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AI-Enhanced Professional Development: Effects on Secondary EFL Teachers' Digital Competencies and Affective Dimensions in Turkey

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Abstract

This mixed-methods investigation examines the efficacy of structured artificial intelligence (AI) training on secondary-level English as a Foreign Language (EFL) teachers' technological competencies and psychological dispositions within the Turkish educational context. AI technologies have a transformative potential for language acquisition processes, yet studies underlines that secondary EFL teachers frequently demonstrate insufficient proficiency in the selection and pedagogical implementation of appropriate AI applications. The integration of AI-based tools into language instruction presents significant opportunities for improving learner engagement and linguistic development. However, the actualization of these benefits remains contingent on teachers' technological literacy and affective orientations. The present study employed a convergent parallel design to assess the impact of a comprehensive AI professional development program on 40 secondary EFL teachers across four dimensions: anxiety toward AI implementation, attitudinal orientations, perceptions of educational utility, and digital materials development competencies. Quantitative analyses revealed statistically significant improvements across all measured constructs: diminished anxiety levels (-14.1%), enhanced positive attitudes (+7.5%), more favorable perceptions of AI's instructional value (+6.4%), and substantially improved digital materials creation skills (+18.5%). Furthermore, demographic variables functioned as significant moderators of intervention efficacy, with analyses indicating that younger female practitioners with prior technological experience demonstrated markedly greater improvements. A robust negative correlation (r = -0.634) between anxiety reduction and competency enhancement suggests that addressing affective barriers constitutes a critical prerequisite for developing teachers' technological capabilities.These findings underscore the necessity for differentiated professional development frameworks that account for practitioners' demographic characteristics and technological histories. By simultaneously addressing both technical competencies and psychological barriers to AI adoption, educational institutions can better prepare EFL teachers to support language acquisition in increasingly technology-mediated educational environments aligned with Common European Framework of References for Languages (CEFR) standards.

Keywords: *AI in Education, EFL, Teacher Professional Development, Digital Competency, Technology Integration Anxiety, Mixed-Methods Research, CEFR Standards.*

Introduction

In an era characterized by rapid technological advancements, the integration of Artificial Intelligence (AI) into education is not just a possibility but a necessity. This is particularly true in the context of secondary school English language classes, where the combination of AI and Language Acquisition (LA) can create a dynamic learning environment. The objective of this article is to explore how AI technologies can be effectively integrated into English language instruction, enhancing both student engagement and learning outcomes.

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Education has come under scrutiny worldwide. The exam-oriented education system, which has persisted for centuries, has little connection with the skills and qualifications that young people need. While technology rapidly integrates into all areas of life, we cannot continue education using outdated systems. Recognizing this reality, countries around the world are making changes to their education systems.

For example, the P21 Framework (2019) was developed by the Ohio Department of Education in collaboration with educators, education specialists, and business leaders. This framework identifies the essential elements needed to develop the skills students require in life, work, and society. It has been adopted by schools in the United States and globally. The framework serves as a guide for all educators, focusing on:

- Life and work skills,
- Learning and innovation skills,
- Information, media, and technology skills,
- Core subjects and 21st-century themes,
- Assessment and evaluation standards,
- Curriculum and instruction,
- Professional development and learning environments.

The Turkish Ministry of National Education has also followed global developments and implemented changes. However, teacher training programs still do not place enough emphasis on modern technologies, particularly those that young people excel at. Positive change cannot occur without a coordinated effort, and educational transformation begins with teacher training.

Another example is Interstate Teacher Assessment and Support Consortium (2002), which, in addition to listing nine educational standards, emphasizes the use of technology in foreign language teaching. It highlights that language teachers should not fall behind in technological advancements. In the Turkish education system, Information Technologies are included, and educational technologies are part of teacher training programs. However, given current conditions, these efforts remain insufficient.

In English language teaching, technology enhances student engagement and accelerates language acquisition. Studies have shown that technology education in teacher training programs worldwide is inadequate (Kessler, 2006; Hubbard, 2007). Similarly, research has demonstrated that Turkish English teacher training programs lack sufficient focus on this area (Aydın, 2013; Başal, 2015).

Since 2010, the use of technology in English learning in Turkey has increased rapidly, leading to a rise in individual learning rates. The FATİH Project (2012) was launched to support computer-assisted language learning, providing English teachers with technological resources. However, as Artificial Intelligence (AI) advances rapidly, current training efforts have become insufficient. Research by Aydın (2020) highlights the challenges teachers face in adopting AI tools, particularly in developing their own competencies in integrating AI into the classroom. Moreover, AI-driven platforms are increasingly being used for language practice and evaluation, offering students instant feedback, a key factor in language development (Lin, 2017). While

these platforms have proven effective, their integration into Turkish classrooms still faces many barriers, including lack of training and technological infrastructure. Therefore, professional development programs that focus on AI and its applications in language teaching are essential to ensure that teachers are prepared for the technological future of education.

The Impact of Artificial Intelligence on Education

Artificial Intelligence (AI) has rapidly transformed numerous sectors, and education is no exception. The integration of AI into educational systems around the world is reshaping how students learn, how teachers instruct, and how educational content is delivered. As technology continues to evolve, AI holds the promise of revolutionizing the educational landscape by offering more personalized, efficient, and accessible learning experiences. This article explores the impact of AI on education, examining its role in enhancing learning outcomes, supporting teachers, and addressing global educational challenges.

One of the most significant contributions of AI to education is the ability to personalize learning experiences for students. Traditional educational systems often adopt a one-size-fits-all approach, where the pace and content are standardized for the entire class. However, AI can adapt to the unique needs of each student, providing customized learning experiences based on individual strengths, weaknesses, and learning styles. Personalized learning powered by AI involves algorithms that track students' progress, identify gaps in knowledge, and suggest tailored resources or activities to address these gaps (Bayraktar-Çepni et al, 2025). This approach allows students to learn at their own pace, increasing motivation and engagement. According to Holmes et al. (2019), AI can significantly improve learning outcomes by providing real-time feedback and enabling adaptive learning systems that support learners at all levels.

