



**AN INVESTIGATION INTO FACTORS INFLUENCING BEHAVIORAL
INTENTIONS TO USE AI-BASED EDUCATIONAL TECHNOLOGIES
AND AI-TPACK EDUCATIONAL NEEDS: A MIXED-METHODS
STUDY OF CHINESE PRE-SERVICE EFL TEACHERS**

ZONGBI QIN

**DOCTOR OF PHILOSOPHY
IN
ENGLISH FOR PROFESSIONAL DEVELOPMENT**

**SCHOOL OF LIBERAL ARTS
MAE FAH LUANG UNIVERSITY**

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**THIS DISSERTATION IS A PARTIAL FULFILLMENT OF
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Advisor Maneerat Chuaychoowong, Ed. D.

ABSTRACT

Artificial intelligence (AI) in education offers the potential for a more personalized, flexible, inclusive, and engaging learning experience and a more advanced educational environment. However, there is a noticeable gap in understanding the behavioral intentions (BI) of Chinese pre-service EFL teachers regarding their future use of AI-based educational technologies. Furthermore, the identification and analysis of the educational needs of pre-service EFL teachers in the context of AI-assisted EFL education remains limited.

The objectives of this study were to identify the factors influencing Chinese pre-service EFL teachers' behavioral intention to use AI-based educational technologies, to examine the degree of influence and correlations among these factors, to identify pre-service EFL teachers' AI-TPACK educational needs and examine stakeholder perceptions to inform effective EFL teacher preparation for AI-assisted EFL teaching and learning.

An extended Unified Theory of Acceptance and Use of Technology (UTAUT) model incorporating four AI-TPACK constructs was adopted. Nine factors, including performance expectancy (PE), effort expectancy (EE), social influence (SI), facilitating condition (FC), behavioral intentions, AI Technological Knowledge (AI-TK), AI Technological Pedagogical Knowledge (AI-TPK), AI Technological Content Knowledge (AI-TCK), and AI-TPACK, were examined. Following a convergent parallel mixed methods design, data were collected through a questionnaire and semi-structured interviews with pre-service EFL teachers, an administrator, ICT teachers,

and in-service EFL teachers. Structural equation modelling and comparative analyses were conducted. Quantitative and qualitative findings were triangulated.

Results showed that behavioral intentions were positively predicted by performance expectancy ($\beta = .259, p < .001$), social influence ($\beta = .391, p < .001$), and AI Technological Knowledge ($\beta = .481, p < .001$), with AI-TK being the strongest predictor. AI-TK had direct effects on AI-TPK ($\beta = .757, p < .001$) and AI-TCK ($\beta = .627, p < .001$), while its effect on AI-TPACK was non-significant. Facilitating conditions emerged as the most influential factor, exerting strong effects on PE, EE, and AI-TK. Unexpectedly, AI-TCK ($\beta = -.379, p < .001$) and AI-TPK ($\beta = -.326, p < .035$) negatively influenced effort expectancy, and some hypothesized paths were not supported.

For AI-TAPCK educational needs, the results indicate that AI-TK ($M = 3.57, SD = 0.64$) was the most critical area of need. However, in interviews, participants prioritized AI-TPACK, while AI-TK ranked last. Pre-service teachers demonstrated awareness of AI's pedagogical potential but lacked confidence in deep integration.

Administrators regarded AI as a tool rather than a replacement for teachers, ICT teachers highlighted efficiency and ethical concerns, and in-service EFL teachers emphasized insufficient AI training. All groups agreed on the importance of interdisciplinary collaboration, ethical awareness, and systematic training. For EFL teacher preparation, pedagogical foundations should be established before the integration of AI-based educational technologies. Pre-service teachers should be supported in developing technical adaptability, enhancing ethical awareness, and developing interdisciplinary competence to ensure effective and responsible educational AI applications. Furthermore, AI-related training should be started early, and building it up from basic knowledge to hands-on application to improve EFL teachers' preparedness.

This study contributes to research on AI technology acceptance in EFL education and provides implications for technology acceptance modeling in the AI era, EFL teacher education and professional development, school leadership, policy-making, and ethical dimensions of AI in education.

Keywords: Artificial Intelligence in Education, Behavioral Intention, China, Educational Needs, Pre-service EFL Teachers, Technology Adoption

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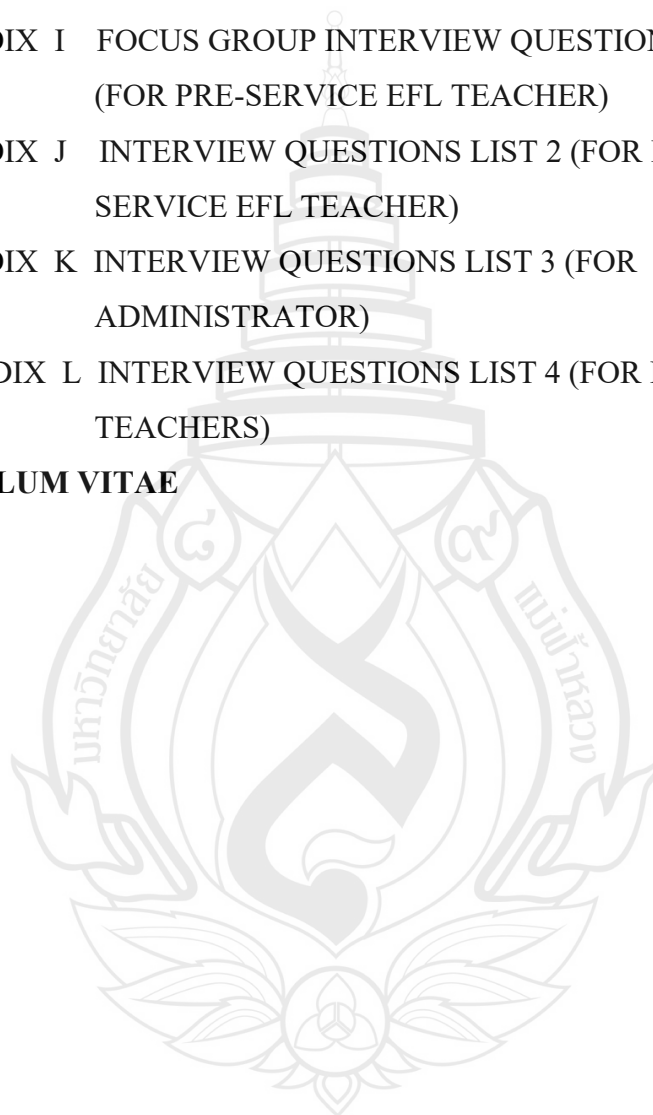
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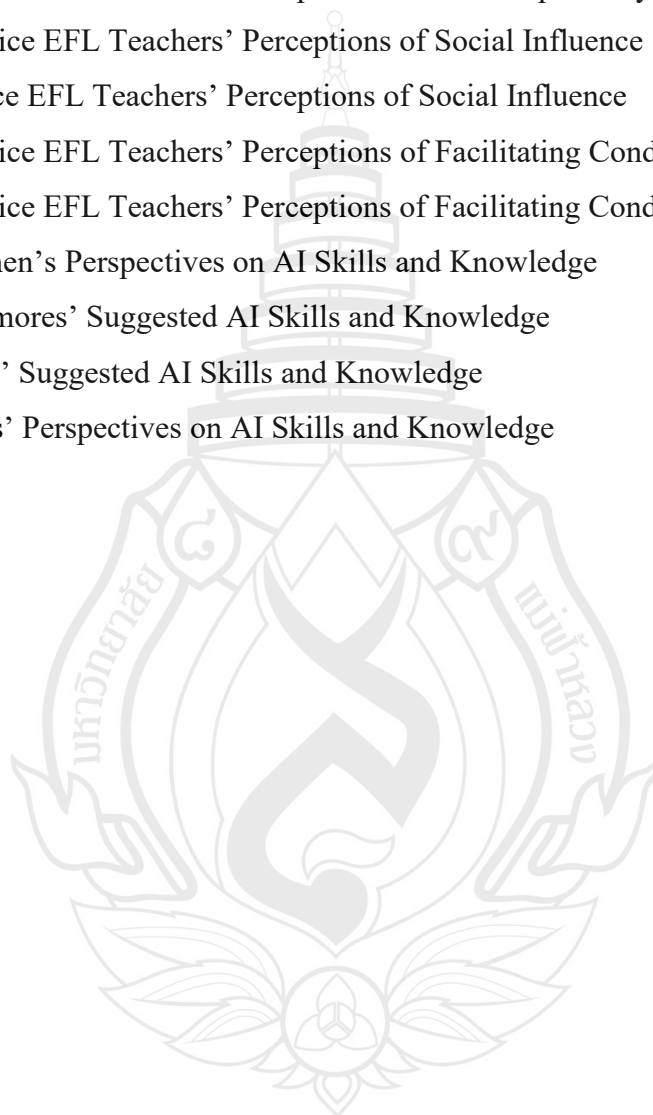
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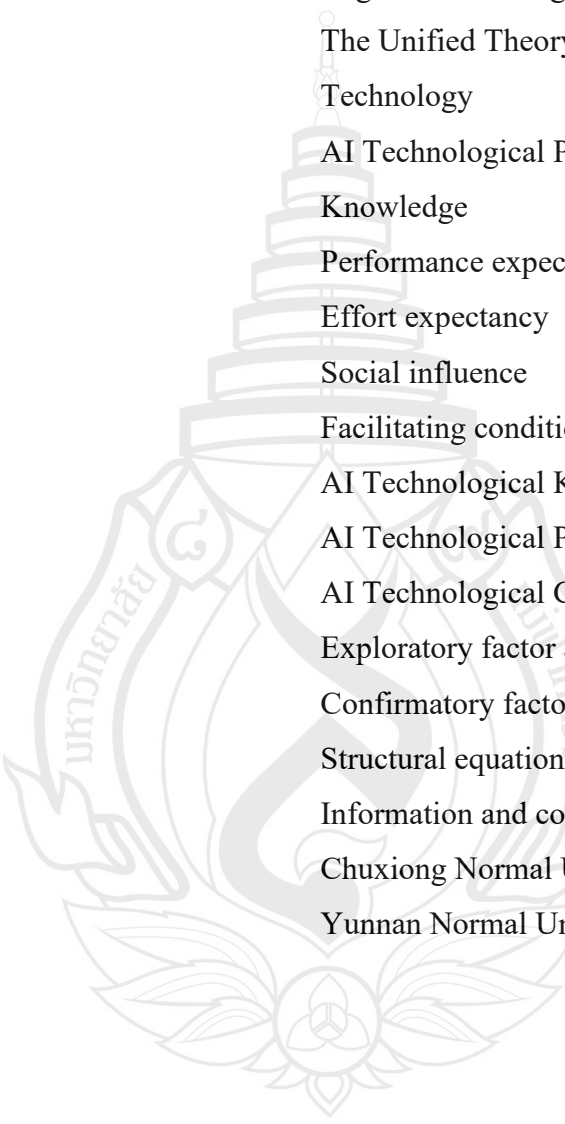
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ABBREVIATIONS AND SYMBOLS



AI	Artificial Intelligence
BI	Behavioral Intentions
EFL	English as a Foreign Language
UTAUT	The Unified Theory of Acceptance and Use of Technology
AI-TPACK	AI Technological Pedagogical Content Knowledge
PE	Performance expectancy
EE	Effort expectancy
SI	Social influence
FC	Facilitating condition
AI-TK	AI Technological Knowledge
AI-TPK	AI Technological Pedagogical Knowledge
AI-TCK	AI Technological Content Knowledge
EFA	Exploratory factor analysis
CFA	Confirmatory factor analysis
SEM	Structural equation modelling
ICT	Information and communication technology
CXNU	Chuxiong Normal University
YNNU	Yunnan Normal University

CHAPTER 1

INTRODUCTION

This chapter aims to set the scene for the study. First, it provides background information on the present study (section 1.1). Second, it states the research problems (section 1.2), the research objectives (section 1.3), the research questions (section 1.4), the significance of the study (section 1.5), the scope of the study (section 1.6), and the definition of key terms in the study (section 1.7). Finally, section 1.8 provides an overview of the dissertation.

1.1 Background of Study

Over the last few years, there has been much discussion about introducing artificial intelligence into educational environments with specific reference to EFL education. The advent of educational technology based on AI is creating a new chapter in education for both teachers and learners. With regards to the prevailing efforts and the future technologies, several research works (Laanpere et al., 2014; Luckin et al., 2016; Mayer-Schönberger & Cukier, 2014; Timms, 2016) emphasized that artificial intelligence has greatly revolutionized education, including efficiency, global learning, personalized learning, smarter content, and better effectiveness and efficiency in educational management, among others.

AI has profoundly reshaped educational pedagogy (Luckin et al., 2022). Several studies (Gao, 2021; Kim, 2024; Klimova et al., 2022; Kuo, 2020; Noviyanti, 2020; Pokrivčáková, 2019) have found that AI can improve language learning and teaching. Artificial intelligence can enhance vocabulary learning (Wang & Reynolds, 2024), correct English pronunciation (Noviyanti, 2020), enhance student learning outcomes and teaching efficiency (Gao, 2021), and expand teaching and learning activities (Pokrivčáková, 2019). Furthermore, AI can help to foster autonomy (Mahendra et al., 2023) and stimulate interest (Petrescu et al., 2023). Through the lens of teachers, AI can assist teachers and monitor their learners' learning progress. AI can help give

immediate feedback and meet learners' demands instantly (Keuning & van Geel, 2021; Zawacki-Richter et al., 2019), as well as promote efficient assessment and feedback of learners' complex knowledge (Chen et al., 2021). AI can assist teachers in evaluating the teaching process while also facilitating lesson preparation and execution (Celik et al., 2022; Zawacki-Richter et al., 2019). Furthermore, artificial intelligence-driven educational systems can also be utilized to classroom dynamics and student involvement, allowing for the real-time identification of students at risk and prompt intervention (Tsai et al., 2020).

However, the promise of AI in education has yet to be fully fulfilled (Luckin et al., 2022). Its implementation in educational contexts continues to lag behind other industries, like business (Luckin & Cukurova, 2019). A key reason is that teachers' roles in the pedagogical integration of AI tools have been overlooked (Seufert et al., 2021). Moreover, research has primarily focused on the technological aspects related to developing systems (Divekar et al., 2021), while teachers' perspectives on AI utilization have only recently been examined (Chiu & Chai, 2020). Teachers are regarded as vital stakeholders in AI-driven instruction (Seufert et al., 2021), so their perspectives, experiences, and anticipations must be understood for the effective adoption of AI in educational institutions (Holmes et al., 2019).

