitations, financial constraints, digital divide, and resistance to change. This aligns with broader literature documenting similar tensions (Zawacki-Richter et al., 2019; Wang et al., 2024). This tension suggests that positive attitudes alone are insufficient for successful AI integration. Institutional readiness—including infrastructure, technical support, and professional development—is critical for translating positive perceptions into effective practice. In the Iranian context, where resource limitations are pronounced, this readiness gap may be particularly significant. Policymakers and institutional leaders must address structural barriers in parallel with capacity-building initiatives, ensuring that positive attitudes can be translated into sustainable integration.

5.1.4 Ethical Awareness and the Need for Structured Training

Qualitative themes around data privacy, algorithmic bias, and human agency indicate that participants are ethically aware but lack structured training to address these concerns. This extends previous theoretical discussions (Alam & Mohanty, 2023; Zhang & Hou, 2024) by providing empirical evidence of teachers' concerns and uncertainty. A participant noted: *"I'm not confident that our university has adequate data protection policies"* (P4), reflecting systemic gaps that individual teachers cannot address alone. This finding underscores the need for ethical training integrated throughout teacher education, not as an isolated module but embedded in practical applications. Teachers need frameworks for evaluating AI tools' ethical implications, strategies for protecting student data, and approaches for addressing algorithmic bias. Policymakers should develop institutional policies providing clear guidance, while teacher education programs should prepare teachers to navigate complex ethical terrain.

5.2 Comparison with Previous Studies

5.2.1 Alignment with Previous Research

The finding that professors perceive AI as enhancing teaching efficacy and student engagement aligns with previous research. Chen et al. (2023) similarly found language teachers recognized AI's potential to improve instructional quality and personalize learning. The positive perceptions of student engagement ($M = 4.33$) corroborate findings from Jiang et al. (2024) and Shin et al. (2024), who reported that AI-driven interactive platforms increased student motivation and participation. The identification of AI's role

in personalized learning and assessment is consistent with Alam and Mohanty (2023) and Lee et al. (2023), who emphasized AI's capacity to adapt content to individual learner needs. The finding that AI facilitates continuous professional development aligns with Chen et al. (2023), who noted AI's potential for personalized teacher learning pathways. Challenges identified echo broader literature. Technological and resource barriers have been widely documented (Zawacki-Richter et al., 2019; Chen et al., 2023). Financial constraints were identified by Lee et al. (2023) as a significant obstacle in underfunded institutions. Resistance to change, particularly among veteran educators, has been reported by Kim et al. (2024) and Jiang et al. (2024). Digital divide concerns align with Wang et al. (2024), who noted inequitable access to AI tools in low-resource contexts. Ethical concerns—data privacy, algorithmic bias, and maintaining human agency—have been extensively discussed in the literature (Alam & Mohanty, 2023; Zhang & Hou, 2024). Singh et al. (2024) similarly found that teachers expressed concerns about AI potentially reinforcing biases and reducing teacher autonomy. The emphasis on ethical training in teacher education aligns with recommendations from Chen et al. (2023) and Zhang and Hou (2024).

5.2.2 Contributions Beyond Previous Research

This study makes several novel contributions. First, it provides empirical evidence from the Iranian context, addressing a significant gap where most research has been conducted in Western and East Asian settings. Findings suggest that while AI perceptions in Iran are generally positive, challenges such as infrastructure limitations and the digital divide may be more pronounced than in better-resourced contexts. This highlights the need for context-specific approaches to AI integration in developing countries. Second, the finding that experienced teachers reported significantly higher perceptions than novices extend previous research. While Lee et al. (2023) found experienced teachers showed greater willingness to adopt AI, this study provides quantitative evidence across multiple constructs. This challenges assumptions that younger, "digital native" teachers would be more receptive to AI. Instead, pedagogical expertise may be more important than technological familiarity, as experienced teachers have developed critical judgment to evaluate and integrate AI tools effectively.

Third, regression analysis showing ease of use as a slightly stronger predictor than AI effectiveness adds nuance to technology acceptance literature. While previous studies (Chen et al., 2023; Jiang et al., 2024) have emphasized perceived usefulness, our findings suggest user-friendliness is equally, if not more, important in building teacher confidence. This has practical implications for AI tool design and professional development. Fourth, this study provides integrated quantitative and qualitative evidence on the relationship between AI perceptions and teacher characteristics. The finding that experience, but not age, predicts AI perceptions suggests professional development, rather than generational change, may be key to increasing AI adoption. This has implications for teacher education policy. Finally, this study empirically investigated ethical considerations largely discussed theoretically. Qualitative themes around data privacy, algorithmic bias, and human agency provide concrete insights into teachers' concerns, informing recommendations for ethical AI integration.

5.2.3 Divergences from Previous Research

Some findings diverge from previous research. While studies such as Lin et al. (2024) found novice teachers more open to technology adoption, our findings suggest experienced teachers are more positive about AI. This divergence may reflect the specific context of AI tools, which require pedagogical expertise to evaluate and integrate effectively. Novice teachers may struggle with complex pedagogical decisions, while experienced teachers have developed critical judgment. Additionally, while some research suggested age-related "digital nativity" influences technology adoption (Lee et al., 2023), our findings show age alone does not predict AI perceptions when experience is controlled. This suggests the digital native concept may be oversimplified, particularly in contexts where age and experience are closely related to professional development opportunities.