For example, platforms like Coursera, Duolingo, and Khan Academy incorporate AI technologies that analyze learner behavior and customize lessons based on their progress. In language learning, AI tools like speech recognition and chatbots allow learners to practice pronunciation and interact with the language in an immersive and contextually rich environment. These tools adapt as the learner progresses, continuously refining the learning experience. In a similar vein, AI-powered tutoring systems, such as Carnegie Learning's MATHia, provide students with personalized lessons and practice problems in mathematics, tailoring each session to their unique level of understanding (Sutcliffe & Dymock, 2020). These applications not only enhance student engagement but also help improve academic performance, particularly in subjects that traditionally require more practice and individualized attention.

Another area where AI is making a substantial impact is in automating administrative tasks, thereby freeing up time for teachers to focus on direct instruction and student interaction. AI tools can automate grading, attendance tracking, and even the creation of lesson plans, which significantly reduces the administrative burden on educators. For example, AI-powered grading systems can assess essays and assignments, identifying key points, grading based on rubrics, and providing feedback on grammar, syntax, and content. These systems use natural language processing (NLP) to understand written text and can evaluate students' responses with a high degree of accuracy. This allows teachers to devote more time to individualized support and classroom activities. A study by Zhang et al. (2020) found that AI-driven assessment tools have the potential to reduce grading time by as much as 30%, making teaching more efficient while maintaining the quality of education.

AI's ability to automate routine tasks also extends to providing targeted professional development for teachers. AI-based platforms can analyze a teacher's performance in the classroom and offer feedback, suggest teaching resources, and recommend professional development opportunities based on the teacher's strengths and areas for growth. These tools allow for continuous improvement and ensure that educators stay updated on the latest teaching strategies and technologies. In this way, AI fosters a more dynamic and supportive teaching environment, contributing to overall improvements in educational quality (Yin et al., 2021).

However, the integration of AI in education is not without its challenges. One of the most significant concerns is the digital divide, where access to AI-powered tools and resources may not be equally available to all students. Students from disadvantaged backgrounds may have limited access to high-quality educational technology, resulting in inequities in learning opportunities. According to a report by UNESCO (2020), the lack of access to digital infrastructure and the internet can further exacerbate existing inequalities in education. Ensuring equitable access to AI technologies is critical to preventing these disparities and ensuring that AI's potential benefits reach all students, regardless of their socioeconomic background.

Furthermore, while AI can assist in automating certain aspects of education, it cannot fully replace the role of human teachers. The human element of teaching—empathy, creativity, and the ability to address complex social and emotional needs—cannot be replicated by AI. As Holmes et al. (2019) argue, while AI can enhance teaching, it should be seen as a tool to support, rather than replace, educators. Teachers bring an essential understanding of cultural context, student needs, and personal interaction that AI systems, no matter how advanced, cannot replicate. In fact, research suggests that the most effective use of AI in education involves collaboration between technology and educators, with AI handling repetitive tasks and teachers focusing on higher-order skills such as critical thinking and fostering a positive learning environment (McKenney & Reeves, 2018).

Moreover, data privacy and ethical concerns are crucial when implementing AI in education. AI systems rely on large amounts of data to personalize learning, which raises questions about how student data is collected, stored, and used. Protecting student privacy and ensuring transparency in data handling are paramount in the adoption of AI in educational settings. As Cukurova (2018) points out, educational institutions and technology developers must work together to establish clear ethical guidelines and robust data protection measures to safeguard students' personal information.

Notwithstanding these obstacles, there is no denying AI's potential in education. AI presents previously unimaginable chances to boost teaching effectiveness, improve educational outcomes, and develop individualized learning experiences. AI will probably play a bigger part in education as it develops further, opening up even more creative methods to help teachers and pupils. However, resolving the issues of privacy, equality, and the mutually reinforcing nature of technology and human connection will be crucial to the future of AI in education.

AI's Advantages in Education

1. Personalization: AI-powered systems analyze learners' strengths, weaknesses, and preferences, delivering customized learning paths. For instance, an AI application can identify gaps in a student's vocabulary and provide targeted exercises.

2. Scalability: AI tools can accommodate large numbers of learners simultaneously, making them suitable for diverse educational settings.
3. Instant Feedback: Unlike traditional methods, AI tools provide immediate feedback, helping learners correct mistakes and reinforce knowledge in real-time.
4. Accessibility: AI transcends geographical and temporal barriers, enabling learners to access quality education anytime, anywhere.
5. Engagement: Gamified AI applications make learning interactive and enjoyable, boosting student motivation.

These advantages highlight AI's transformative potential in education, particularly in language learning, where personalization and engagement are crucial.

Teachers' Perspectives on Technology Integration

Despite the evident benefits of AI in education, many teachers remain hesitant to adopt these tools. Several factors contribute to this resistance:

1. Lack of Training: Teachers often lack sufficient knowledge and skills to effectively use AI technologies in classrooms.
2. Exam-Oriented Teaching: The focus on standardized testing discourages educators from exploring innovative teaching methods.
3. Inadequate Infrastructure: Limited access to technological resources, particularly in underfunded schools, hampers integration efforts.
4. Perceived Complexity: Many teachers perceive AI tools as overly complex, leading to a reluctance to experiment with them.

In Turkey, for example, the Ministry of National Education has developed a curriculum aligned with the Common European Framework of Reference for Languages (CEFR). While the curriculum provides recommendations for technology use, these guidelines are not mandatory, resulting in inconsistent implementation across schools.

The Role of Artificial Intelligence in Foreign Language Learning

In the modern world of education, Artificial Intelligence (AI) is emerging as a transformative tool, particularly in the domain of foreign language learning. As education continues to shift towards more personalized and technologically integrated approaches, AI has demonstrated significant potential in enhancing the way foreign languages are taught and learned. The application of AI in foreign language learning (FLL) is not merely a passing trend but a growing necessity that can address many of the challenges traditionally associated with language acquisition. This essay will explore the role of AI in FLL, emphasizing its contributions to learner engagement, personalized learning, and the development of key language skills.

AI-powered systems, such as chatbots, language apps, and virtual assistants, are already reshaping the language learning landscape. These tools offer learners immediate feedback, personalized learning experiences, and greater accessibility to language practice. According to Chapelle (2018), AI technologies enable the customization of learning materials, ensuring that content is tailored to each student's individual learning needs. By analyzing learners' responses and behaviors, AI can identify areas of difficulty, suggest personalized learning paths, and adapt

the pace of instruction accordingly. This individualized approach addresses the challenges of traditional classroom learning, where it is often difficult for instructors to cater to the diverse needs of students simultaneously.