Given the expected widespread use of AI in education, teacher training should be recognized as a crucial aspect towards empowering teachers to exploit educational technology toward improving instructional procedures (Pedro et al., 2019). Teachers likewise ought to develop and adopt additional skills and competencies as they embrace the AI-based digital innovation wave (Luckin et al., 2016). Pokrivčáková (2019) emphasized that teachers in the language field need adequate training to effectively implement AI technologies in instructional settings and take full advantage of their benefits. Nevertheless, Moorhouse (2024) noted that novice English teachers were unprepared to use generative AI (GAI) tools in their teaching and had limited knowledge about them. De la Vall and Araya (2023) recommended professional development, mentorship, and collaboration to prepare language teachers for AI use, while Moorhouse (2024) stressed the urgent need to assess their readiness for effective AI integration. If teachers' readiness is better understood, their training needs can be identified, and professional development programs can be designed accordingly. To

fully maximize AI's promise in education, teachers need to understand the pedagogical significance of AI-based technologies (Xu, 2020). The effective application of AI in teaching depends on teachers' pedagogical knowledge for utilizing such technologies (Cavalcanti et al., 2021). For instance, recognition of the benefits of AI-based tools encourages teachers to integrate them in ways that enhance learner motivation and engagement (Wang et al., 2021). Similarly, teachers with greater AI knowledge are more capable of selecting suitable tools for instruction (Edwards et al., 2018). Such knowledge also allows them to support individualized instruction and provide prompt feedback (Popenici & Kerr, 2017). Thus, examining teachers' knowledge of AI integration is essential.

AI is expected to transform teachers' professional knowledge in AI-supported teaching (Seufert et al., 2021). In this regard, the capacity to integrate AI-based systems both technologically and pedagogically is essential for teachers. The TPACK framework offers an explanation of the essential knowledge teachers need to use AI tools in education. The TPACK framework emphasizes teachers' professional knowledge for effectively utilizing technology in instruction (Mishra & Koehler, 2006) and is regarded as a flexible model that can be adapted to various pedagogical practices and technologies (Mishra et al., 2010; Valtonen et al., 2014). According to Edwards et al. (2018), Pre-service teachers need distinctive skills and knowledge to determine the most suitable AI-based tools for teaching, which is based on TPACK implementation.

Previous studies (Abdelhalim, 2016; Sabzian & Gilakjani, 2013) found that foreign language teachers generally approve of computer-assisted language learning (CALL) and embrace contemporary technologies in teaching. However, many remain hesitant to use ICT extensively due to internal factors such as low motivation, difficulties integrating ICT with established teaching and learning practices, and fears of losing authority, control over students, or student respect, as well as external factors including limited resources, insufficient support, rigid curricula, and time pressure (Pokrivcakova, 2019). In 2019, the Chinese government initiated a national policy for educational modernization to promote the integration of AI in education and enhance AI and AIED-related professional development activities for teachers (Chiu et al., 2020). To advance the development of future AI-assisted pedagogical models, it is essential to prioritize understanding teachers' perspectives (Chai et al., 2021). Despite

the significant potential of AI to facilitate EFL learning, teachers need to overcome various barriers when integrating new technologies into teaching (Tsai & Chai, 2012). Therefore, it is essential to examine teachers' adoption of AI as well as the associated internal and external factors when using AI in EFL courses (An et al., 2022).

Previous studies have examined the factors that influence technology adoption, considering the UTAUT model, which comprises performance expectancy, effort expectancy, social influence, and facilitating condition. Nevertheless, studies are limited that concentrate exclusively on the behavioral intentions of the Chinese pre-service EFL teachers towards AI-powered education technology. In addition, several studies underscored the significance of TPACK in EFL teaching. Technology, pedagogy, and content knowledge are combined to create efficient teaching approaches known as the TPACK framework. However, little research has been conducted on how this knowledge is integrated with the educational needs of pre-service EFL teachers, especially within the Chinese scenario, regarding the adoption of AI-based educational technology.

Nowadays, there is a rapid growth of artificial intelligence (AI)-driven educational technology in China. In response, in 2016, the Chinese government announced plans to become one of the leading poles of AI development in the world by 2030, with over 730 million internet users (Pedro et al., 2019). Within this broader technological plan, China also defined its national AI strategy for the education sector. The Development Plan of New Generation Artificial Intelligence (The State Council of China, 2017) suggested that AI would be employed to advance the transformation of teaching methods. Smart classroom systems, as well as online applications utilizing artificial intelligence, are gaining popularity nowadays in Chinese EFL classrooms.

In China, English is taught as a compulsory subject throughout all stages of the school curriculum (Teng, 2017). The emphasis on English proficiency and the inclusion of technology in the curriculum in China started back in the last century. In its modernization, China has been aggressively investing in education technology. The Ministry of Education considers educational computerization the impetus behind modernization and quality education in China (Li & Ni, 2011). The adoption of AI-based technologies supports the national education and technology goals. In 2018, China's CPC Central Committee and the State Council issued the Opinions on

Comprehensively Deepening the Reform of Teacher Team Construction in the New Era, calling for teachers to adapt to emerging technologies such as AI and actively engage in educational and instructional activities. In 2021, the General Office of the Ministry of Education released the Notice on the Second Batch of Pilot Recommendations for AI-Promoting Teacher Team Construction, emphasizing the construction of an intelligent education system for teachers. Hence, it is vital to assess EFL teachers' technology knowledge and expertise in China, paying particular attention to EFL teachers' pedagogical needs (Teng, 2017).

According to Thornbury (2006), needs analysis involves identifying learners' needs before developing a course, with learners' attitudes, preferences, and favored learning methods and pedagogical approaches contributing to the process. This analysis can then inform both the course content, including the syllabus and materials, and the methodology. However, studies examining English teachers' preparedness for using AI and their training needs for AI implementation remain limited, despite the popularity and accessibility of AI in English teaching in China (Chan & Tang, 2024). In the study of Kim and Su (2024) on AI convergence education showed that teachers' TPACK improved, but more personalized educational programs that integrate AI tools into teaching procedures were needed. This suggests that present educational frameworks may not sufficiently train pre-service teachers for the challenges of integrating AI into their teaching. To address the gap, the educational needs of Chinese pre-service EFL teachers regarding the use of AI-based educational technology in their future teaching practice were explored by examining their self-assessed knowledge of AI-TPACK in the present study.

To address the growing trend of incorporating AI into EFL education, the present study examined the behavioral intention of Chinese pre-service EFL teachers to employ AI-based educational technologies in their future teaching practice and the associated influencing factors. The AI Technological Pedagogical Content Knowledge (AI-TPACK) framework and the Unified Theory of Acceptance and Use of Technology (UTAUT) served as the theoretical underpinning for this study, which examined the factors that influence pre-service EFL teachers' behavioral intentions to use AI-based educational technologies. The UTAUT model investigates individual perceptions of factors influencing their intention to utilize technology (Venkatesh et al., 2003),

whereas TPACK assesses teachers' knowledge of incorporating technology into instruction (Zhou et al., 2017), and functions as an additional component to UTAUT (Lim & Harwati, 2021). The UTAUT method emphasizes usefulness and utility, whereas the TPACK framework highlights teachers' knowledge. Studies have combined the two frameworks to predict pre-service teachers' technology use intentions, showing strong predictive power (Bardakci & Alkan, 2019; Teo et al., 2019).

1.2 Statement of Problems

The integration of AI into educational technology has revolutionized the field of English as a foreign language (EFL) instruction, offering personalized, adaptive learning experiences, real-time feedback, improved learner cognitive and motivational outcomes, and reshaping teacher competencies in the digital era (Peña-Acuña, 2024; Zhang & Umeanowai, 2025). However, despite some previous studies on AI adoption and behavior intention (An et al., 2022; Hsu, 2024; Liu et al., 2024; Mei, 2024; Wen et al., 2024; Zou et al., 2023) in the Chinese EFL context, several of these studies focused on learners (Hsu, 2024; Liu et al., 2024; Zou et al., 2023), students (Wen et al., 2024), and K-12 EFL teachers (An et al., 2022). Mei (2024) examined Chinese pre-service teachers but concentrated on their intentions to use the Chinese AI-assisted pronunciation training application "Clip" among 11 pre-service EFL teachers in their own learning rather than in teaching. Thus, there is a noticeable gap in our understanding of the behavioral intentions of pre-service EFL teachers in China regarding their intention to use AI-based educational technology in their future teaching practice. Furthermore, Chan and Tang (2024) assessed final-year pre-service EFL teachers' readiness for artificial intelligence and their training needs through a TPACK-based model at a local university in Hong Kong, while Ye et al. (2025) investigated the readiness and learning needs of Chinese pre-service EFL teachers at a university in central China. To our knowledge, the identification and analysis of the educational needs of pre-service teachers in the context of AI-based EFL instruction remain underexplored. This study, therefore, addresses two key issues.

The central problem to be researched in the proposed study is the issue of Chinese pre-service EFL teachers' behavioral intentions to adopt AI-based educational technology in EFL teaching. As a basis for this study, the researcher identified two key problems requiring investigation. The first major issue is the lack of insight into behavioral intentions. Factors influencing Chinese pre-service EFL teachers' intention to use AI-based educational technology in their future classrooms are not well documented. Understanding their behavioral intentions is crucial for the effective implementation of these tools. Without a clear understanding of teachers' behavioral intentions, efforts to integrate AI-based educational technologies into EFL classrooms may result in superficial adoption, ineffective pedagogical use, or resistance to sustained implementation. Therefore, drawing on the UTAUT model (Venkatesh et al., 2003) and the AI-TPACK framework (Ning et al., 2024), four external factors, such as performance expectancy, effort expectancy, social influence, and facilitating conditions, and four internal factors, including AI-TK, AI-TPK, AI-TCK, and AI-TPACK, were examined.

The second major issue identified as a foundation for this study concerns the inadequate understanding of AI-TPACK educational needs. The specific educational needs related to AI-based EFL teaching and learning have not been sufficiently examined among EFL teachers, particularly pre-service EFL teachers. Preparing teachers for AI-assisted education is recognized as one of the six main future challenges in the incorporation of AI into education (Pedro et al., 2019). Like educational leaders and policymakers elsewhere, who have often relied on top-down teacher training programs rather than inclusive approaches that involve teachers as co-designers (Hardy, 2012), China has also adopted a one-size-fits-all model for teacher professional development (O'Sullivan, 2018). However, conducting a needs analysis is essential before designing training programs or curricula. Additionally, existing research pays limited attention to teacher preparation, professional development, and support for employing advanced technologies in educational settings (e.g. Rienties & Toetenel, 2016; Tammets & Ley, 2023; Van Leeuwen et al., 2014). Pre-service teachers are a unique and critical group. Their preparation directly predicts the future direction and quality of EFL teaching in China. Compared to in-service EFL teachers, pre-service EFL teachers' perspectives are shaped by limited classroom experience, different

training backgrounds, and more exposure to new AI tools during teacher education programs. As digital natives, pre-service EFL teachers more frequently and flexibly engage with AI technologies, which affect their understanding and perceptions of AI-assisted language teaching and learning. Importantly, their intention to use AI-based educational technologies and AI-TPACK educational needs not only reflect their readiness but also indicate the demands for curriculum reform and redesign of teacher training programs. Therefore, understanding pre-service EFL teachers' educational needs regarding the adoption of AI-based educational technology is vitally important for guiding the design of training programs or curricula that directly address these needs and for fostering both their intentions and skills to integrate AI tools into their future teaching practices.

There are two core gaps in behavioral intention research and AI-TPACK research. Despite the rapid expansion of AI-based EdTech in China, little is known about the factors that influence Chinese pre-service EFL teachers' behavioral intention to adopt AI in future teaching and AI-TPACK educational needs. Therefore, this mixed-method study seeks to bridge these gaps by investigating the behavioral intentions of pre-service EFL teachers in China towards the use of AI-based educational technology and identifying their specific educational needs in this rapidly evolving educational landscape. Addressing these issues is essential for supporting the integration of AI tools in EFL instruction and for preparing future EFL educators in China to exploit AI-based technology to strengthen learning outcomes.

This research aims to explore factors affecting prospective EFL teachers' intentions to utilize AI-based educational technology in teaching. It is grounded in the UTAUT model, which posits that external factors influence teachers' intentions to use AI-based educational technology in English as a foreign language instruction. Additionally, the study employs the TPACK framework developed by Mishra and Koehler (2006) to provide a theoretical underpinning for teachers' internal factors regarding AI-based educational technology adoption. The rationale for combining the two theoretical frameworks is listed as follows: Firstly, examining behavioral intention through UTAUT alone is insufficient, as acceptance does not necessarily translate into meaningful pedagogical integration. Teachers may perceive AI tools as useful or easy to use, yet still lack the pedagogical and content-specific knowledge required to

integrate them effectively into EFL teaching. Conversely, the TPACK framework, while well-suited to capturing teachers' pedagogical knowledge structures, does not explicitly account for contextual and usability-related factors that shape technology acceptance and intention before classroom implementation. Secondly, pre-service EFL teachers' teaching practices are still forming. Their behavioral intention and pedagogical knowledge develop concurrently and interactively rather than sequentially. Therefore, integrating UTAUT with TPACK enables a more comprehensive analysis of AI adoption by capturing both external acceptance conditions and internal pedagogical readiness and educational needs, which is essential for understanding not only pre-service EFL teachers' intention to use AI, but also their educational needs to use AI in pedagogically meaningful ways. This approach offers a comprehensive understanding of the relationship between external usability factors and internal pedagogical factors, and it evaluates AI-TPACK to reveal the educational needs of pre-service EFL teachers in China.

The present study offers theoretically grounded and data-driven insights on the behavioral intentions of Chinese pre-service EFL teachers concerning AI-based educational technology, as well as their emergent educational needs. The study contributes to the ongoing discourse about AI in education and improvements for preparing EFL teachers, which ultimately shapes the future of EFL teaching in China over the next few years.

1.3 Research Objectives

The main purpose of this study is to investigate the key factors that influence Chinese pre-service EFL teachers' behavioral intentions to adopt AI-based educational technologies and their AI-TPACK educational needs, and examine stakeholders' perceptions to inform effective EFL teacher preparation. It also aims to draw implications for policy making and curriculum that can enhance Chinese pre-service EFL teachers' preparation and EFL education in China.

Thus, the research objectives are:

RO1. To identify the factors that influence Chinese pre-service EFL teachers' behavioral intention to use AI-based educational technologies in their future EFL teaching practice.

RO 2. To explore the degree of influence and correlations among the identified factors.

RO3. To identify pre-service EFL teachers' AI-TPACK educational needs and examine stakeholders' perceptions to inform effective EFL teacher preparation for AI-assisted EFL teaching and learning.

1.4 Research Questions

Based on the objectives of the study, three research questions are formulated in the present study.

RQ 1. What are the factors that influence Chinese pre-service EFL teachers' behavioral intentions to use AI-based educational technologies in their future EFL teaching practice?

RQ 2. What are the degrees of influence and correlations of these factors?

RQ 3. How to prepare pre-service EFL teachers for AI-assisted EFL teaching and learning?

Sub-Research Question

SRQ3.1. What are the AI-TPACK educational needs of Chinese pre-service EFL teachers?

SQR3.2. What are the perceptions of administrators, ICT teachers, and in-service EFL teachers toward the use of AI-based educational technologies in EFL teaching and teacher preparation?

Unpacking these questions, this study builds on knowledge in both the UTAUT model and the TPACK framework.