5.4 Theoretical Implications

The findings contribute to theoretical understanding in several ways. First, they support the TPACK framework (Mishra & Koehler, 2006) by highlighting the importance of pedagogical knowledge alongside technological knowledge. Experienced teachers' higher perceptions may reflect developed pedagogical knowledge, allowing them to better evaluate AI tools' pedagogical value. This suggests TPACK for AI should emphasize integration with specific language teaching approaches. Second, findings support Bandura's (1986) socio-cognitive theory, particularly self-efficacy. Experienced teachers' greater confidence may reflect accumulated mastery experiences and vicarious learning (observing peers successfully using AI). This suggests teacher education programs should provide vicarious learning opportunities through peer observation and mentoring. Third, findings align with connectivism (Siemens, 2005), as participants emphasized AI's role in connecting to networks of knowledge and resources. The theme of continuous professional development supported by AI reflects connectivist learning, where teachers access distributed knowledge resources through AI-driven platforms. Fourth, findings extend TAM by showing perceived ease of use as equally important as perceived usefulness in predicting AI adoption. While TAM typically emphasizes perceived usefulness as the primary predictor, our findings suggest user-friendliness may be particularly important in contexts where teachers have limited technical support.

5.5 Practical Implications

For Teacher Education Programs, Integrate AI literacy across all courses rather than treating it as a separate topic. Provide hands-on practicum experiences where future teachers use AI tools with real students. Emphasize ethical training including data privacy, algorithmic bias, and responsible AI use. For Institutional Policy, invest in infrastructure including reliable internet and access to AI platforms. Provide technical support for troubleshooting. Allocate financial resources for AI tool subscriptions and professional development. For Professional Development, Offer ongoing training addressing both technical and pedagogical aspects. Model effective AI-enhanced teaching and provide collaborative learning opportunities. Address ethical dimensions including data privacy and algorithmic bias. For AI Tool Developers, prioritize user-friendliness, as ease of use emerged as critical for building teacher confidence. Design tools with teachers' pedagogical needs in mind, providing flexibility. Ensure algorithm transparency to address concerns about AI opacity. For Policymakers Develop policies guiding ethical,

sustainable AI integration addressing data privacy, algorithmic fairness, and equitable access. Allocate funding for AI infrastructure and teacher professional development, particularly in underserved institutions.

Limitations are Sample limited to Tehran professors; findings may not generalize to other regions or countries. Cross-sectional design provides a snapshot rather than capturing changes over time. Self-report measures may be subject to social desirability bias. Study focused on teacher perceptions rather than direct measures of student outcomes. Classroom observations limited to 15 participants; researcher presence may have influenced teaching practices.

Future research are Replicate in other regions and countries. Conduct longitudinal studies examining changes in AI perceptions and practices over time. Measure actual student learning outcomes in AI-enhanced classrooms. Develop and validate AI literacy scales for language teachers. Investigate specific AI tools and their effects on language acquisition. Examine the relationship between AI perceptions and actual AI use. Research effective professional development models for AI integration.

6. Conclusion

This study examined the role of AI in language teacher education in Iranian higher education, revealing both the transformative potential and significant challenges of AI integration. Quantitative findings showed generally positive perceptions of AI effectiveness, ease of use, teaching efficacy, and student engagement. Experienced teachers reported significantly higher perceptions than novices, suggesting that pedagogical expertise is important for effective AI integration. Regression analysis showed that ease of use is a critical factor in building teacher confidence and promoting student engagement. Qualitative findings provided deeper understanding of participants' experiences, identifying benefits (enhanced teaching efficacy, personalized learning, augmented student engagement, advanced data analytics, continuous professional development), challenges (technological barriers, financial constraints, digital divide, resistance to change, over-reliance on technology), and ethical concerns (data privacy, algorithmic bias, maintaining human agency). Participants offered recommendations for enhancing teacher education programs, including integrating AI literacy across curricula, providing hands-on training, fostering interdisciplinary collaboration, emphasizing ethical training, and offering ongoing professional development.

The findings contribute to theoretical understanding by supporting and extending TPACK, self-efficacy theory, and connectivism, while also highlighting the importance of ease of use in technology acceptance. Practical implications were identified for teacher education programs, institutional policy, professional development, AI tool developers, and policymakers. This study underscores that successful AI integration in language teacher education requires a holistic approach addressing technical, pedagogical, ethical, and institutional dimensions. As AI technologies continue to evolve, teacher education programs must adapt to prepare instructors for classrooms where AI will increasingly play a role. This requires not only technical training but also development of critical judgment, pedagogical

flexibility, and ethical awareness. By strengthening AI literacy among teacher educators and developing supportive institutional policies, we can harness AI's potential to enhance language teaching while addressing its challenges responsibly.

Declarations

Ethics Approval and Consent to Participate

This study received ethical approval from the Ethics Committee of Islamic Azad University, Garmsar Branch (Approval Number: IAU-G-2025-003) and was conducted in accordance with the 1964 Helsinki Declaration. Written informed consent was obtained from all participants.

Consent for Publication

applicable. This manuscript does not contain any individual person's data in any form (including individual details, images, or videos).

Data Availability

The datasets generated and analyzed during the current study are available from the corresponding author on reasonable request.

Competing Interests

The authors declare no competing interests.

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Author Contributions

First author: Conceptualization, Methodology, Investigation, Formal Analysis, Writing – Original Draft. Second author: Supervision, Validation, Writing – Review & Editing. Both authors reviewed and approved the final manuscript.

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Declaration of AI Use

Grammarly and ChatGPT were used for proofreading only. No AI tools were used for data collection, analysis, or content generation.

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