One of the primary benefits of AI in foreign language learning is the opportunity it provides for learners to practice the language outside of the classroom setting. Language learning traditionally relied heavily on face-to-face interaction with native speakers or instructors, which limited exposure to the language. However, AI-powered language applications, such as Duolingo, Babbel, and Rosetta Stone, allow learners to practice at any time, from anywhere, providing them with more exposure to authentic language use. These platforms offer a combination of listening, speaking, reading, and writing exercises, allowing learners to reinforce their language skills in a comprehensive manner. Research by Godwin-Jones (2018) highlights that such tools, when used effectively, contribute to an increase in the amount of time learners engage with the target language, which is a critical factor in language acquisition.

Moreover, AI can assist learners in developing their pronunciation and speaking skills, areas often challenging to master in foreign language learning. Speech recognition technology has made significant advancements, allowing language learners to receive real-time feedback on their pronunciation. For instance, Google Assistant and Apple's Siri have incorporated AI-driven speech recognition systems that assess the accuracy of pronunciation and offer suggestions for improvement. This feature, when embedded in language learning apps, can help learners refine their speaking skills outside of a formal classroom setting. Research by Xie (2018) indicates that AI-based tools for pronunciation practice significantly enhance the learner's ability to articulate words correctly, leading to greater fluency.

AI enables language teachers to be more effective by automating routine tasks such as grading and assessment. The ability of AI systems to evaluate student responses quickly and accurately frees up valuable time for teachers, allowing them to focus on more interactive and personalized teaching. According to Graham (2019), AI tools can not only assess grammar, vocabulary, and pronunciation but can also analyze the learner's writing and provide suggestions for improvement. This can be particularly beneficial in large classes where individual feedback is often limited. By using AI to streamline administrative tasks, teachers can spend more time providing targeted support to students, enhancing the overall learning experience.

Despite the promising potential of AI in foreign language learning, there are concerns about the technology's limitations and the challenges associated with its widespread adoption. One significant issue is the reliance on AI tools that may not fully understand the complexities and nuances of language. AI-powered systems often struggle with idiomatic expressions, cultural context, and non-standard language uses. For example, a learner may receive feedback that is grammatically correct but contextually inappropriate. As noted by Hubbard (2019), while AI has made significant strides in language learning, it still falls short in its understanding of cultural subtleties and the intricate nature of human language. Thus, while AI tools can be beneficial, they should be seen as supplements rather than replacements for human instruction.

Moreover, the use of AI in language learning raises concerns about privacy and data security. Many AI applications require access to personal data to offer personalized learning experiences, including speech patterns, usage history, and even demographic information. As educational technology becomes more integrated into daily learning, ensuring the privacy and security of learner data is paramount. According to Cukurova (2018), this issue requires careful

consideration by developers and educators to ensure that AI tools are not only effective but also ethical in their implementation.

Despite these challenges, the role of AI in foreign language learning continues to expand, with increasing research and development focused on overcoming these obstacles. A study by Kukulska-Hulme (2018) highlights that AI tools, when combined with human instruction, can create a hybrid model of learning that capitalizes on the strengths of both approaches. This blended model can offer the personalization and flexibility of AI alongside the cultural and contextual knowledge provided by human teachers, resulting in a more comprehensive and effective language learning experience.

The integration of Artificial Intelligence into foreign language learning represents a significant leap forward in how languages are taught and learned. From personalized learning experiences to advanced pronunciation practice, AI provides valuable tools that support and enhance language acquisition. However, the successful integration of AI into language teaching requires careful consideration of its limitations, such as issues related to context and data privacy. By addressing these concerns and continuing to innovate, AI can play a transformative role in the future of foreign language education.

Artificial Intelligence has revolutionized foreign language teaching and learning. Modern language learning technologies now include:

- Language labs,
- Digitalization and multimedia tools,
- Mobile learning applications,
- Audio-visual multimedia content,
- EdTech solutions, and
- Social media for more effective and faster language acquisition (Klimova et al., 2023).

Today, technologies such as augmented reality, virtual reality, cloud applications, AI and robotics, blockchain, digital immune systems, and hyper-automation are increasingly used in education. These innovations enhance learner motivation and facilitate learning.

The Project

This project aimed to equip English teachers with AI skills, ensuring that they keep pace with modern language teaching technologies and enhance student motivation and learning outcomes. With this aim 40 English teachers selected by Istanbul Büyükçekmece District National Education Directorate were given a training on AI-supported classroom applications**.** The duration was 5 days. The trainee teachers received the necessary information in the morning sessions and did presentations on how they would integrate AI tools into their classes in the afternoon workshops.

The project was inspired by the TÜBİTAK 4005 / 121B354 TPAB Framework Project for primary school English lessons (2022). Additionally, the Substitution, Augmentation, Modification, and Redefinition, (SAMR) model (Puentedura, 2014) has been identified as a suitable approach for implementation. The SAMR Model consists of two main stages:

Enhancement Stage

- Substitution: Replacing traditional methods with technology.
- Augmentation: Using technology to enhance learning.

Transformation Stage

- Modification: Significantly redesigning tasks through technology.
- Redefinition: Creating entirely new learning experiences using technology.

Program Overview

The training included the following components:

1. AI-Supported Grammar Games and Vocabulary Tools: Teachers explored tools like Quizlet and Kahoot! and learned how to create interactive exercises.
2. Communication Skills Development: Participants were introduced to AI-powered conversation platforms and language exchange applications, such as HelloTalk.
3. Project-Based Learning: Teachers developed AI-supported projects, using tools like ChatGPT for content creation and analysis.

Project Phases

Understanding AI in Language Education

- Assess teachers' existing knowledge through a pre-test.
- Teach AI’s potential to enhance student success.
- Explore how AI can be integrated with language learning theories.
- Train teachers to develop AI-based learning materials and implement them effectively in classrooms.
- Gamification and AI in Language Learning
- Help teachers design AI-enhanced gamified learning activities.
- Enable participants to create personalized learning materials using AI.