1.5 Significance of Study

This study holds significant relevance and offers several key contributions to the fields of English language education, technology integration in English language teaching, and EFL teacher preparation, particularly within the context of China. As China places considerable emphasis on English language proficiency for global competitiveness, understanding the factors that influence the behavioral intentions of pre-service EFL teachers regarding AI-based educational technologies is crucial to foster pre-service EFL teachers' behavioral intentions to use AI in their future teaching practice. The study's findings can pave the way for the development of more effective and innovative EFL teaching practices, benefiting both EFL teachers and students. By shedding light on the factors that influence the intentions of pre-service EFL teachers in China to adopt AI-based educational technologies, this research can provide policymakers, curriculum developers, and EFL teacher educators with theoretically grounded and data-driven insights. These insights can help shape policies and curricula that align with the evolving educational landscape and better prepare future EFL teachers for the AI-rich digital age.

Understanding the educational needs of pre-service EFL teachers based on AI-TPACK can guide EFL teacher programs to be relevant, engaging, and ultimately contribute to the enhancement of teaching practices, ensuring that pre-service EFL teachers are adequately equipped with the technological, pedagogical, and content knowledge required to excel in their roles in AI-rich context, finally leading to improved educational outcomes. In addition, it can also contribute to pre-service EFL teachers' preparation and education in other higher education institutions in the country, and other Asian universities, particularly those that share a similar context. Similar context refers to linguistic, cultural, educational, socioeconomic, and global factors that are commonly shared among Asian countries.

Theoretically, this study contributes to the refinement of technology acceptance and competence models in the AI era by extending UTAUT and AI-TPACK to the context of AI-assisted EFL education. By empirically examining pre-service EFL teachers' acceptance and AI-TPACK competence development, this study provides

evidence for identifying additional determinants and potential moderators influencing AI adoption and pedagogical integration, thereby advancing theory on teacher technology use in AI-assisted language education.

In sum, this research not only addresses the unique educational and technological landscape of China but also provides valuable lessons and implications for the broader global education community. It contributes to the ongoing transformation of EFL education by unraveling the intricate relationship between pre-service EFL teachers, AI-based educational technology, and their educational needs, ultimately enhancing the quality of education and the preparedness of EFL teachers in the digital age.

1.6 Scope of the Study

The Scope of the present study is as follows: firstly, the research region and site. The study was conducted in Yunnan, a province in southwestern China, with a focus on pre-service EFL teachers in Chuxiong Normal University (CXNU).

Secondly, the participants were the students who were currently enrolled in the EFL teachers' program at CXN University. All the students majored in English Language education and enrolled from 2019 to 2024. This study focused on the perceptions of the pre-service EFL teachers regarding the adoption of AI-based educational technologies, and perceptions and experiences of in-service EFL teachers, the administrators of the EFL teachers' education program, and ICT teachers concerning AI-based educational technologies integration and EFL teacher preparation.

Thirdly, based on the UTAUT model and the TPACK framework, the research focused on the factors influencing the behavioral intentions of the pre-service EFL teachers to integrate AI-based educational tools, platforms, and applications in their future teaching practice. The study examined the educational needs of pre-service EFL teachers based on AI-TPACK, and the perceptions of administrators, ICT teachers, and in-service EFL teachers toward the use of AI-based educational technologies in EFL teaching and teacher preparation.

Fourthly, the present study did not test moderators (e.g. gender, age, experience voluntariness of use) in the UTAUT model.

Finally, the present research covered a specified duration of twelve months, running from January 2024 to January 2025.

1.7 Definition of Key Terms

The purpose of this part is to define the key terms that were used in the present study context.

1.7.1 Behavioral intention refers to the user's anticipated commitment to carry out plans and make decisions concerning technology use (Venkatesh et al., 2003). In the present study, behavioral intention refers to Chinese pre-service EFL teachers' plans and decisions regarding the use of AI-based educational technology in their future English language teaching practice. It can be determined by Performance Expectancy, Effort Expectancy, Social Influence, Facilitating Conditions, AIL-TK (AI Language Technological Knowledge) and AI-TPACK (AI Technological Pedagogical Content Knowledge) in previous studies.

1.7.2 AI-based educational technologies refer to AI-enabled digital tools, systems, and platforms that integrate artificial intelligence techniques such as natural language processing, speech recognition, and adaptive algorithms to support teaching and learning processes. In the present study, this term operationally denotes technologies that pre-service EFL teachers use or intend to use for instructional and learning-related purposes in English language education. These technologies include generative AI systems for language input, instructional support, and feedback, such as ChatGPT, Kimi, Wenxin Yiyan, Tongyi Qianwen, and Doubao; intelligent tutoring and speech-recognition-based systems that support pronunciation training and personalized learning, such as iFlytek, iFlytek Mars, Squirrel AI, and Liulishuo; AI-powered translation tools that assist comprehension and language mediation, including Youdao Translation and Baidu Translation; AI-supported language learning applications for vocabulary and skill development, such as BaiCiZhan and Shanbay English; and AI-supported learning management and smart classroom platforms that facilitate

instructional organization and classroom interaction, such as the Chaoxing Xuexitong Platform and the Seewo Whiteboard. Within this study, AI-based educational technologies are examined in terms of pre-service EFL teachers' acceptance and pedagogical integration rather than their underlying technical mechanisms.

1.7.3 Pre-service EFL teachers are individuals who are trained to teach English as a Foreign Language (EFL) but have yet to complete their professional training or certification. They enroll in teacher education programs where they receive instruction, guidance, and practical experience in teaching English to non-native speakers. In the present study, pre-service EFL teachers are Chinese student teachers currently enrolled in EFL teacher training program at CXNU from 2019 to 2024.

1.7.4 AI-TPACK educational needs analysis in the present study is based on the definition of Thornbury (2006), which is the process of specifying Chinese pre-service EFL teachers' educational needs regarding adoption of AI-based educational technologies in their teaching practice, considering the AI-TPACK model. Pre-service EFL teachers' self-assessed AI-TPACK knowledge was employed to examine their educational needs. Pre-service EFL teachers' AI-TPACK educational needs were determined by a 5-point Likert scale. The AI-TPACK educational needs ranging from the lowest needs ($M=4.21-5.00$) to the highest needs ($M=1.00-3.00$) which was developed based on previous studies (Chan and Tang, 2024; Ye et al., 2025) and the actual distribution of item mean scores obtained in the present study

1.8 Organization of the Dissertation

This dissertation consists of five chapters. Chapter one gives the overview of this study, the background of the study, the statement of the problems, the research objectives, the research questions, the significance of the study, the scope of the study, and the definition of key terms.

Chapter two presents the literature review on the relevant areas of the study. It centers around the following topics: AI policies and AI development in China, EFL teacher preparation in the AI age, factors influencing EFL teachers' behavioral intention, EFL teachers' TPACK- related study, systematic review of related studies

(2015–2024), AI-TPACK needs analysis, theoretical models and the research model, and a summary of the chapter.

Chapter three presents the research methodology used in this study. This begins with the research design of the study, and is followed by the research site, research participants, research instruments, research instrument translation, pilot study, data collection procedures, and data analysis. The ethical issues are also discussed in this chapter.

Chapter four reports the findings of quantitative research and qualitative research. Quantitative research findings begin with demographics of the participants, factor structure refining and measurement model development, descriptive statistics and reliability analysis, results of measurement model test, results of structural model testing, and AI-TPACK educational needs analysis. while the findings of the qualitative research include demographics of the interviewees, results of pre-service EFL teachers' interviews, in-service EFL teachers' interviews, administrator' Interview, and ICT teachers' interviews.

Chapter five provides a conclusion of the results and findings, a discussion of research findings, the theoretical Implications, the practical implications, the limitations of the study, and the recommendations for future research.

CHAPTER 2

LITERATURE REVIEW

This chapter presents a review of literature on the relevant areas of the current study. The review will focus on the following topics: AI policies and AI development in China (section 2.1), EFL teacher preparation in the AI Age (section 2.2), Factors influencing EFL teachers' behavioral intention (section 2.3), EFL teachers' TPACK-related study (section 2.4), AI-TPACK needs analysis (section 2.5), Systematic review of related studies (2015-2024) (section 2.6), theoretical models and the research model (section 2.7) and a summary of the chapter (section 2.8).

2.1 AI Policies and AI Development in China

In 2017, the Chinese government published the National Strategy for AI Development by the State Council, and the publication of this policy document, perhaps more than any other event in recent years, drew international attention to China's technological developments and encouraged the idea of a grand national strategy for global AI domination (Knox, 2020). The National Strategy for State AI Development outlines a long-term vision for AI talent development, focusing on building an AI academic discipline and establishing AI pilot institutes.

China's AI policy objectives are outlined in a document called New Generation Artificial Intelligence Development Plan (AIDP), which was scheduled by the State Council in July 2017. According to AIDP, the broad objective of this policy is to establish China as a leading center of AI innovation globally by 2030 and to utilize AI as a major engine for China's industrial modernization and economic transformation (State Council of the People's Republic of China, 2017). AIDP also emphasizes the importance of applying AI to a broader range of fields, including social development and defense, and the need to establish ethical guidelines and standards for its implementation. Overall, the plan offers a thorough AI strategy. The AIDP consists of three main stages, each with a set of goals that are summarized in Table 2.1.

Table 2.1 Summary of AIDP

Stage	Year	Aim
Stage 1	By 2020	● Keep competitiveness against other powers and improve the environment for AI development. - Establish a 150 billion yuan or more AI industry. ● Create the foundational moral guidelines, regulations, and policies for important AI fields.
Stage 2	By 2025	● Reach significant advancements in the core theory of AI and taking the lead globally in specific applications. ● Increase the value of the main AI industry to more than 400 billion yuan. ● Create and incorporate ethical guidelines and legal frameworks for AI.
Stage 3	By 2030	● Become a global innovation center for AI. ● It is anticipated that the AI market will grow to over double its current size to one trillion yuan. ● Upgrade laws and standards is also expected to face new emerging challenges.

In 2018, the Action Plan for Artificial Intelligence Innovation in Colleges and Universities was released. This policy aims to promote the innovation and application of artificial intelligence in education, utilizing smart technology to support innovation in talent training models, enhance teaching methods, and improve educational management capacity, thereby building a Smart, networked, personalized, and long-term education system (MEPRC, 2018a).

The policy also aims to support university teachers in popularizing artificial intelligence education and related research work in primary and secondary schools. It involves developing courses on artificial intelligence-related knowledge and skills in pre-service and in-service training for teachers, thereby cultivating their ability to implement intelligent education (MEPRC, 2018a), calling for AI development to build a strong country of education, a strong country of science and technology, and a smart society (MEPRC,2018a).

According to the White Paper on Artificial Intelligence Standardization (2018 edition) published by the China Electronics Standards Institute (2018), the seven primary AI technologies are machine learning, natural language processing, knowledge mapping, computer vision, human-computer interaction, biometric recognition, virtual reality, and augmented reality. To differing degrees, each is utilized in education; however, biometric recognition, machine learning, and natural language processing are employed more frequently (China Electronics Standardization Institute, 2018).

UNESCO (2019) adopted and published the Beijing Consensus on Artificial Intelligence and Education during the International Conference on Artificial Intelligence and Education. The consensus was the first international document in history to provide guidelines and proposals for the scientific application of AI technology, with the intention of incorporating this guidance into the 2030 Education Agenda (UNESCO, 2019). In the consensus segment of AI to empower teaching and teachers, it is proposed that “on Dynamically review and define teachers’ roles and required competencies in the context of teacher policies, strengthen teacher training institutions, and develop appropriate capacity-building programs to prepare teachers to work effectively in AI-rich education settings (UNESCO, 2019, p. 5).” The policies reviewed in this part are shown in the following table (see Table 2.2).

Table 2.2 Summary of Policies Reviewed

Issue Year	Policy	Issuer
In 2017	New Generation Artificial Intelligence Development Plan’ (AIDP)	The State Council
In 2018	Action Plan for Artificial Intelligence Innovation in Colleges and Universities	The State Council
In 2018	White Paper on Artificial Intelligence Standardization 2018	China Electronics Standardization Institute
In 2019	Beijing Consensus on Artificial Intelligence and Education	UNESCO

In 2016, China's Ministry of Education mandated that the education sector of local governments set aside a minimum of 8% of their budget for digitalizing education.

The nation is prepared for the largest digital education experiment in history, with 95% of schools having Internet access (Pedro et al, 2019). Currently, popular AI applications such as DingTalk Future Campus, Tencent Smart Campus, and Baidu Smart Classroom are offered by internet giants like Alibaba, Tencent, and Baidu, respectively. In addition to AI testing platforms like SenseStudy and Robot Rover Mini/Pro, smart hardware products like machine translation and machine learning are offered by AI companies like iFLYTEK and SenseTime. AI education platforms, such as N-Brain AI Learning Platform, AI Classroom Teacher, Adaptive Tutoring K-12 AI application, Uni smart learning system, Hitalk Oral English Classes, etc., have been developed by education technology companies like New Oriental Education, Squirrel AI Smart Adaptation Education, and Hujiang Education (Li, 2023). The education community has commended the Chinese government for making AI in education a national strategy.

These national AI policies and development efforts show China's strategic commitment to adopting artificial intelligence to education. However, turning the policy goals into classroom practice is ultimately dependent on teachers' professional capacity. This shift foregrounds the critical role of EFL teacher preparation in the AI age, as discussed in the following section.

2.2 EFL Teacher Preparation in the AI Age

Normal universities and teachers' colleges in China are primarily responsible for preparing elementary and secondary school teachers. Students majoring in English education in these institutions are expected to become EFL teachers upon graduation, usually through four-year bachelor's programs. Most EFL pre-service teachers acquire their technological and pedagogical knowledge within these programs. Scholars have emphasized that strong competence in computer applications is crucial for EFL teacher preparation (Anderson & Nunan, 2003; Marinova-Todd et al., 2001).

Yang et al. (2004) surveyed over 3,000 teachers across ten provinces and revealed that teacher education programs fail to meet the ICT demands of schools. Moreover, Zhong et al. (2003) argued that ICT courses in EFL pre-service teacher education are largely marginalized. The study of Wu (2002) found that limited or no

specialization in ICT-integrated teaching. The few available courses, such as Public Computer Basics, Computer Application, Internet Technology, and Educational Technology, which are general and disconnected from the EFL teaching context. Even though some universities have started offering courses that integrate technology and EFL instruction, they continue to be marginal (Zhong et al., 2003). The limited availability of TPACK-centered practice in EFL pre-service teacher education is underscored by the persistent gap between technology and pedagogy. Nevertheless, that research suggested that the technology knowledge of EFL pre-service teachers in China is still inadequate.