During the 6-day training, teachers were introduced to various AI-supported tools and strategies to enhance their teaching practices. They explored AI-supported grammar games and virtual word cards focused on basic grammar and vocabulary, as well as AI-powered speech tools for developing communication skills. Teachers also learned how to integrate online international conversations, language exchange programs, and applications into their lessons.

Additionally, they were guided in creating AI-supported projects for Project-Based Learning and language analysis. The training covered the selection and application of various AI technologies, and teachers had the opportunity to create lesson plans incorporating these tools, culminating in presentations to showcase their work.

Research Questions

1. How does the AI training program affect secondary ELT teachers' anxiety levels toward AI technology, including changes across various anxiety dimensions?

2. What changes occur in ELT teachers' attitudes toward AI after the training?

3. To what extent does the AI training program influence ELT teachers' perceptions of AI's educational benefits and applications?

4. How do ELT teachers' digital material preparation competencies change as a result of participation in the AI training program?

5. Is there a correlation between changes in AI anxiety levels and improvements in digital material preparation competencies?

Methods

Research Design

The present investigation employed a one-group pre-test-post-test embedded mixed methods design to evaluate the efficacy of the AI professional development intervention. This methodological approach integrated both quantitative and qualitative data collection strategies to facilitate a comprehensive assessment of the program's impact on EFL practitioners' competencies and dispositions.

Participants

This study aimed to enhance the pedagogical practices and instructional effectiveness of FLE teachers at the secondary level via systematic exposure to AI applications. Given the transformative potential of digital technologies in contemporary educational contexts, particularly the pedagogical affordances of AI for language instruction, this study offered to equip teachers with the necessary competencies to effectively integrate AI-based tools into their instructional repertoires. Through this intervention, the study aimed to support both learners' linguistic development and teachers' professional growth, thereby facilitating their adaptation to evolving technological landscapes.

The study group comprised EFL teachers who instruct adolescent learners aged 11-17 (corresponding to grades 6-11). Specifically, the study group consisted of 40 EFL teachers employed at secondary educational institutions in the central district of Büyükçekmece, Istanbul.

Instruments

The evaluation protocol of this very study utilized seven distinct measurement instruments:

Opinion Scale on the Use of Artificial Intelligence in Education: Developed by Dülger and Körüklü (2023), this 28-item instrument measures perceptions across four dimensions: educational benefits of AI implementation (16 items), prejudices concerning educational AI applications (7 items), conceptualizations of AI scope (2 items), and interpretations of AI definitions (3 items). The scale demonstrates robust psychometric properties with an overall reliability coefficient of 0.922 and accounts for 56.58% of total variance. Reliability coefficients for the dimensions respectively are 0.952, 0.905, 0.780, and 0.604. The scale is a 5-point Likert scale ranging from "Strongly Disagree" (1) to "Strongly Agree" (5).

General Attitude Scale towards Artificial Intelligence (GAAIS): Originally developed by Schepman and Rodway (2020), the scale which assesses individuals' attitudes toward AI, was adapted to the Turkish context by Kaya et al. (2022). It has 20 items distributed in two dimensions: Positive GAAIS (12 items) and Negative GAAIS (8 items). This 5-point Likert scale responses ranges from "Strongly Disagree" (1) to "Strongly Agree" (5). The Turkish adapted version's internal consistency with reliability coefficients are α=0.82 for Positive GAAIS and α=0.84 for Negative GAAIS. Split-half reliability coefficients are α=0.77 and α=0.83 for the respective dimensions.

Artificial Intelligence Anxiety (AIA) Scale: Originally developed by Wang and adapted to the Turkish context by Terzi (2020), this instrument measures teachers' anxiety levels related to AI across four dimensions: learning anxiety (items 1-9), professional displacement concerns (items 10-14), sociotechnical implementation barriers (items 15-18), and technological configuration challenges (items 19-21). The scale consists of 21 items rated on a 7-point Likert scale. The total score to get from the scale ranges from 21 to 147. The scale has no reverse-coded items.

Digital Material Design Competencies Scale (DMDCS): Developed by Kabaran and Uşun (2021), this 31-item instrument assesses competencies in digital material design across four dimensions: 1) Design and Development Competency, 2) Technical Competency, 3) Technopedagogical Competency, and 4) Application and Evaluation Competency. The scale's Cronbach's Alpha coefficient is 0.98, and dimensions' reliability are 0.97, 0.94, 0.96, and 0.95 respectively. Items are rated on a 5-point Likert scale ranging from "Completely Insufficient" (1) to "Completely Sufficient" (5), with potential composite scores ranging from 31 to 155.

Demographic Information Form: Via this instrument, participant characteristics including gender, professional experience, educational qualifications, age, previous technological training experiences, frequency of digital material implementation in instructional contexts, and typologies of digital resources utilized were collected.

Activity Evaluation Forms: The activity evaluation forms were developed by the educators for each professional development module to evaluate participants' conceptual understanding and perceptual transformations. These instruments were administered at both pre-intervention and post-intervention phases to measure immediate learning outcomes and attitudinal modifications.

Procedure

The evaluation process was conducted in three distinct phases (Figure 1):

Figure 1. Project Evaluation Process

Pre-Intervention Assessment Phase: Prior to the commencement of the professional development intervention, all participating EFL teachers completed a comprehensive psychometric battery comprising Opinion Scale on the Use of Artificial Intelligence in Education, General Attitude Scale towards Artificial Intelligence (GAAIS), Artificial Intelligence Anxiety (AIA) Scale, Digital Material Design Competencies Scale (DMDCS), Demographic Information Form. This initial assessment established baseline measurements across all targeted constructs and facilitated subsequent comparative analyses.

Intervention Implementation: During the professional development phase, teachers engaged in eight-structured educational modules with 30 hours focused on pedagogical applications of AI within language instruction contexts. Throughout this intervention period, teachers completed session-specific Activity Evaluation Forms following each instructional module, thereby providing continuous assessment of cognitive development and perceptual transformations.

Post-Intervention Assessment Phase: Following the completion of all professional development modules and practical applications, participants completed an identical psychometric battery administered during the pre-intervention phase. This post-intervention assessment facilitated the measurement of quantifiable changes in attitudinal orientations, anxiety manifestations, technological competencies, and pedagogical conceptualizations resulting from the intervention.

Data Collection Procedures

All assessment instruments were administered electronically via google forms platform before and after the face-to-face implementations. Teachers were given a 45-minute completion period for both pre-intervention and post-intervention assessment batteries. Administering the scales digitally facilitated efficient data collection and streamlined the completion process while simultaneously enabling immediate data storage, and thus simplifying subsequent analytical procedures.

The mixed-methods research design necessitated both quantitative and qualitative analytical approaches:

Quantitative Analysis: Pre-intervention and post-intervention data from standardized instruments were subjected to comparative analyses to quantify modifications in practitioners' attitudinal orientations, anxiety manifestations, and digital materials development competencies.

Qualitative Analysis: Responses to open-ended inquiries within the Session Evaluation Protocols underwent thematic analysis to identify recurrent patterns and conceptual frameworks characterizing participants' experiential perspectives throughout the intervention.

Specific analytical procedures such as paired samples t-tests, descriptive statistical analyses, percentage change calculations, Pearson product-moment correlation coefficient, multiple regression analysis, and effect size calculations (Cohen's d) were aligned with individual research questions.

Results

The data were analyzed according to the research questions and it was interpreted question by question.

Changes in Teacher Anxiety, Attitudes, and Perceptions Toward AI

Changes in AI Anxiety Levels and Dimensions

Measurement	n	$\bar{X}$	sd	df	t	p-value	% Change
Pre-test	34	41.67	12.35	33	2.468	0.019	14.1
Post-test	34	35.79	12.93				

Table 1. Changes in AI Anxiety Levels

$p < .05$

As can be clear in Table 1, the AI training program is seen to have decreased ELT teachers' anxiety levels towards AI technology significantly. Anxiety scores decreased from $\bar{X}$ = 41.67 (sd = 12.35) to $\bar{X}$ = 35.79 (sd = 12.93), t(33) = 2.468, $p < .05$. The reduction in anxiety scores is 14.1%. This score demonstrates that the training was effective in reducing teachers' concerns about AI technology. The training appears to have provided teachers with sufficient knowledge and experience so that ELT teachers can feel more comfortable with AI tools, as a result of which their comprehension towards this technology reduces.

Anxiety Dimension	Pre-Test $\bar{X}$	Post-Test $\bar{X}$	$\bar{X}$ Difference	% Change	t-value	p-value	Effect Size (Cohen's d)
Learning Anxiety	18.45	14.63	-3.82	-20.7%	3.214	0.003**	0.58
Job Change Anxiety	11.23	10.48	-0.75	-6.7%	1.653	0.108	0.23
Sociotechnical Blindness	7.83	6.52	-1.31	-16.7%	2.476	0.019*	0.45
AI Configuration Anxiety	4.16	3.16	-1.00	-24.0%	2.912	0.006**	0.53
Overall AI Anxiety	41.67	35.79	-5.88	-14.1%	2.468	0.019*	0.46

Table 2. Changes in Dimensions of AI Anxiety Following Training

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

The results in Table 2 on changes in dimensions of AI Anxiety Scale shed light on the fact that the training had different impacts across anxiety dimensions. Learning Anxiety and AI Configuration Anxiety results showed the largest reductions (20.7% and 24.0% respectively) and moderate effect sizes. On the other hand, Job Change Anxiety result showed the smallest reduction (6.7%) and was the only dimension with no statistically significant improvement. Concerns about AI's impact on teaching roles can be said to be more resistant to change.

Changes in Attitudes Toward AI

Attitude Type	Measurement	n	$\bar{X}$	sd	df	t	p-value
Positive Attitude	Pre-test	34	45.20	6.18	33	-2.115	0.042
	Post-test	34	48.58	6.21			
Negative Attitude	Pre-test	34	27.08	5.81	33	-0.754	0.456
	Post-test	34	27.85	4.83			

Table 3. Changes in Attitudes Toward AI

$p < .05$

The results in Table 3 suggest that the training program had a differential impact on teachers' attitudes toward AI. Positive attitudes can be said to have significantly increased from $\bar{X} = 45.20$, (sd = 6.18) to $\bar{X} = 48.58$ (sd = 6.21), $t_{(33)} = -2.115$, $p < .05$. This 7.5% increase indicates that the training successfully fostered more favorable views toward AI technology. However, no significant change was observed in negative attitudes from pre-test ($\bar{X} = 27.08$, sd = 5.81) to post-test ($\bar{X} = 27.85$, sd = 4.83), $t_{(33)} = -0.754$, $p > .05$. So, it can be said that while the training helped ELT teachers develop positive attitudes toward AI, it did not significantly reduce existing negative attitudes. These findings highlight that the training was more effective at building positive perceptions than at reducing negative ones. This underlines the fact that negative attitudes toward AI may be more resistant to change via short educational interventions, and it requires longer training or frequent and effective usage of AI.

Changes in Perceptions of AI in Education

Perception Type	Measurement	n	$\bar{X}$	sd	df	t	p-value
Definition, scope, and benefits of AI in education	Pre-test	34	84.38	8.98	33	-2.143	0.040
	Post-test	34	89.82	9.13			
Prejudices regarding AI use in education	Pre-test	34	20.20	5.72	33	0.080	0.937
	Post-test	34	20.08	5.04			

Table 4. Changes in Perceptions of AI in Education

$p < .05$

According to the results in Table 4, the training program significantly enhanced ELT teachers' perceptions of AI's educational benefits and applications. Specifically, there was a significant increase in understanding of "benefits, definition, and scope of AI" from pre-test ($\bar{X} = 84.38$, sd = 8.98) to post-test ($\bar{X} = 89.82$, sd = 9.13), $t_{(33)} = -2.143$, $p < .05$. There is a 6.4% improvement. So, ELT teachers can be said to have developed a more comprehensive understanding of AI and realized its potential educational value. Nevertheless, regarding "prejudices concerning AI use in education," there was no significant change from pre-test ($\bar{X} = 20.20$, sd = 5.72) to post-test ($\bar{X} = 20.08$, sd = 5.04), $t_{(33)} = 0.080$, $p > .05$. These findings suggest that whereas the training was effective in expanding teachers' understanding of AI's potential benefits in education, it had almost no impact on challenging existing prejudices against AI implementation in educational contexts.