Regarding AI integration and teacher preparation. Guan et al. (2025) carried out a qualitative study involving 24 pre-service teachers and found that: (1) these teachers tend to use AI only when necessary, (2) they require deeper knowledge of AI principles and ethical considerations for its effective integration in education, and (3) they largely perceive AI as a mere tool rather than an active educational collaborator. The results highlight the need to raise awareness of how teachers' roles and responsibilities may evolve in AI-enhanced learning environments, emphasizing the importance of targeted training programs to support teachers' success in AI-integrated education. Similarly, Edmett et al. (2024) reported that worldwide teacher education and ongoing professional development (CPD) programs are generally insufficient for enhancing teachers' digital literacy skills. This longstanding deficiency makes equipping teachers to work with AI a significant challenge. According to Moorhouse and Kohnke (2024), many teachers are unable to deal with the impacts of AI owing to a lack of confidence and competence. Therefore, teacher training and preparation are necessary. Ismail et al. (2024) conducted a systematic review and put forward several approaches to prepare teachers for the AI era, including developing AI literacy, providing educational opportunities. And suggested that teacher training institutions integrate fundamental training of AI applications for instruction into the teacher education programme. Similarly, Fujieda (2025) proposed redesigning English teacher preparation programs in Japan as a result of the widespread use of artificial intelligence (AI) in language instruction. Also, advocate for developing courses on educational technology regarding AI integration to generate informed perspectives and develop important competencies. Moreover, Pokrivčáková (2019) proposed a framework to better equip foreign

language teachers for the integration of AI-powered tools, highlighting their potential to simplify teaching, reduce workload, and enhance effectiveness. The study further called for a reconsideration of the established requirements for CALL educators in the context of artificial intelligence and the evolving landscape of language teacher education.

EFL teacher preparation in China has traditionally emphasized general pedagogical and technology-related training, yet courses explicitly connecting technology with English language teaching have remained peripheral (Wu, 2002; Zhong et al., 2003). Consequently, many graduates enter the profession with inadequate ICT and digital pedagogy skills, a weakness that has long hindered their ability to respond to the technological needs of elementary and secondary schools (Yang et al., 2004). With the shift from basic ICT integration to AI-enhanced learning environments, this longstanding problem has become more pressing, as pre-service teachers often view AI as a supplementary tool, lack confidence in its pedagogical use, and demonstrate limited awareness of its principles and ethical implications (Guan et al., 2025). International research reinforces these concerns, showing that teacher education and professional development programs worldwide remain insufficient for preparing teachers to navigate the challenges of AI integration (Edmett et al., 2024; Kohnke et al., 2023; Moorhouse & Kohnke, 2024). Although the Ministry of Education in China launched actions like the *Education Informatization 2.0 Action Plan* (MEPRC, 2018b) and included AI in the *New Generation Artificial Intelligence Development Plan* (State Council of the People's Republic of China, 2017). Both plans underscore the importance of training teachers who are digitally competent and ready for AI. However, the implementation of these plans in EFL teacher preparation programs is still inconsistent and fragmented. Scholars have advocated for reforms—including the incorporation of AI literacy, the integration of AI-based educational technology courses, and a redesign of curricula to meet the changing demands of the AI age (Fujieda, 2025; Ismaill et al., 2024; Pokrivčáková, 2019), yet policy goals persistently exceed the realities of teacher preparation. Without a systematic restructuring of teacher education programs, the gap between national AI goals and classroom practice will remain, limiting AI's transforming potential in English language education.

2.3 Factors Influencing EFL Teachers' ICT Acceptance

2.3.1 International Context

The adoption of technology in English as a Foreign Language (EFL) teaching has been the focus of research in the past few decades. The Unified Theory of Acceptance and Use of Technology (UTAUT) has been a widely used model to examine technological adoption in various fields, and there is no exception for EFL teaching. This part aims to investigate recent studies on factors that influence technology adoption in EFL teaching by using the UTAUT model both in China and internationally. Many studies have examined factors that influence technology adoption in EFL teaching using the UTAUT model in the past few decades. For example, a study by Koral and Akay (2017) measured the technology acceptance level of teachers by using the Unified Theory of Acceptance and Use of Technology in English Language teaching. The study included performance expectancy, effort expectancy, attitude towards using technology, social influence, facilitating conditions, self-efficacy, and anxiety as the predictors for teachers' technology acceptance level. The results revealed that participants in this study had an above-average level of technology acceptance. Hence, Mohammad-Salehi et al. (2021) investigated factors that influence EFL teachers' adoption of Web 2.0 Technologies by extending the UTAUT model with TPACK as a construct. The study's findings showed that the behavioral intention (BI) of EFL teachers to use Web 2.0 technologies was positively and directly impacted by two factors: performance expectancy (PE) and social influence (SI). Nevertheless, TPACK and effort expectancy (EE) had no discernible effects on BI. It was also discovered that the real use behavior (UB) of Web 2.0 technologies was positively and directly impacted by facilitating conditions (FC) and behavioral intention (BI). Moreover, TPACK demonstrated a strong impact on EE and PE. This study adds significantly to the understanding of technology acceptance, especially when considering how Web 2.0 technologies are being adopted by EFL teachers in Iran.

Similarly, Wen and Hua (2020) conducted a study in the Malaysian context to investigate ESL teachers' intention in adopting online educational technologies during the COVID-19 pandemic. They found that many factors surfaced that affected teachers'

intention to adopt online educational technologies. Teachers' self-perceived ICT competence and accessibility to infrastructure and online resources were strongly correlated with teachers' behavioral intention, whilst the suitability of the working environment was moderately correlated with teachers' behavioral intention. Amongst all the factors, the accessibility to infrastructure and online resources are the most important factors that determine teachers' intention to adopt online educational technologies.

Moreover, the study conducted by Önalán and Gökçe (2020) focused on exploring the perceptions of 70 university-level Turkish EFL teachers regarding technology integration in their teaching practices. The factors examined in the study were teachers' knowledge about computer software programs, personal computer-use habits, attitudes toward and self-confidence in integrating computer-based technologies into teaching, and their views about school climate and support. Participants have positive attitudes toward using technology in their teaching, they have a high level of self-confidence in integrating technology into their teaching, they enjoy a positive school climate among colleagues, but they see limited support from administration, especially in terms of technological infrastructure and instructional encouragement. In the same vein, Raygan and Moradkhani (2022) examined the variables affecting technology integration in the context of Iranian EFL. The goal of the study is to determine whether the attitudes, TPACK, and school climate of EFL teachers have an impact on their ability to successfully integrate technology into their lessons. The findings showed that attitude and TPACK are important predictors of technology integration. It was verified by looking at the indirect path coefficients that teachers' attitudes, through a mediating role in school climate, predict technology integration. The theory utilizes independent variables and dependent variables, and findings are concluded in Table 2.3.

Table 2.3 Detailed Information of Reviewed Articles

Article	Theory	Participants	IV	DV	Findings
Koral and Akay (2017)	the UTAUT model	Lecturers at Anadolu University School of Foreign Languages	performance expectancy, effort expectancy, attitude towards using technology, social influence, facilitating conditions, self-efficacy, anxiety	technology acceptance level of teachers	The findings revealed that participants were above average level of technology acceptance.
Wen and Hua (2020)		Malaysian ESL teachers	Teachers' self-perceived ICT competence, accessibility to infrastructure and online resources, the suitability of working environment	ESL teachers' intention in adopting online educational technologies	Teachers' intention to utilize online educational technology is primarily determined by their access to infrastructure and online resources.
Önalın and Gökçe (2020)		university-level Turkish EFL teachers	Teachers' knowledge about computer software programs, personal computer-use habits, attitudes toward integrating computer-based technologies and self-confidence integrating computer-based technologies school climate, support.	computer-based technologies integration	Teachers' concerns and attitudes towards technology primarily focus on personal and informational issues, with modest technology-mediated teaching behaviors. Positive beliefs about technology integration led to increased task intensity, impact concerns, and technology-mediated teaching behaviors.

Table 2.3 (continued)

Article	Theory	Participants	IV	DV	Findings
Mohammad-Salehi et al (2021)	extending the UTAUT model with TPACK as a construct	Iranian EFL teachers from private language institutes	performance expectancy (PE), social influence (SI), effort expectancy (EE), Behavioral intention (BI), the real use behavior (UB), TPACK	EFL teachers' adoption of Web 2.0 Technologies	1) Performance expectancy (PE) and social influence (SI) had a favorable and direct influence on EFL teachers' behavioral intention (BI) to adopt Web 2.0 technologies. 2) There were no significant impacts of effort expectancy (EE) or TPACK on BI. 3) Facilitating conditions (FC) and behavioral intention (BI) had a beneficial and direct influence on the real use behavior (UB) of Web 2.0 technologies. 4) TPACK had a significant influence on PE and EE.

Table 2.3 (continued)

Article	Theory	Participants	IV	DV	Findings
Raygan and Moradkhani (2022)		Iranian EFL teachers	attitudes, TPACK, and school climate	Technology integration	1) Attitude and TPACK are significant factors of technology integration. 2) Teachers' attitudes, which play a moderating role in school climate, predict technological integration.

Internationally, some scholars are inclined to utilize the UTAUT model and TPACK model to examine factors influencing EFL teachers' intentions or actual use behavior to accept technology, and other scholars try to explore the factors by situating their study in their own contexts. Therefore, apart from the variables based on the UTAUT model and TPACK, contextual variables are added, including attitude towards using technology, self-efficacy, anxiety, Teachers' self-perceived ICT competence, accessibility to infrastructure and online resources, the suitability of working environment, teachers' knowledge about computer software programs, personal computer-use habits, attitudes toward integrating computer-based technologies, and self-confidence in integrating computer-based technologies, school climate, and support.

In summary, these studies advance the knowledge of the factors affecting the acceptance and integration of technology in EFL instruction by addressing a range of issues related to technology acceptance, purpose, and actual use in diverse cultural and educational contexts.

2.3.2 Chinese Context

In the Chinese EFL teaching context, extensive research focused on exploring the factors that influence EFL teachers' technology adoption has been conducted in the past few decades. These studies shed light on the attitudes, pedagogical beliefs, concerns, and intentions of EFL teachers towards technology, as well as the contextual

and cultural factors that shape the technology adoption and usage in China. To start with, the study by Yang and Huang (2008) highlights the limited adoption of technology in EFL teaching despite the growing pressure to integrate it into educational practices. The findings reveal that teachers' concerns and attitudes towards technology primarily revolve around personal and informational issues, and their technology-mediated teaching behaviors remain modest, with most teachers using technology for preparing activities rather than structuring higher levels of usage in their classrooms. Positive higher levels of computer training, literacy, a well-supported school environment, creative teaching practices, and positive beliefs about technology integration led to higher task intensity, impact concerns, and more technology-mediated teaching behaviors. The research emphasizes the importance of addressing teachers' concerns and providing support and training to enhance technology integration in EFL classrooms. Likewise, Liu et al. (2017) explore the influence of teachers' pedagogical beliefs on technology adoption in the university-level EFL context. The study demonstrates that constructivist-oriented pedagogical beliefs positively influence teachers' perceptions of technology's usefulness, ease of use, and attitude towards technology adoption. On the other hand, transmissive-oriented beliefs did not significantly affect teachers' attitudes towards technology. This research underscores the significance of constructivist approaches in promoting technology integration in EFL teaching.

Mei et al. (2018) explored the variables influencing the intention of pre-service EFL teachers to use Web 2.0 technologies for language learning. The technological pedagogical content knowledge model and the technology acceptance model were incorporated into the research model, revealing that facilitating conditions play a crucial role in teachers' intention to use CALL 2.0. Teo et al. (2019) investigated predictors of pre-service teachers' use of Web 2.0 technologies for teaching purposes and discovered that they perceived usefulness, perceived enjoyment, subjective norm, technological pedagogical and content knowledge, and facilitating conditions had statistically significant direct effects on intention to use Web 2.0 technologies. Similarly, Teo et al. (2018) conducted a study to assess the intentions of English teachers in China to use technology in the classroom. To investigate relationships among these variables, eight variables were included based on the technology acceptance model: perceived

usefulness (PU), perceived ease of use (PEU), attitude toward use, behavioral intention (BI), computer self-efficacy (CSE), technology complexity (TC), facilitating conditions (FC), and constructivist teaching beliefs (CTB). A self-report questionnaire was used to collect data from 183 English professors at five Chinese universities, which were then analyzed using a structural equation model. The results showed that the proposed model is a good fit. Three factors, PU, FC, and CTBs, were discovered to be significant predictors of attitude toward usage, although PEU and TC were not. Furthermore, PU, CSE, and CTBs are significant antecedents for teachers' BIs to use technology. Huang et al. (2019) investigate the attitudes of Chinese EFL teachers towards technology use and identify factors influencing their technology acceptance. The study emphasizes the importance of facilitating conditions, perceived usefulness, subjective norm, and technology mania in encouraging technology adoption. The research offers a deeper understanding of technology acceptance theories and contextual factors in China, contributing to the promotion of technology integration in EFL teaching.

Finally, Zhang and Chen (2022) delve into the interactions between teacher internal variables (TPACK, affective attitudes, evaluative attitudes) and technology usage in EFL teaching. The study reveals the positive influence of TPACK and evaluative attitudes on technology use, with facilitating conditions playing a crucial role in encouraging technology adoption. This research advances our comprehension of technology acceptance in the EFL context, especially regarding the impact of teachers' pedagogical beliefs. The details of the reviewed articles were shown in Table 2.4.

Table 2.4 Summary of Empirical Studies on Technology Integration and Acceptance among EFL Teachers in China

Article	Theory	Participants	IV	DV	Findings
Yang and Huang (2008)		high school English teachers	teachers' behavior, concerns and beliefs	Integrating information technology	Teachers' concerns and attitudes towards technology primarily focus on personal and informational issues, with modest

Table 2.4 (continued)

Article	Theory	Participants	IV	DV	Findings
					technology-mediated teaching behaviors. Positive beliefs about technology integration lead to increased task intensity, impact concerns, and technology-mediated teaching behaviors.
Liu et al. (2017)		Tertiary EFL teacher	constructivist-oriented pedagogical beliefs, transmissive-oriented beliefs	technology adoption	The study found that constructivist-oriented pedagogical beliefs have a positive impact on teachers' judgments of technology's usefulness, ease of use, and attitude toward technology adoption.
Mei et al. (2018)	The TPACK framework and the TAM	Pre-service EFL teachers	Perceived usefulness, Perceived ease of use, CALL 2.0 self-efficacy, Subjective norms, Facilitating conditions, Technological pedagogical and content knowledge,	the intention of preserving EFL teachers to use Web 2.0 technologies	intention to use CALL 2.0 was predicted most strongly by facilitating conditions

Table 2.4 (continued)

Article	Theory	Participants	IV	DV	Findings
Teo et al. (2019)	The TPACK framework and the TAM	pre-service teachers	perceived usefulness, perceived enjoyment, subjective norm, technological pedagogical and content knowledge, facilitating conditions	Pre-service teachers' intention to use Web 2.0 technologies	perceived usefulness, perceived enjoyment, subjective norm, technological pedagogical and content knowledge, and facilitating conditions had statistically significant direct effects on intention to use Web 2.0 technologies
Teo et al. (2018)	the TAM model	Tertiary EFL teacher	perceived usefulness (PU), perceived ease of use (PEU), attitude toward use, behavioral intention (BI), computer self-efficacy (CSE), technology complexity (TC), facilitating conditions (FC), and constructivist teaching beliefs (CTBs)	intentions of English teachers in China to use technology	Three factors, PU, FC, and CTBs, were found to be significant predictors of attitude toward usage, but PEU and TC were not. Furthermore, PU, CSE, and CTBs are important predictors of instructors' BIs for technology.
Huang et al. (2019)	the TAM model	Tertiary EFL teacher	facilitating conditions, perceived usefulness, subjective norm, and technology mania, policy influence	technology acceptance	The study emphasizes the importance of facilitating conditions, perceived usefulness, subjective norm, and technology mania in encouraging technology adoption.

Table 2.4 (continued)

Article	Theory	Participants	IV	DV	Findings
Zhang and Chen (2022)	The TPACK framework	Tertiary EFL teacher	TPACK, affective attitudes and evaluative attitudes	F2F instruction technology use Online instruction technology use	The study demonstrates that TPACK and evaluative attitudes have a positive effect on technology use, with facilitating conditions playing a crucial part in increasing technology adoption.

Chinese scholars prefer to use the TAM model and TPACK framework as theoretical bases for exploring technology acceptance in EFL education; the gap lies here that the UTAUT model is rarely used. Pre-service EFL teachers and tertiary teachers are the main participants of the research. Some of the researchers explored factors that are contextualized in China, including teachers' concerns and beliefs, constructivist-oriented pedagogical beliefs, transmissive-oriented beliefs, CALL 2.0 self-efficacy, computer self-efficacy (CSE), technology complexity (TC), technology mania, policy influence, affective attitudes, and evaluative attitudes. In China, researchers involved in technology acceptance studies are quite centralized, so more researcher comes from different backgrounds with different research experiences are called for. Overall, the studies collectively highlight the complexities of technology adoption in EFL teaching in China. While teachers generally recognize the potential benefits of technology, various factors, such as concerns, attitudes, pedagogical beliefs, and facilitating conditions, influence their actual use of technology in the classroom. Policymakers, educators, and teacher educators must consider these findings to design effective strategies and support systems for enhancing technology integration in EFL classrooms. By recognizing the complexities of technology adoption and considering the specific contextual factors in China, stakeholders can develop effective strategies to promote successful technology integration in EFL classrooms, ultimately benefiting both teachers and students.

In brief, a review of literature internationally and in the Chinese context reveals that factors relating to technology use in EFL teaching have been well documented. However, only a few studies have been conducted with Chinese pre-service EFL teachers. Although the UTAUT model is popularly used internationally, it is rarely used in China to explore technology acceptance in EFL education. To fill the gaps in the literature, the present study focuses on pre-service EFL teachers' intentions to use AI-based educational technology in their future teaching, combining the UTAUT model and the TPACK framework to examine factors that influence their behavioral intentions.

2.4 EFL Teachers' TPACK- Related Study and Needs Analysis

The term "analysis of needs" originated in India during the 1920s (West, 1994). Subsequently, in the late 1960s, it resurfaced in connection with the emerging interest and development of English for specific purposes, where needs analysis became an essential tool. During the early 1970s, these types of studies gained prominence and have since evolved to address inquiries concerning the adaptation of teaching methods to suit the learning audience and the training of learners in effective learning strategies (West, 1994). Needs analysis studies (NASs) also aim to uncover the appropriate learning needs, goals, desires, and limitations within each context, as well as identify suitable learning strategies and materials. Initially, external researchers conducted NASs without considering the opinions and knowledge of those directly involved in educational programs (Cano et al., 2023). However, this approach began to be problematized by perspectives such as Jasso-Aguilar (1999) highlighted the value of insiders' perspectives in needs analysis (NA). Jasso-Aguilar (1999) further asserted that insiders, being directly involved, provide valuable insights for program improvement that go beyond what external auditors can offer. According to Thornbury (2006), needs analysis is the process of specifying the learner's needs before designing a course; learners' attitudes, expectations, and preferred learning/teaching styles can also feed into the overall analysis. And the analysis can be used to inform both the content of the course, including syllabus and materials, and the methodology.

2.4.1 EFL Teachers' TPACK- Related Study in the International Context

Globally, EFL teachers' professional development has been explored in various contexts and cultures. A study on a professional development program for incorporating technology into EFL classrooms was carried out by Ansyari (2015). The program enhanced English lecturers' TPACK through the TPACK framework, active engagement, authentic collaborative experiences, and comprehensive support. Furthermore, positive participant feedback and increased TPACK scores were observed post-program, confirming the effectiveness of the technology integration-focused professional development.

Similarly, Turgut (2017) conducted a study to compare TPACK levels among teacher-candidates, pre-service, and in-service EFL teachers in Turkey. The analysis of both quantitative and qualitative data unveiled notable distinctions among these groups. The study underscores the significance of fostering PCK and TCK for successful technology integration. Furthermore, the research indicates that limited direct teaching experience hampers prospective teachers' effective utilization of technology in instruction (Turgut, 2017). Furthermore, Bostancioğlu and Handley (2018) crafted and validated a questionnaire to assess the "Total PCK" (TPACK) for English as a Foreign Language (EFL). This questionnaire has garnered broad adoption by numerous researchers within the EFL domain.

Drajati et al. (2018) undertook a study focusing on the perception and adoption of TPACK literacy by both pre-service and in-service teachers. Utilizing qualitative research, the study collected data from questionnaires distributed among 100 pre-service and in-service teachers. The outcomes of the study encompass the TPACK literacy of teachers, highlighting three key facets: Pedagogical Content Knowledge for Multimodal Literacy, Technological Pedagogical Knowledge (21st Century Learning), and Knowledge about digital media tools. The research's implications provide insights and alternative pathways for implementing the TPACK model within English classrooms. Furthermore, it underscores the potential benefits for enhancing the professional development of English teachers in the future.

Nazari et al. (2019) investigated differences in the perception of Technological Pedagogical Content Knowledge (TPACK) and its impact on professional development between novice and experienced Iranian EFL teachers. The results of the quantitative

analysis showed that the pedagogical knowledge and pedagogical content knowledge subscales were significantly higher for experienced teachers. On the other hand, novice teachers scored higher overall in TPACK, technological pedagogical knowledge, technological content knowledge, and technological knowledge. Qualitative results showed that novice and experienced EFL teachers had different preferences for customized professional development programs. Furthermore, both groups emphasized how working together in professional development courses can improve knowledge. Similarly, Fuad et al. (2020) explored Indonesian language teachers' Technological Pedagogical Content Knowledge (TPCK) and their readiness for online learning during the COVID-19 outbreak. Conducted in Lampung, Indonesia, the survey involved 318 teachers. Quantitative and qualitative analyses of questionnaires revealed that teachers adapted well to online learning, utilizing diverse technological tools and platforms. While most teachers demonstrated positive TPCK towards online learning, some senior teachers struggled with technology integration, resulting in monotonous classes. The research findings can inform policymakers to enhance the learning system.

In conclusion, the collective exploration of EFL teachers' professional development across diverse countries, utilizing various research methods, and involving distinct research subjects has yielded valuable insights into the integration of technology in language education. Ansyari's (2015) study showcased the effectiveness of a technology-focused professional development program in enhancing English lecturers' TPCK. Turgut's (2017) investigation highlighted the role of pre-service, in-service, and formation programs in influencing EFL teachers' perceptions of TPACK, underscoring the significance of pedagogical and technological knowledge. Bostancıoğlu and Handley (2018) contributed by designing a questionnaire to assess TPACK, aiding researchers in gauging EFL teachers' readiness for technology integration. Dražati et al. (2018) delved into the adoption of TPACK literacy by pre-service and in-service teachers, identifying crucial dimensions such as Pedagogical Content Knowledge, Technological Pedagogical Knowledge, and Knowledge about digital media tools. Nazari et al. (2019) exploration of novice and experienced EFL teachers' perceived TPACK disparities and their impact on professional growth brought forth divergent preferences for tailored professional development. Lastly, Fuad et al.

(2020) delved into the readiness of Indonesian language teachers for online learning, revealing a range of adaptive strategies amidst technology integration challenges.

2.4.2 EFL Teachers' TPACK-related Study in China

Several studies have meticulously examined EFL teachers' Technological Pedagogical and Content Knowledge (TPACK), focusing on the seven variables (Technological Knowledge, Content Knowledge, Pedagogical Knowledge, Technological Pedagogical Knowledge, Pedagogical Content Knowledge, Technological Pedagogical Content Knowledge, and Technological and Pedagogical Content Knowledge). Cheng (2017) conducted a survey to examine Taiwanese native language teachers' Technological Pedagogical and Content Knowledge (TPACK). 172 in-service Hakka language teachers participated in the study and provided their opinions on TPACK. Seven TPACK framework components were covered in the questionnaire. The results showed that although native language instructors were generally satisfied with their TPACK, their confidence levels in Content Knowledge (CK), Technological Knowledge (TK), and Technological Pedagogical Knowledge (TPK) were relatively modest. Moreover, the duration of teaching experience correlated positively with the teachers' perceived levels of Content Knowledge (CK), Pedagogical Knowledge (PK), and Pedagogical Content Knowledge (PCK) (Cheng, 2017).

In the study conducted by Zhou et al. (2022), researchers examined potential differences in the availability of professional development (PD) opportunities for English as a Foreign Language (EFL) teachers based on their years of experience in foreign language teaching. The investigation employed semi-structured interviews with 60 primary EFL teachers from seven primary schools in a medium-sized urban school district in China. The research employed descriptive statistics and multiple Chi-square tests for analysis. Surprisingly, the findings revealed that more experienced primary EFL teachers exhibited less technological pedagogical knowledge, contradicting the conventional notion that experienced teachers possess superior teaching expertise. Consequently, the study recommends comprehensive technology-focused PD training for EFL teachers in China, regardless of their teaching experience, to enhance their instructional capabilities.

In a more recent study, Huang and Xie (2022) investigated the Technological Pedagogical and Content Knowledge (TPACK) of Chinese EFL teachers in using

interactive whiteboards (IWBs). The research utilized surveys and multi-case interviews involving secondary school EFL teachers. The findings showed that Chinese EFL teachers generally considered themselves proficient in TPACK, with content knowledge ranking highest (5.545) and technological knowledge ranking lowest (5.147). Interestingly, teachers with higher professional titles perceived their TPACK as lower. Challenges in implementing IWBs in English teaching included limited self-efficacy, traditional teaching beliefs, inadequate technical support and training, deficiencies in IWBs for English instruction, and time constraints. The study contributes to technology adoption literature and underscores the need for tailored training to enhance teachers' TPACK. Policymakers and educational institutions should address non-teaching responsibilities to facilitate sustained technology integration in English teaching.

In Summary, the reviewed studies as a whole advance our knowledge of TPACK among Chinese EFL teachers. They draw attention to how complex TPACK is and how it affects professional development, student learning, and teaching methods. The results highlight the need for continuous professional development, cooperative learning environments, and specialized assistance to bridge the knowledge gaps and successfully incorporate technology into EFL teaching settings.

2.4.3 EFL Teachers' Needs Analysis

In the transformed educational context in the post-pandemic era, the role of teachers is disrupted (Barron et al., 2021). In this context, understanding and addressing the professional development needs of EFL teachers worldwide have gained significant importance. This exploration delves into the multifaceted landscape of EFL teaching, aiming to identify the diverse and evolving professional development needs of EFL educators across the globe. By examining these needs, to gain an in-depth understanding of EFL teachers' professional development needs in different countries and contexts, and to identify the gap in the specific field.

The study of Moncada et al. (2002) investigated the needs of English as a Foreign Language (EFL) teachers in Medellín, Colombia, through qualitative methods involving public and private school teachers. The research reveals three distinct domains of their professional lives where needs arise: as workers, instructors, and learners. The prevalent focus on their role as instructors has led to neglecting the

significance of the other domains. The study emphasizes EFL teachers' preference for holistic professional development programs that encompass all three areas and calls on teacher educators to explore ways to address these needs effectively.

Wall (2008) conducted a case study focused on the support needs of Thai high-school English as a Foreign Language (EFL) teachers in terms of language proficiency and teaching methodology. The study used semi-structured interviews and questionnaires to explore teachers' expressed needs, and a Teaching Knowledge Test (TKT) and language scores from interviews to assess their observed needs. Despite having good resources, the teachers desired further in-service training. Interestingly, the study revealed that the teachers had noticeable needs they were unaware of, particularly related to English proficiency and communicative lesson planning. The findings highlight the importance of not solely relying on teachers' self-reported needs, as objective needs-assessment methods are also essential. In the same year, Igawa (2008) delved into the professional development needs of Japanese and Korean EFL (English as a Foreign Language) teachers through an open-ended questionnaire. It operated under the premise that teachers, being professionals, require ongoing growth through various developmental processes. The research included 44 teachers from Japan and Korea, both non-native (38) and native (6) English speakers, participating in an international PD seminar in Tokyo. The findings revealed several perceived needs, encompassing teaching methods, language improvement (for non-native speakers), communication skills, motivation, and more. These challenges are context-specific, rooted in factors like students, parents, school environment, curriculum, and society, yet many of these challenges are common among EFL practitioners across different countries. Zein (2017) conducted a research study examining the viewpoints of educators and teacher trainers regarding the professional development requirements of primary English as a Foreign Language (EFL) teachers. The research puts forth a framework for tailored professional development aimed at primary EFL teachers. This framework incorporated elements such as the profiles of EFL teachers, their needs, and the distinct nature of their professional context.

Soodmand and Doosti (2017) conducted a study focusing on the professional development (PD) needs of Iranian English teachers using questionnaires and interviews. It revealed that conventional methods like one-shot workshops and self-

study dominated PD delivery, which didn't align with teachers' preferred interactive and collaborative methods, such as workshops, online learning, and peer observation. The research led to a designed implementation of interactive PD activities. The findings underscore the importance of identifying teachers' actual PD needs through needs analysis, highlighting the significance of interaction and technology for effective teacher education. It emphasizes the need for adapting in-service courses to contemporary educational changes and the role of teachers in seeking continuous professional development to stay relevant in a changing world. Oudah and Altalhab (2018) examined the perceptions and needs of Saudi English as a Foreign Language (EFL) teachers regarding training programs within Saudi Arabia. The research involved 215 EFL teachers who completed a semi-structured questionnaire, with 10 of them also participating in interviews. The study's key findings indicate a positive attitude among Saudi EFL teachers towards training programs, recognizing their effectiveness in addressing various needs, such as teaching aids, assessment strategies, and classroom activities to support language development. However, the teachers also expressed a demand for training specifically related to teaching English at the primary school level and highlighted the importance of having well-qualified trainers. The study closes by suggesting implications and recommendations based on its outcomes.

Derakhshan et al. (2020) explored the connection between teachers' Continuing Professional Development (CPD) needs, views of research, and their perceived success among 177 Iranian English as a Foreign Language (EFL) teachers. Participants completed three questionnaires, assessing their CPD needs, views of research, and perceptions of successful teaching characteristics. Both Pearson correlation and Structural Equation Modeling (SEM) results indicated a positive and significant relationship between teachers' success, their views of research, and CPD needs, including sub-components. This suggests that successful EFL teaching is associated with positive attitudes towards research and attention to CPD needs. The study recommends that EFL teachers enhance their research literacy through various means, like research training and participation in related events. It also encourages teacher educators to tailor professional development programs to address specific needs within their educational context, thereby preparing effective teachers capable of navigating the challenges of the classroom. Assalahi (2021) explored EFL teachers' perceptions of

their professional development needs assessment concerning the professional standards for English Language teachers in Saudi Arabia. The research employed a descriptive design with convenience sampling and included 65 EFL teachers from public schools. A self-administered online questionnaire with 14 questions and 88 items was used to assess teachers' awareness of the standards, their professional development preferences, and identified needs. The findings indicated strong interest in both formal and informal professional development activities, with teachers agreeing that professional development improves teaching and learning. Lack of time was noted as a hindrance to engaging in professional development. Teachers recognized the usefulness of professional standards for planning their development and identified key competencies for their professional growth. The study underscores the importance of acknowledging challenges to engagement in professional learning and suggests considering factors that enable or discourage teachers from pursuing their development goals. It concludes by emphasizing the utility of using professional standards as a framework for teachers' professional development needs assessment and offering insights for future research and PD support.