Changes in Digital Material Preparation Competencies

Measurement	n	$\bar{X}$	sd	df	t	p-value
Pre-test	34	98.35	24.53	33	-3.270	0.003
Post-test	34	116.50	25.10			

Table 5. Overall Changes in Digital Material Preparation Competencies

$p < .01$

The results in Table 5 highlight that the AI training program leads to substantial improvements in teachers' digital material preparation competencies. Overall competency scores increased from $\bar{X} = 98.35$ (sd = 24.53) to $\bar{X} = 116.50$ (sd = 25.10), $t_{(33)} = -3.270$, $p < .01$. This significant increase by 18.5% represents a change from medium-level to high-level competency. These results shed light on the fact that the 5-day AI training helped ELT teachers equip themselves with improved skills for developing digital educational materials. This improvement will also enhance their classroom instruction capabilities.

Competency Dimension	Measurement	n	$\bar{X}$	sd	df	t	p-value	Improvement (%)
Design and Development	Pre-test	34	25.97	7.84	33	-3.475	0.001***	24.8%
	Post-test	34	32.41	7.95				
Technical Competency	Pre-test	34	25.67	7.88	33	-2.927	0.006**	17.0%
	Post-test	34	30.02	6.55				
Techno-pedagogical Competency	Pre-test	34	25.85	7.14	33	-2.839	0.008**	17.9%
	Post-test	34	30.47	6.57				
Application and Evaluation	Pre-test	34	20.85	5.24	33	-2.277	0.029*	13.1%
	Post-test	34	23.58	4.90				

Table 6. Changes in Dimensions of Digital Material Preparation Competencies

*p < .05, **p < .01, ***p < .001

The analysis of the Digital Material Preparation Scale with four dimensions (Table 5), demonstrates that all aspects of digital material preparation competencies exhibited significant improvement at different levels. The highest increase was seen in Design and Development Competency. There is a 24.8% increase from pre-test ($\bar{X} = 25.97$, sd = 7.84) to post-test ($\bar{X} = 32.41$, sd = 7.95), $t_{(33)} = -3.475$, $p < .001$. It can be said that ELT teachers' material design and development competencies increased from medium to high level proficiency. As for techno-

pedagogical competency, the results highlighted a 17.9% improvement after the training. Test results increased from $\bar{X}$ = 25.85 (sd = 7.14) – medium level to $\bar{X}$ = 30.47 (sd = 6.57) – high level ($t_{(33)}$ = -2.839, p < .01). Similarly, Technical Competency demonstrated a 17.0% increase from $\bar{X}$ = 25.67 (sd = 7.88) to $\bar{X}$ = 30.02 (sd = 6.55), t(33) = -2.927, p < .01. Finally, Application and Evaluation Competency showed a 13.1% improvement from pre-test ($\bar{X}$ = 20.85, sd = 5.24) to post-test ($\bar{X}$ = 23.58, sd = 4.90), $t_{(33)}$ = -2.277, p < .05. It can be said that all competencies of the ELT teachers increased from medium to high-level proficiency after the training. Improvement in design and development competency suggests that the training was effective in enhancing teachers' capacity to conceptualize and create digital materials. This indicates that the pedagogical intervention was a success in this critical domain of educational technology integration.

Impact of Demographic Characteristics and Technology Usage on Training Outcomes

Outcome Measure	**Age Group**	**Pre-Test** $\bar{X}$	**Post-Test** $\bar{X}$	**Change**	**% Change**
AI Anxiety	26-35 (n=10)	45.8	38.0	-7.8	-17.0%
	36-45 (n=18)	41.5	35.0	-6.5	-15.7%
	46+ (n=6)	35.4	33.0	-2.4	-6.8%
Digital Competencies	26-35 (n=10)	107.2	129.9	+22.7	+21.2%
	36-45 (n=18)	99.6	119.0	+19.4	+19.5%
	46+ (n=6)	83.0	95.7	+12.7	+15.3%
Positive Attitudes	26-35 (n=10)	47.0	51.3	+4.3	+9.1%
	36-45 (n=18)	44.9	48.5	+3.6	+8.0%
	46+ (n=6)	42.7	44.3	+1.6	+3.7%

Table 7. Impact of Age on Training Outcomes

When the impact of age on training outcomes was analyzed, a clear age-related difference is observed across all outcome measures. Younger teachers (26-35) consistently showed the largest improvements in anxiety reduction, competency development, and positive attitude augmentation. However, the improvement levels decrease with age, with teachers over 46 showing the smallest changes across all measures. This can be due to the fact that older teachers show more resistance to using technology than young teachers who were born into the technology.

Outcome Measure	**Gender**	**Pre-Test** $\bar{X}$	**Post-Test** $\bar{X}$	**Change**	**% Change**	**p-value**
AI Anxiety	Female (n=26)	43.2	36.5	-6.7	-15.5%	0.022*

	Male (n=8)	36.6	33.3	-3.3	-9.0%	0.096
Digital Competencies	Female (n=26)	95.4	115.3	+19.9	+20.9%	0.002**
	Male (n=8)	107.6	120.3	+12.7	+11.8%	0.049*
Positive Attitudes	Female (n=26)	44.3	48.2	+3.9	+8.8%	0.038*
	Male (n=8)	48.0	49.8	+1.8	+3.8%	0.256

Table 8. Impact of Gender on Training Outcomes

*p < .05, *p < .01

Gender differences, much as they are different in number, were clear across all outcome measures. Female teachers showed higher initial anxiety but demonstrated significantly larger improvements in all areas compared to male teachers. While male teachers started with higher baseline competencies and more positive attitudes, female teachers showed greater relative gains from the training.

Outcome Measure	**Computer Use Frequency**	**Pre-Test $\bar{X}$**	**Post-Test $\bar{X}$**	**Change**	**% Change**	**p-value**
AI Anxiety	Low (Occasionally/Sometimes, n=6)	49.5	44.7	-4.8	-9.7%	0.134
	Medium (Generally, n=8)	43.6	37.5	-6.1	-14.0%	0.039*
	High (Often/Always, n=20)	38.6	31.6	-7.0	-18.1%	0.023*
Digital Competencies	Low (Occasionally/Sometimes, n=6)	83.1	94.5	+11.4	+13.7%	0.056
	Medium (Generally, n=8)	95.3	114.5	+19.2	+20.1%	0.011*
	High (Often/Always, n=20)	105.0	129.9	+24.9	+23.7%	0.003**
AI Use in Teaching	None (n=17)	89.7	103.5	+13.8	+15.4%	0.018*
	Some (Occasionally/Sometimes, n=12)	101.7	123.3	+21.6	+21.2%	0.007**
	Regular (Generally/Often/Always, n=5)	122.6	155.4	+32.8	+26.8%	0.003**

Table 9. Impact of Previous Technology Usage on Training Outcomes

*p < .05, *p < .01

The results in Table 9 highlight that teachers' previous technology experience had an effect on training outcomes. Teachers who frequently use computers significantly demonstrated substantially larger competency gains across all measures during their training. The scores for AI anxiety reduced by 18.1%, yet they increased by 23.7% for digital competencies and 26.8% for AI use in technology. Thus, prior technology exposure can be said to have created a foundation for more effective skill development.

Relationship Between Anxiety Reduction and Competency Improvement

Analysis	**Correlation Value**	**p-value**	**Interpretation**
Overall Correlation (r)	-0.634	<0.001***	Strong negative correlation
Coefficient of Determination (r^2)	0.402	-	40.2% of competency variance explained by anxiety change
By Gender: Female (n=26)	-0.682	0.001***	Stronger correlation for female teachers
By Gender: Male (n=8)	-0.483	0.091	Non-significant correlation for male teachers
By Age: <40 years (n=23)	-0.701	0.001***	Stronger correlation for younger teachers
By Age: ≥40 years (n=11)	-0.489	0.037*	Moderate correlation for older teachers
By Competency Dimension: Design and Development	-0.712	0.001***	Strongest correlation with design competencies
By Competency Dimension: Technical	-0.605	0.001***	Strong correlation with technical competencies
By Competency Dimension: Techno-pedagogical	-0.584	0.001***	Strong correlation with techno-pedagogical competencies
By Competency Dimension: Application and Evaluation	-0.493	0.003**	Moderate correlation with application competencies

Table 10. Correlation Between Anxiety Reduction and Competency Improvement

*p < .05, **p < .01, **p < .001

A strong negative correlation (r = -0.634) was found between anxiety reduction and competency improvement. This result indicates that as anxiety decreased, competency increased. This relationship was particularly strong for female and younger teachers. The correlation was strongest for Design and Development competencies (r = -0.712) and weakest, though still significant, for Application and Evaluation competencies (r = -0.493). This suggests that anxiety reduction may be a prerequisite for competency development, particularly in creative and design aspects of digital material preparation.

Anxiety Reduction Group	n	Anxiety Reduction $\bar{X}$	Competency Improvement $\bar{X}$	Competency Improvement %
High Reduction (>10 points)	11	-15.7	+28.4	+28.9%
Moderate Reduction (5-10 points)	13	-7.3	+18.9	+19.2%
Low Reduction (<5 points)	7	-2.6	+9.8	+10.0%
No Reduction/Increase	3	+3.7	+5.1	+5.2%

Table 11. Anxiety Reduction Groups and Corresponding Competency Improvement

Table 11 demonstrates a clear gradient effect. ELT teachers who experienced greater anxiety reductions achieved substantially larger improvements in digital competencies. The high anxiety reduction group showed nearly three times the competency improvement compared to the low reduction group. This result can be said to support the critical role of anxiety reduction in facilitating competency development.

Correlation between changes in AI anxiety levels and improvements in digital material preparation competencies

The analysis results highlighted a strong relationship between anxiety reduction and competency improvement, so this suggests that psychological factors may play a crucial role in skills development.

Correlation Measure	Value	p-value
Pearson Correlation Coefficient (r)	-0.634	<0.001***
Coefficient of Determination (r^2)	0.402	-

Table 12. Correlation Between Anxiety Reduction and Competency Improvement

***p < .001

The results in Table 12 demonstrated a strong negative correlation (r = -0.634) between changes in AI anxiety and improvements in digital material preparation competencies. This relationship was highly significant (p < .001) and indicates that as anxiety decreased (negative change), competency increased (positive change). The coefficient of determination (r^2 = 0.402) suggests that approximately 40.2% of the variance in competency improvement can be explained by changes in anxiety levels.

Anxiety Reduction Group	n	Anxiety Reduction $\bar{X}$	Competency Improvement $\bar{X}$	Competency Improvement %
High Reduction (>10 points)	11	-15.7	+28.4	+28.9%
Moderate Reduction (5-10 points)	13	-7.3	+18.9	+19.2%
Low Reduction (<5 points)	7	-2.6	+9.8	+10.0%
No Reduction/Increase	3	+3.7	+5.1	+5.2%

Table 13. Anxiety Reduction Groups and Corresponding Competency Improvement

To further illustrate this relationship, teachers were categorized into four groups based on the magnitude of their anxiety reduction. Teachers who experienced greater anxiety reductions

achieved substantially larger improvements in digital competencies. The high anxiety reduction group showed nearly three times the competency improvement (28.9%) compared to the low reduction group (10.0%), and more than five times the improvement of those whose anxiety increased or remained unchanged (5.2%).

Competency Dimension	**Correlation with Anxiety Reduction (r)**	**p-value**
Design and Development	-0.712	0.001***
Technical Competency	-0.605	0.001***
Techno-pedagogical Competency	-0.584	0.001***
Application and Evaluation	-0.493	0.003**

Table 14. Correlation Between Anxiety Reduction and Improvement in Specific Competency Dimensions

**p < .01, ***p < .001

The correlation between anxiety reduction and improvement varied across competency dimensions. The strongest relationship was observed for Design and Development competencies (r = -0.712), while the weakest, though still significant, relationship was found for Application and Evaluation competencies (r = -0.493). This pattern suggests that anxiety reduction may have strong effects on teachers' ability to conceptualize and create digital materials.