Poonpon (2021), conducted by Thailand TESOL, examined the professional development needs of English language schoolteachers in Thailand. The research involved 4,220 participants and employed an online questionnaire distributed through various methods. The questionnaire addressed demographic data as well as the needs of teachers regarding pedagogical development, technological advancement, knowledge and skill development, and future participation in Thailand TESOL activities. The mean, standard deviations, percentages, and content analysis were all used in the data analysis. The results showed that while grammar and vocabulary needed less improvement, teachers needed to improve speaking, listening, pronunciation, and cross-cultural communication. Pedagogical skills such as creative material development, teaching methodologies, and technology-based learning were also identified as crucial areas for development. The study shed light on the most popular training forms, types, lengths, and channels for career advancement. To meet the needs of teachers and improve English language instruction in Thailand, the results guide policymakers, training organizations, and Thailand TESOL.

In a recent study by Ngo et al. (2023), they undertook a phenomenological

investigation to explore the perceived needs for professional development (PD) among Vietnamese tertiary English as a foreign language (EFL) teachers. Anchored in the principles of andragogy theory, the research revealed that EFL educators emphasized a strong need for content-focused, ongoing, collaborative, and career-stage-specific PD activities in the future.

In examining the collection of studies, it is evident that they collectively contribute to our understanding of English as a Foreign Language (EFL) teachers' professional development needs, perceptions, and preferences across diverse contexts. The studies encompass a variety of topics, methodologies, and research subjects, shedding light on the multifaceted nature of EFL teacher development needs.

In terms of research topics, the studies delved into various dimensions of EFL teachers' professional development needs. Some studies focused on identifying specific areas of improvement, such as language proficiency, pedagogical skills, and technological literacy. Others examined teachers' perceptions of successful teaching, attitudes toward research, and preferences for training designs and approaches. Additionally, studies highlighted the role of professional standards and their alignment with teachers' development needs.

Methodologically, the studies employed different approaches, including qualitative methods such as interviews (Moncada et al., 2002; Zein, 2017), open-ended questionnaires (Igawa, 2008), quantitative questionnaires (Derakhshan et al., 2020; Assalahi, 2021; Poonpon, 2021), and mixed methods were employed by Wall (2008), Oudah and Altalhab (2018), and Assalahi (2021), as well as quantitative analyses like Pearson correlation coefficients and Structural Equation Modeling. This methodological diversity enriches the understanding of EFL teachers' needs by triangulating insights from multiple angles and allowing for a comprehensive exploration of the research questions at hand.

Regarding research subjects, the studies encompassed a wide range of participants, including EFL teachers from various countries such as Colombia (Moncada et al., 2002), Thailand (Poonpon, 2021; Wall, 2008), Japan and Korea (Igawa, 2008), Australia (Zein, 2017), Iran (Soodmand & Doosti, 2017; Derakhshan et al., 2020), and Saudi Arabia (Oudah & Altalhab, 2018; Assalahi, 2021). The diverse pool of participants offers a comprehensive perspective on EFL teachers' needs and

preferences, considering the variations in their educational systems, cultural contexts, and professional experiences. However, potential research gaps lie here, in the collected studies, participants, EFL teachers, are mainly in-service EFL teachers from primary (Zein, 2017; Poonpon, 2021; Oudah & Altalhab, 2018) or secondary schools (Poonpon, 2021; Wall, U., 2008; Igawa, 2008), pre-service EFL teachers' needs are rarely touched.

2.5 AI-TPACK Needs Analysis

This part is focused on reviewing the previous literature on AI-TPACK needs analysis (2.5.1) and theoretical rationale for AI-TPACK needs analysis (2.5.2) to examine the present situation of EFL teachers' needs and the research gap within the field.

2.5.1 Review of the AI-TPACK Needs Analysis Related Studies

Recent studies emphasize the increasing importance of needs analysis in teachers' needs for AI integration, but significant methodological and contextual limitations remain. Chan and Tang (2025) applied a TPACK-based framework to evaluate the AI readiness of preservice English teachers in Hong Kong, recommending professional training in AI tool selection, implementation, progress monitoring, pedagogy design, and resource evaluation for English teaching. While valuable, the study would benefit from a mixed-methods approach, including qualitative insights, to strengthen the framework and enhance the robustness of its findings. Similarly, the AI-TPACK needs of Chinese pre-service EFL teachers were investigated by Ye et al. (2025). The study revealed important education needs, such as knowing how to deliver personalized instruction, apply AI to English speaking and listening, and develop cohesive AI-supported instructional approaches, and familiarity with AI tools. The importance of targeted education initiatives that integrate AI technologies, pedagogical approaches, and ethical considerations in preparing teachers for AI-powered educational contexts was underscored. Their work provides important initial insights, yet it relies largely on perceived competencies. It does not incorporate multiple stakeholders' perspectives, which may overlook a broader systemic or multi-perspective understanding of preservice EFL teachers' needs. Additionally, Mingyeong

and Lee (2023) examined pre-service teachers' AI-related educational needs in Korea using the TPACK framework, Borich's needs analysis, and the Locus for Focus model. Their findings highlighted Ethics and TPK competencies as priorities and revealed strong demand for practical, applicable knowledge. However, the study's national focus limits its relevance to China, where distinct policies, infrastructures, and teacher training systems shape AI integration differently.

2.5.2 Theoretical Rationale for AI-TPACK Needs Analysis

Taken together, prior studies on AI-TPACK needs analysis have provided valuable empirical insights into teachers' perceived competencies and training priorities; however, they tend to conceptualize educational needs primarily as individual skill deficits. Such an approach risks overlooking the complex, situated, and future-oriented nature of teachers' professional learning in AI-enhanced educational contexts. Drawing on needs analysis theory, the present study conceptualizes AI-TPACK educational needs as a multidimensional construct encompassing needs, problems, and expectations. Within this framework, needs refer to perceived gaps between existing AI-TPACK competence and instructional demands; problems capture contextual and systemic constraints that hinder the development of AI-TPACK; and expectations reflect pre-service and in-service EFL teachers' future-oriented beliefs regarding the pedagogical value and feasibility of AI-assisted EFL teaching and learning. This theoretical positioning aligns with the integrative nature of the AI-TPACK framework and provides a coherent basis for examining teachers' AI-TPACK educational needs from multiple stakeholder perspectives in the Chinese EFL context.

The present study used a mixed-method approach that combined quantitative surveys and qualitative interviews to investigate AI-TPACK educational needs from multiple perspectives, including pre-service teachers, in-service teachers, administrators, and ICT teachers. This design enables a more nuanced and context-sensitive understanding of educational needs for developing AI competencies in Chinese EFL education. By integrating diverse viewpoints, the study not only captured pre-service EFL teachers' skill gaps and educational needs but also considered institutional and systemic factors that shape AI adoption and teacher preparedness. In doing so, it addressed gaps in prior research. It provided empirical evidence to inform the design of targeted interventions and teacher education programs, ensuring that AI

integration is both pedagogically meaningful and practically feasible.

2.6 Systematic Review of Related Studies (2015–2024)

Comparing with traditional selective and descriptive narrative review, systematic review uses a transparent and replicable procedure to select, screening and analyzing relevant research. This approach minimizes bias, ensures comprehensive coverage of the literature, and provide a structured synthesis of the research findings. Considering the continuing expansion of AI research in EFL education in China, a systematic review is especially suitable, as it enables the rigorous and evidence-based examination of overall trends, methodological patterns, and research gaps. This part adopts systematic methods to provide a more credible description of the current state of research while also laying a solid foundation for the development of the theoretical model and research design in this dissertation.

A growing body of research has explored the role of AI in education broadly and in language education specifically. Systematic reviews have examined AI in higher education (Zawacki-Richter et al., 2019), machine learning assessment (Zhai et al., 2020), deep learning (Guan et al., 2020), e-learning (Tang et al., 2023), and language education (Yang & Kyun, 2022). Yang and Kyun (2022), for instance, reported that 68% of AI-related language education studies focused on English, underscoring the predominance of English as a focal point and the importance of understanding AI applications in this context. More recently, several systematic reviews have addressed AI in English education, covering broad trends, AI's role in English education (Ghafar et al., 2023; Yu & Nazir, 2021), and general overviews (Rahmanto & Indah, 2023; Sharadgah & Sa'di, 2022). Other reviews have examined specific aspects such as learning motivation and achievement (Yang, 2024; Xu & Wang, 2024; Javaid, 2024), challenges and opportunities (Al-khreshehm, 2024; Dai & Liu, 2024), emerging AI technologies like ChatGPT (Asad et al., 2024; Fitria, 2020) and emotional AI (Liu et al., 2024), as well as targeted language skills such as interactional and communicative competence (Rusmiyanto et al., 2023; Zhai & Wibowo, 2023), affective factors (AlTwijri & Alghizzi, 2024), and academic writing (Raheem et al., 2023). In addition,

some reviews have focused on prospective teachers (Peña-Acuña & Durão, 2024) and teacher perspectives (Zulkarnain & Yunus, 2023). While these studies have advanced understanding, most have taken a micro-level perspective, concentrating on particular technologies, skills, or teacher groups, and relatively few have addressed the EFL context in a comprehensive manner (Jiang, 2022).

At the same time, the global EdTech landscape highlights China as one of the leading nations, alongside the United States and India, in advancing AI-driven educational innovations (HolonIQ, 2024). China's New Generation Artificial Intelligence Development Plan (2017) set the goal of building a USD 150 billion AI industry and positioning the country as a global leader in AI by 2030. Within this policy-driven environment, China has witnessed rapid growth in AI-based educational applications, including English language learning. Despite this momentum, systematic reviews focusing on AI in EFL education in China remain limited. Existing reviews have been limited in scope, often overlooking regional perspectives and macro-level analyses of trends, methods, tools, and outcomes.

In light of these gaps, the present review systematically examines the application of AI in EFL education in China between 2015 and 2024. The review analyzes 56 studies identified through a comprehensive search across Scopus, ScienceDirect, ERIC, and CNKI. It aims to map research trends, methodologies, participants, targeted language skills, AI tools employed, and reported outcomes, while also synthesizing the roles of AI in EFL teaching and learning. The following sections present the methodology and findings of this systematic review.

2.6.1 Review Methodology

The systematic review followed the principles of PRISMA proposed by Page et al. (2021). Therefore, this study consists of six phases: Development of inclusion and exclusion criteria, article selection, article screening and inclusion, data extraction, coding and analysis, and presentation of findings.

2.6.1.1 Database Search and Search Terms

Based on the guidelines of PRISMA and the research questions of the review, the author developed the search strategy and search terms.

Table 2.5 Searching Keywords

Core Searching String Components	Keywords
1 AI	"Artificial intelligence", "AI ", "machine learning", "deep learning", "intelligent systems", "natural language processing", "人工智能"
2 EFL	"English as a Foreign Language", "EFL", "language learning", "language teaching", "English language instruction"
3 Teaching and Learning	"Teaching and learning" "English language instruction" "language learning" OR "language teaching", "英语教学"
4 Geographic Focus: China	"China", "Chinese"

Keywords (shown in Table 2.5) related to AI (e.g., "artificial intelligence", "AI "), EFL (e.g., "English as a foreign language", "EFL"), and China (e.g., "China", "Chinese") are combined with "AND", "OR" to form different search strings. Four databases were searched: ERIC (Education Resources Information Center), ScienceDirect, Scopus, and China National Knowledge Infrastructure (CNKI). The search within the abstract, title, and keywords was undertaken from the 4th of August 2024 to the 11th of September 2024. The search keywords are in English and Chinese, which was considered appropriate as CNKI in domestic China is in Chinese. By the characteristics of each database, the searching strings are different, as shown in Table 2.6. The search in the ERIC database yielded fewer results after the brief screening of the title and abstract, so more search terms ("machine learning", "deep learning", "intelligent systems", "natural language processing") were added. In ScienceDirect, two searches with different search strings are conducted to search for more articles that can be included. In CNKI, a search limit was applied to ensure only high-quality articles were included, so only articles published in core journals included in Nanjing University's Chinese Social Sciences Citation Index (南核) and

Chinese Social Sciences Citation Index (北核) were selected. The details of the searching date and searching strings are shown in Table 2.6.

Table 2.6 Searching Recording

Data Bases	Searching Date	Searching String
ERIC	4-Aug-2024	"Artificial intelligence" OR AI OR "machine learning" OR "deep learning" OR "intelligent systems" OR "educational technology") AND ("English as a Foreign Language" OR EFL OR "language learning" OR "language teaching" OR "English language instruction") AND China OR Chinese
ScienceDirect	4-Aug-2024	The 1st search: "artificial intelligence" OR AI AND "English as a Foreign Language" OR EFL OR "language learning" OR "language teaching" OR "English language instruction" AND "China" OR "Chinese" The 2 nd search: AI AND English teaching and learning AND China OR Chinese
Scopus	4-Aug-2024	"Artificial intelligence" OR AI AND "English as a Foreign Language" OR EFL OR "language learning" OR "language teaching" OR "English language instruction" AND "China" OR "Chinese"
China National Knowledge Infrastructure (CNKI)	11-Sep-2024	人工智能(artificial intelligence) 英语教学(English teaching and learning)

2.6.1.2 Inclusion and Exclusion Criteria

After developing the search string, the author of the present study designed inclusion and exclusion criteria (see Table 2.7). Only research that met the following criteria was included.

Table 2.7 Inclusion and Exclusion Criteria

Inclusion Criteria	Exclusion Criteria
Published in peer-reviewed journals	Conferences, book series, chapters in books, books, and dissertations

Table 2.7 (continued)

Inclusion Criteria	Exclusion Criteria
Indexed in ERIC (Education Resources Information Center), ScienceDirect, Scopus, China National Knowledge Infrastructure (CNKI)	Not indexed in ERIC (Education Resources Information Center), ScienceDirect, Scopus, China National Knowledge Infrastructure (CNKI)
Focus on the use of AI in EFL education in China	Not focused on AI in the EFL education, not in China
No systematic reviews	Systematic reviews
Written in English and Chinese	Articles in other languages
Available in full text	Not available in full text
Published between 2015 to July 2024	Published before 2015 and after 2024

2.6.1.3 Selection and Screening

The methodology for selection and screening in this review adhered to the PRISMA guideline (Page et al., 2021) and was illustrated in Figure 2. A total of 1,001,463 records were identified, 1,001,294 records were removed, and 169 records remained after database screening of the title and abstract by the author. Then, 169 records were sought for retrieval, and 44 records were not retrieved for the following reasons: full-text unavailable (n=5) in Scopus and duplication removed (n=39) in CNKI. 120 articles were retrieved and downloaded for eligibility assessment. The researcher tried to ensure that 120 articles were reasonably selected and met the criteria (see Table 2.7). Of the 120 articles, 64 were excluded as they were: not about EFL(n=11), not about AI (n=16), not related to China (n=11), dissertation (n=5), other reasons (n=1), and what should be mentioned was that among the excluded articles, 4 articles selected from Scopus, for some reasons had been retrieved by journal but still can be searched and downloaded from the database and the author of the present study decided to exclude these articles from the review. One article downloaded from CNKI that failed to open was excluded, and 14 book reviews from CNKI were also excluded. Finally, 56 articles were selected after the selection and screening process (see Figure 2.1).