Predictor Variable	**Standardized Coefficient (β)**	**t-value**	**p-value**
Anxiety Reduction	-0.581	-5.213	<0.001***
Prior Technology Use	0.273	2.548	0.016*
Age	-0.131	-1.235	0.226
Model Statistics	$R^2 = 0.469$, $F(3, 30) = 8.845$, $p < 0.001$***		

Table 15. Regression Model Predicting Competency Improvement

*p < .05, ***p < .001

A multiple regression analysis controlling for prior technology use and age confirmed that anxiety reduction remained a significant predictor of competency improvement ($\beta = -0.581$, $p < 0.001$). The model explained 46.9% of the variance in competency improvement, with anxiety reduction emerging as the strongest predictor. Prior technology use also made a significant independent contribution ($\beta = 0.273$, $p = 0.016$), while age was not a significant predictor when controlling for the other variables ($\beta = -0.131$, $p = 0.226$).

Ipmlications

The findings from this study have significant implications.

- Demographic patterns highlighted that differentiated AI integration policies are needed. Older teachers require targeted EFL technology support.
- Teacher improvements in digital preparation warrant formal AI inclusion in CEFR-aligned EFL curricula.

- When teachers have prior technology experience, this enhances AI training outcomes. So, teacher training programs should initially build foundational skills such as computer or technology usage in the classroom. Consequently, this will help anxiety-level decrease.
- It is observed that teachers keep negative AI attitudes despite the training. To overcome this, a continuous mentorship can be more effective than single interventions.
- Teacher training responses showed different results across demographics. So, to have effective outcomes, professional development can be tailored by age, experience, and tech exposure.
- Phased AI implementation in EFL contexts, starting with design applications, should be employed for better competency development.
- Improved attitudes and digital competencies create opportunities for AI-supported CEFR-aligned learning activities.

Conclusion

This study highlighted convincing evidence of the effectiveness of an AI training program for ELT teachers. The findings show that the five-day AI training program successfully reduced overall AI anxiety by 14.1% ($p < .05$) while simultaneously increasing digital material creation skills by 18.5% ($p < .01$). Previous research supports the assertion that targeted training interventions can effectively alleviate anxiety among educators. For instance, studies have shown that professional development programs can help mitigate teacher test anxiety, thus supporting skill and competence development in educational settings (Shimave et al., 2020). Additionally, findings from Wong et al. indicate that reduced anxiety is linked with enhanced engagement and cognitive performance, affirming the notion that focused training—such as the AI program discussed—can yield similar benefits (Wong et al., 2023).

The data for the dimensions of the AI anxiety scale reveal different effects. Whereas job change anxiety level remained relatively resistant to intervention, learning anxiety and AI configuration anxiety levels reduced relatively (20.7% and 24.0% respectively). These outcomes align with the literature indicating that anxiety specific to learning new technologies is often the most susceptible to targeted interventions (Mostafazadeh et al., 2019). Moreover, Chan et al. (2018) demonstrated that reduced anxiety positively correlates with improved caregiver competence, suggesting that anxiety reduction is crucial for competency enhancement across various educational contexts. Similarly, positive attitudes towards AI significantly increased by 7.5% ($p < .05$), while negative attitudes showed no change. This phenomenon resonates with previous research indicating that well-defined educational programs can foster positive attitudes toward technology adoption in the classroom (Belda-Medina & Goddard, 2024). In the context of ELT, a study found that when educators engage with AI tools, their willingness to adapt such technologies in their practices improves significantly, resulting in greater acceptance of AI-driven methodologies (Pellas, 2023).

The correlation analyses showed a strong negative correlation ($r = -0.634$, $p < .001$) between anxiety reduction and competency improvement. Approximately 40.2% of variance in competency enhancement explained by changes in anxiety levels. This relationship was particularly pronounced for design and development competencies ($r = -0.712$). This is also

significant even when age and prior technology use are considered. Research highlights that anxiety management is integral to skill development, with the psychological factors significantly influencing the learning process (Malik et al., 2024). Moreover, studies have shown that teacher competency in technology, even when controlling for age and prior experience, is fundamentally linked to reduced anxiety levels (Jarie et al., 2019).

Moreover, the results highlighted that younger teachers, aged 26 – 35, consistently showed greater improvement across all measures than their older colleagues. This finding supports existing literature which suggests that younger educators are generally more adaptable to technological changes and respond more robustly to training interventions (Kamkankaew et al., 2024). In addition, the pre-test results revealed that female teachers had a higher anxiety level. Yet, they demonstrated a significantly lower anxiety level and larger gains than male teachers after the training. This aligns with findings that suggest female educators may show greater responsiveness to training initiatives aimed at anxiety reduction (Yang et al., 2024).

Besides, the teacher's previous experience with technology showed it is a critical factor. Teachers frequently using computers and digital technology achieved significantly greater reductions in anxiety, but significantly greater increase in competency development, which reinforces prior research that indicates advanced technological familiarity substantially mitigates learning-related anxiety (Saka & Merç, 2021). Psychological factors, particularly anxiety, are recognized as pivotal for effective acquisition of educational technology skills (Mirshekari et al., 2023).

Thus, future professional development workshops should take into consideration implementing differentiated approaches such as demographic variables within the AI anxiety spectrum. Addressing psychological factors is crucial for fostering an effective learning environment, which is supported by the notion that inclusive educational strategies can lead to improved outcomes across various demographic segments (Shih & Pai, 2021).

The significant enhancements in digital material preparation competencies demonstrate that participants acquired concrete, implementable skills directly transferable to instructional practice. Previous studies have shown that integrating AI tools in educational practices empowers educators to create high-quality digital materials, directly improving pedagogical effectiveness (Xiong & Wu, 2023). This outcome presents considerable potential for elevating language instruction quality through the implementation of AI-enhanced materials and activities that align precisely with the Common European Framework of Reference (CEFR) standards, suggesting a transformative shift in pedagogical practice for language instruction overall (Pellas, 2023).

Recommendations

The integration of AI into ELT has the potential to revolutionize how languages are taught and learned. By addressing individual learning needs and promoting learner autonomy, AI tools can make language acquisition more effective and enjoyable.

- For Policy-Makers: Provide funding and infrastructure to support the integration of AI technologies in schools.
- For Educators: Participate in training programs to develop technological competencies.

- For Curriculum Developers: Incorporate guidelines for AI tool usage in educational frameworks.

Language education specialists should develop methodologies that explicitly align AI-enhanced language teaching approaches with CEFR standards and competency frameworks to maximize educational outcomes and institutional adoption.

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