The selection and screening process was conducted manually by the author and no technological tools were used. The whole process took four months from August 2024 to December 2024.

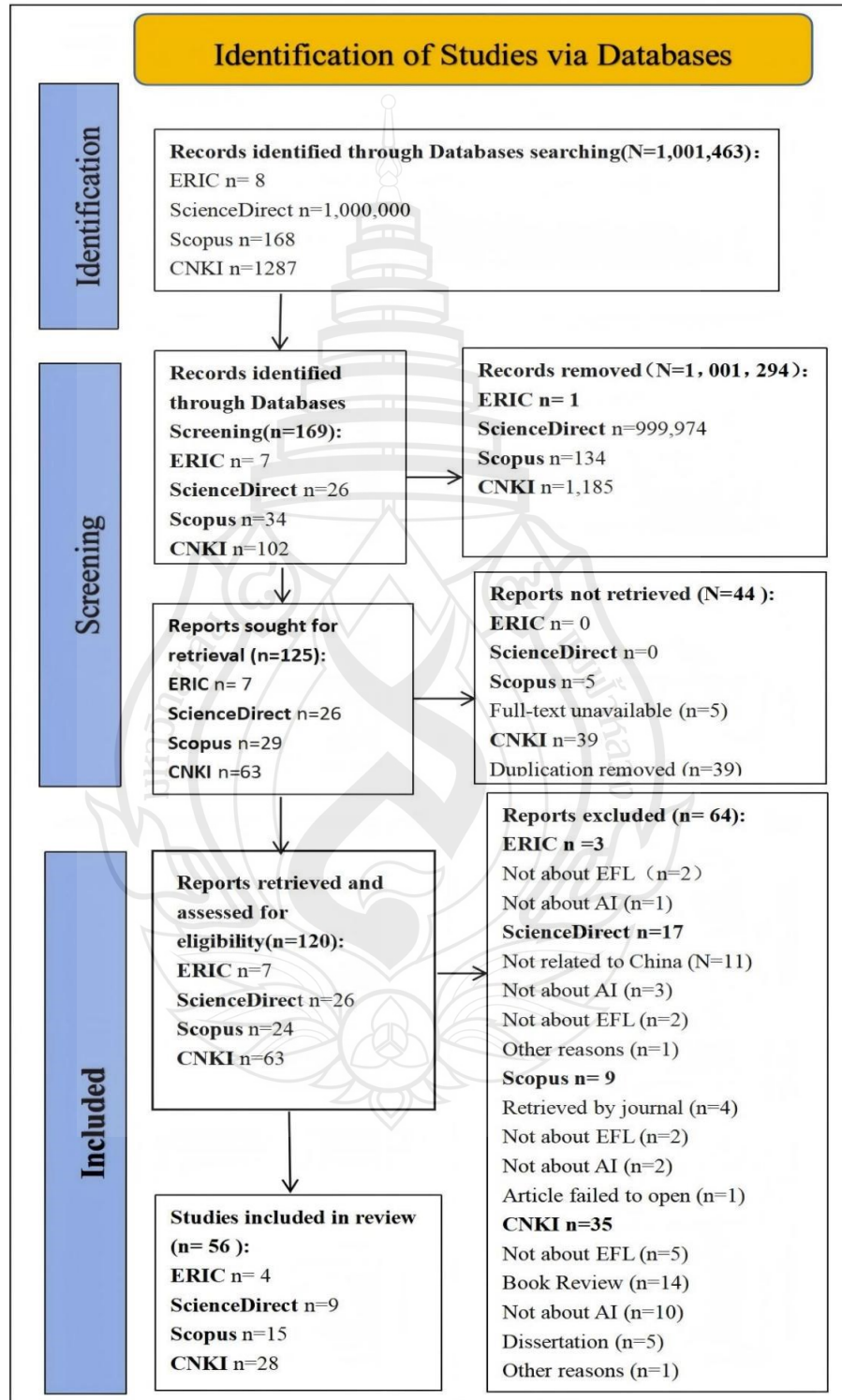


Figure 2.1 The PRISMA Diagram

2.6.1.4 Data Coding and Analysis

This review used the coding methodologies of Heift and Schulze (2007), Hung et al. (2018), and Liang et al. (2021) as guidance for coding and analysis. The categories, the encoding for each category, and references are illustrated in Table 2.8.

Table 2.8 Coding Scheme

Categories	Coding	Sub-coding	References
Publication year	Publication year	-	-
Research topics	Research topics	[A] Design and Evaluation of AI-based Systems and Platforms. [B] Pedagogical Design and Theoretical Frameworks. [C] Adaptive and Personalized Learning [D] Collaborative and Interactive Learning [E] Gamification and Intelligent Learning Tools. [F] Assessment and Evaluation. [G] Learner Motivation, Engagement, and Behavior [H] Adoption, Perceptions and Attitudes, and Behavioral Intention [I] Language Skills and Other Competencies Development [J] Innovative Models for EFL Teaching and Learning [K] Policy and Socio-Cultural Impacts of AI in EFL	Adapted from The TBL research topic (Hsu et al., 2012)

Table 2.8 (continued)

Categories	Coding	Sub-coding	References
Research methodologies	Research designs and methods	[A] Empirical Research [A1] Quantitative [A2] Qualitative [A3] Mixed Methods [B] Experimental Research [B1] Quantitative [B2] Qualitative [B3] Mixed Methods [C] Applied Research [D] Conceptual Research or Theoretical Research [E] System, Model or tool Design	Adapted from Liang et al. (2021) Adopted from (Creswell & Creswell, 2017)
AI's role in EFL teaching and learning	AI's Role	[A] Administration in EFL [A1] Admissions and Scheduling [A2] Drop-out Prediction and Retention [A3] Academic Monitoring [B] Intelligent Tutoring Systems (ITS) in EFL [B1] Content Delivery [B2] Strength Diagnosis and Feedback [B3] Learning Resource Management [B4] Collaborative Learning Facilitation [C] Assessment and Evaluation in EFL [C1] Automated Grading [C2] Feedback Generation [C3] Understanding Assessment [C4] Engagement Monitoring [C5] Teacher Evaluation	Adapted from Liang et al. (2021)

Table 2.8 (continued)

Categories	Coding	Sub-coding	References
		[D] Adaptive Systems and Personalization	
		[D1] Adaptive Content Delivery	
		[D2] Personalized Recommendations	
		[D3] Teacher Support and Design	
		[D4] Individualized Guidance	
		[D5] Knowledge Representation	
		[D6] Adaptive Learning Paths	
		[E]Engagement and Motivation	
		[E1] Motivation Enhancement	
		[E2] Behavioral Analysis	
		[E3] Engagement Enhancement	
		[E4] Interactive Tools	
		[F]English skills	
		[F1] Listening Skills	
		[F2] Speaking Skills and Pronunciation	
		[F3] Reading Skills	
		[F4] Writing Skills	
		[F5] Translation Skill	
		[F6] Vocabulary and Grammar Acquisition	
		[G]Contemporary Competencies Enhancement	
		[G1] Cross-Cultural Competence	
		[G2] Contemporary competencies	

Table 2.8 (continued)

Categories	Coding	Sub-coding	References
Participants	Participants	[A] Students [A1] University Students [A2] Secondary School Students [A3] Primary Students [A4] Cross-level Students [A5] Adult Students [A6] Chinese EFL Learners [B] Teachers [B1] Secondary School Teachers [B2] Pre-service English Teacher [B3] University Teachers [B4] University Teachers and Students [C] Educational Administrators [D] AI Developers [E] Policy Makers [F] No human Participants	Developed by the authors of the present study.
Factors Influencing AI Adoption in EFL Education	Models and Influencing Factors	Qualitative Content Analysis	Factors Influencing AI Adoption in EFL Education

The coding process was conducted manually by resorting to the previous studies and adhering to the research aims and questions of the present review. Online meetings were held to solve the difficulties and ambiguity in categorizing, and a final consensus was achieved on the category and encoding of the present review. Data analysis was performed and visualized in WPS Office Excel.

2.6.1.5 Data Extraction.

Data from 56 articles were extracted through carefully designed Excel reading notes, which were made based on research aims and coding schemes.

For some of the articles in Chinese without English titles, abstracts, and

keywords, the author translated the titles and the extracted data into English. To secure the accuracy of the translation, translation tools such as Google Translate and ChatGPT 4 were resorted to as assistant tools during the translation process.

2.6.2 Descriptive Trends

2.6.2.1 Publication Years

As illustrated in Figure 2.2, although articles published from 2015 to 2024 were searched and screened, no articles published in 2015 and 2016 were included based on the inclusion and exclusion criteria. From 2017 to 2021, only 11 (19.6%) were published. In contrast, the number of publications published increased significantly beginning in 2022. The number of articles increased from 5 in 2022 to 24 in 2024 (see Figure 2.2). There are noticeable trends in the publication years:

Slow growth years (2015-2021): Between 2015 and 2021, the number of papers published was low, with a modest increase from 0 in 2015 and 2016 to only 11 from 2017 to 2021.

Rapid development years (2022-2024): A sharp rise in published papers is observed after 2021, starting with 5 articles in 2022 and increasing to 24 by 2024.

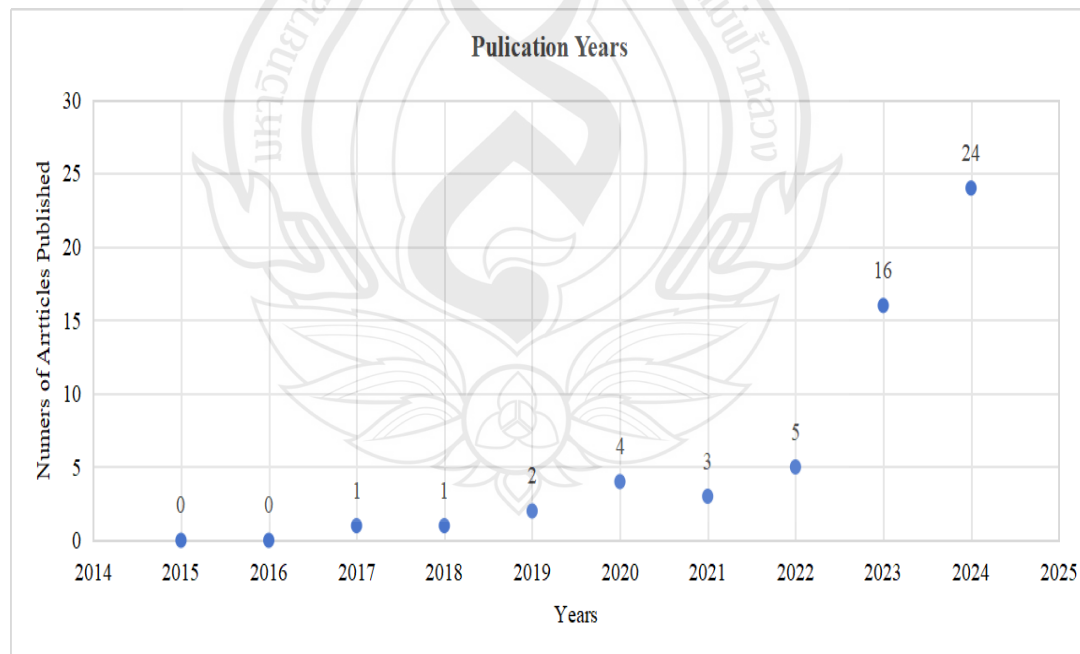


Figure 2.2 Distribution of Articles on Publication Year

2.6.2.2 Research Topics

Figure 2.3 shows the distribution of research topics on AI in EFL education from 2015 to 2024 in China. The most discussed research topics are Design and Evaluation of AI-based Systems and Platforms (20 articles, 35.7%) and Language Skills (16 articles, 28.6%), ranking second. Followed by Adoption, Perceptions and Attitudes, and Behavioral Intention (10 articles, 17.9%), Pedagogical Design and Theoretical Frameworks (10 articles, 17.9%), Innovative Models for EFL Teaching and Learning (9 articles, 16%). The least discussed research topics are Other Competencies (3 articles, 5.4%), followed by Learner Motivation, Engagement, and Behavior (2 articles, 3.6%), while Collaborative and Interactive Learning and Assessment and Evaluation each have 1 article (1.8% each). Moreover, no study has discussed Adaptive and Personalized Learning, Gamification, and Intelligent Learning Tools, as well as the policy and Socio-Cultural Impacts of AI in EFL.

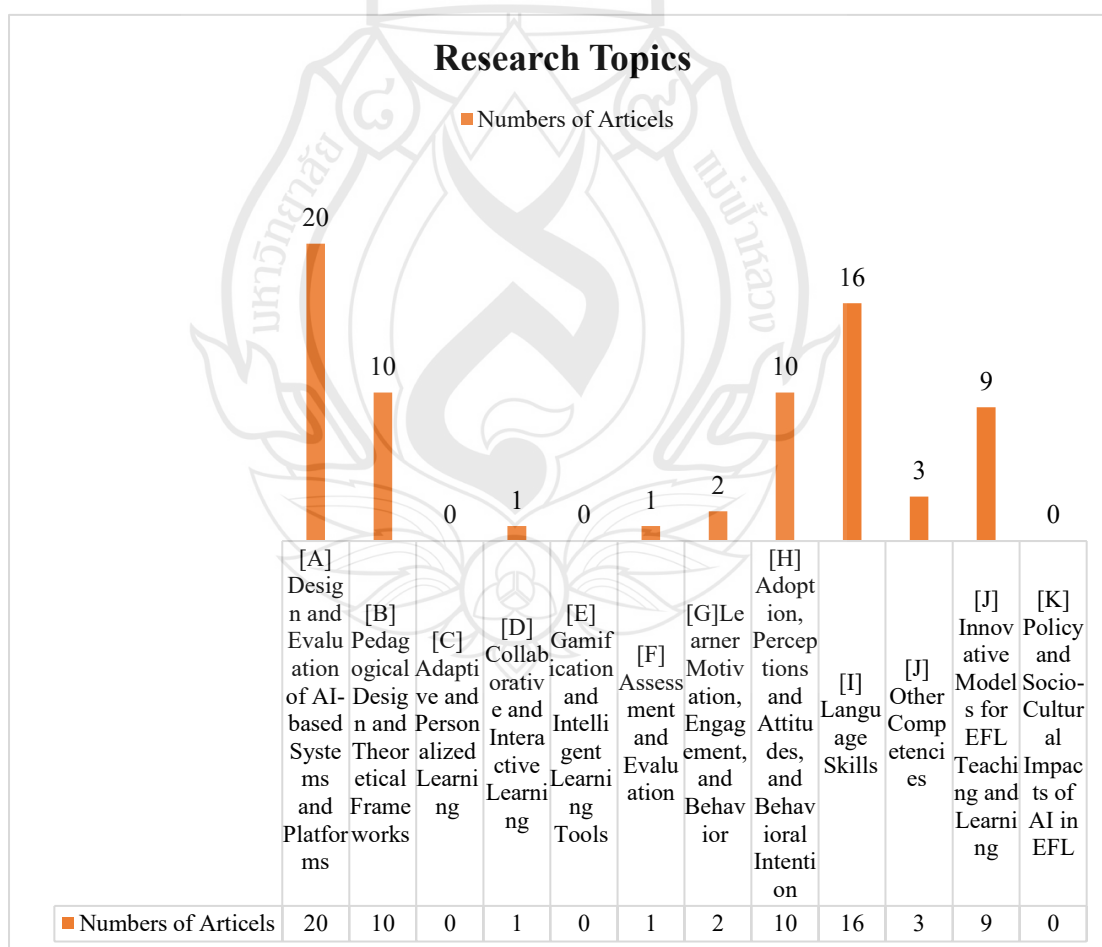


Figure 2.3 Distribution of Articles on Research Topics

2.6.2.3 Research Designs and Methods

Figure 2.4 illustrates the distribution of articles on research designs and research methods. For research designs, Experimental Research and System, Model, or Tool Design are the most common, with 15 articles each, representing 26.8% respectively. This is followed by Empirical Research with 12 articles (21.4%), Applied Research with 8 articles (14.3%), and Conceptual or Theoretical Research comprising 6 articles (10.7%). Based on the research methodologies are classified as quantitative, qualitative, and mixed methods. As shown in Figure 4, Empirical Research and Experimental Research are sub-categorized into quantitative, qualitative, and mixed methods. Mixed Methods are predominant with 15 articles (26.8%), followed by Quantitative Methods comprising 7 articles (12.5%), and Qualitative Methods are the least presented with 5 articles (8.9%); notably, no Qualitative Methods were employed under Experimental Research.

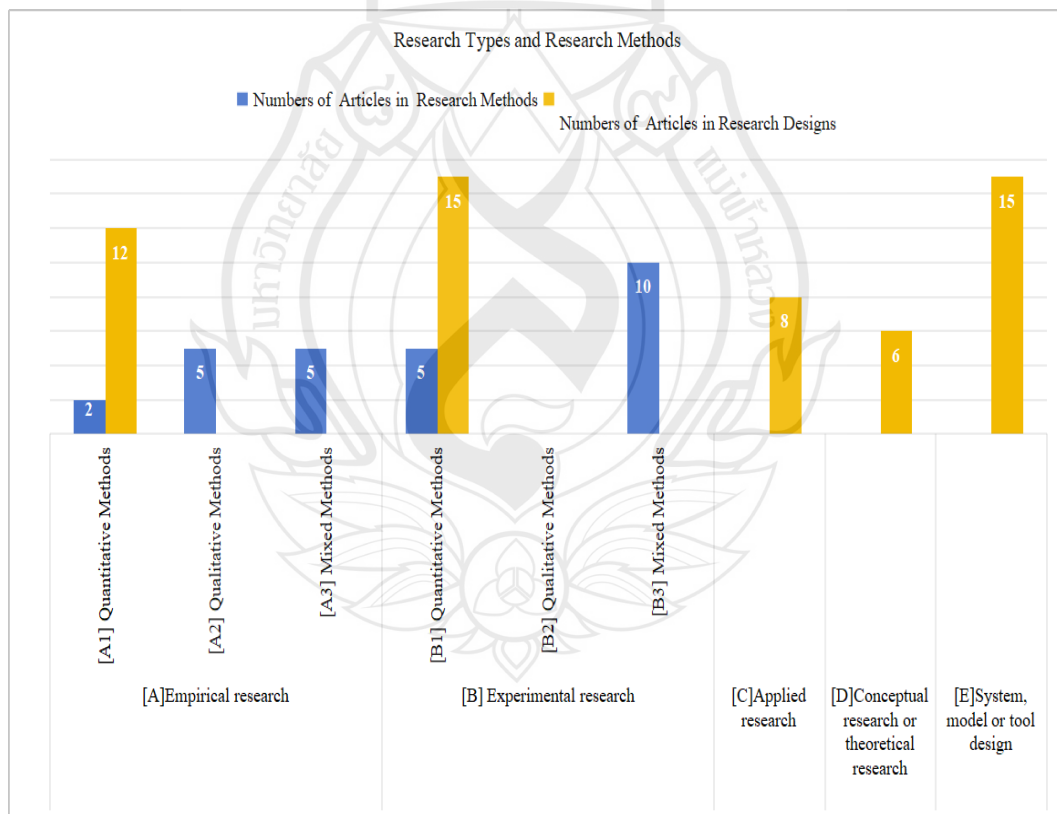


Figure 2.4 Distribution of Articles on Research Designs and Research Methods

2.6.2.4 AI's Role in EFL Education

Figure 2.5 illustrates the distribution of AI's roles in EFL education. English Skills is the most prevalent category (33 articles, 58.9%), followed by Assessment and Evaluation in EFL, and Adaptive Systems and Personalization are less prominent with 8 articles each (14.3%), and Engagement and Motivation (4 articles, 7.1%). Intelligent Tutoring Systems (ITS) in EFL and Contemporary Competencies Enhancement are presented in only 2 articles each (3.6% each). Moreover, Administration in EFL is the least explored, with only 1 article (1.8%). Additionally, 13 selected articles (23.2%) did not examine the role of AI in EFL education.

Regarding distribution among sub-categories: Speaking Skills and Pronunciation comprise the majority with 14 articles (25%), followed by Writing Skills with 10 articles (17.9%). Moreover, Teacher Support and Design is presented in only 4 articles (7.1%). Furthermore, Automated Grading and Feedback Generation each have 3 articles (5.4%). Adaptive Content Delivery, Adaptive Learning Paths, Motivation Enhancement, Listening Skills, Reading Skills, and Translation Skills each consist of 2 articles (3.6%). Additionally, Content Delivery, Drop-out Prediction and Retention, Learning Resource Management, Understanding Assessment, Teacher/Teaching Evaluation, Behavioral Analysis, Interactive Tools, Engagement Enhancement, Vocabulary and Grammar Acquisition, Cross-Cultural Competence, and Contemporary Competencies each have 1 article (1.8%). Finally, no articles discussed Admissions and Scheduling, Academic Monitoring, Strength Diagnosis and Feedback, Collaborative Learning Facilitation, Engagement Monitoring, Personalized Recommendations, Individualized Guidance, and Knowledge Representation.

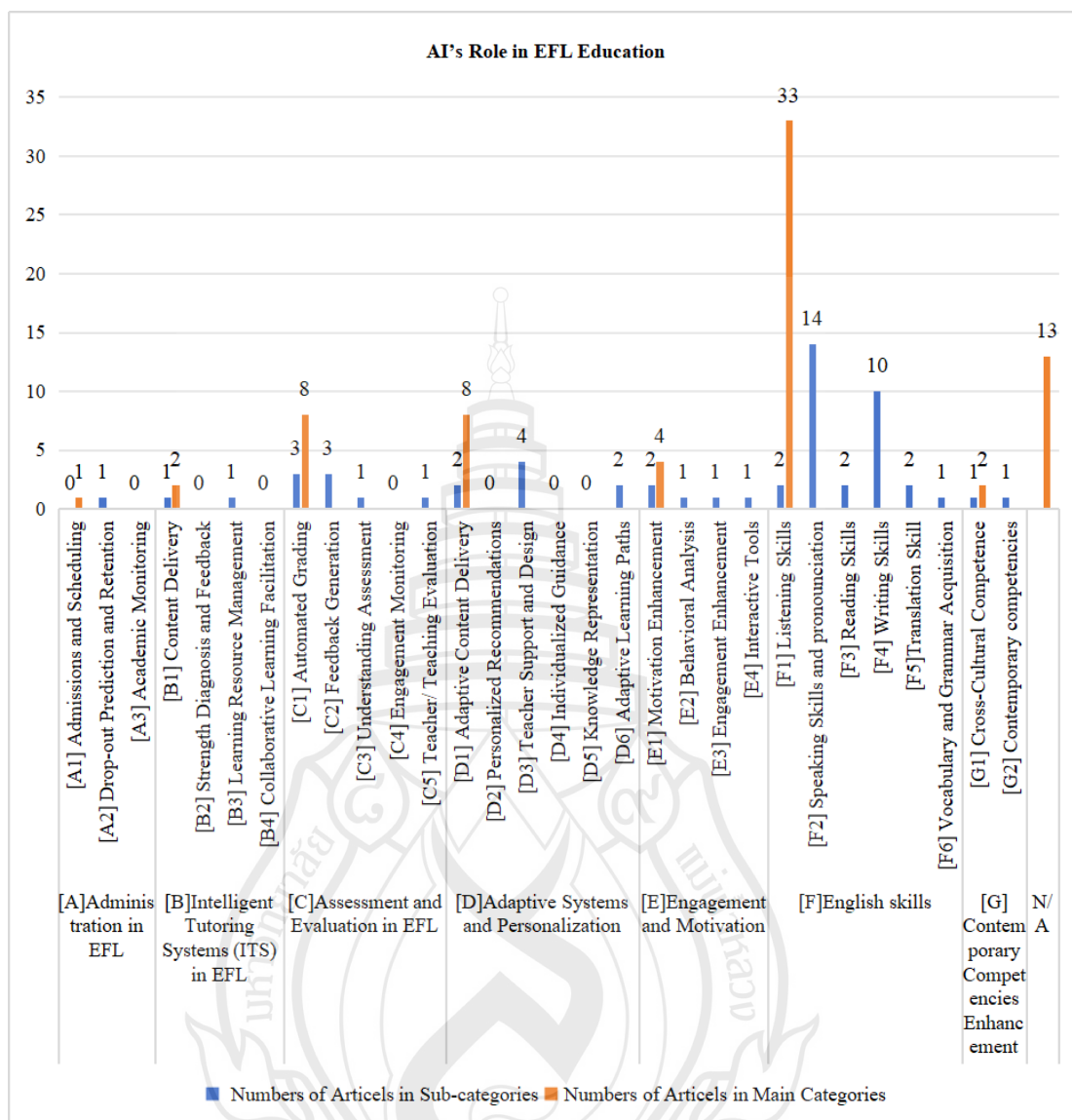


Figure 2.5 Distribution of Articles on AI's Roles in EFL Education

2.6.2.5 Participants

Figure 2.6 illustrates participants' distribution. Among the main categories, Students are the most common, comprising 34 articles (60.7%), followed by Teachers with 6 articles (10.7%), No Human Participants accounting for 28.6% (16 articles) of the total, no article involved Educational Administrators, AI Developers, and Policy Makers. Additionally, in sub-categories, University Students comprised the highest proportion of participants at 44.6% (25 articles). Secondary School Students, encompassing both junior and senior high school students, represented 5.4% (3 articles). Primary School Students, Cross-level Students (including both secondary

school and university students), Secondary School Teachers, and University Teachers and Students each constituted 3.6% (2 articles each) of the total participants. The lowest proportion of participants consisted of Adult Students, Chinese EFL Learners, Pre-service English Teachers, and University Teachers, each accounting for 1.8% (1 article each) respectively.

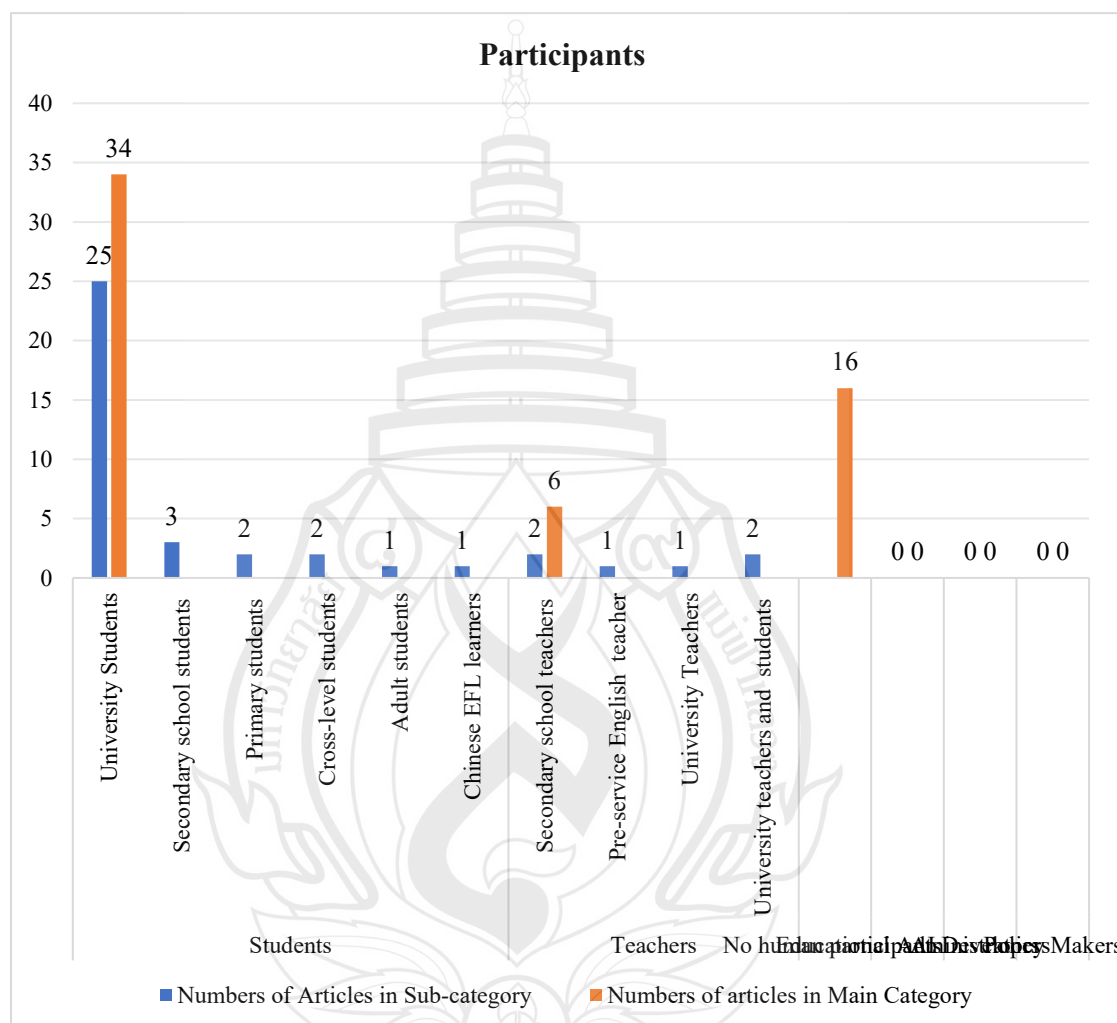


Figure 2.6 Distribution of Articles on Participants

2.6.3.5 Factors and Models Contribute to the Adoption of Artificial Intelligence in EFL education in China

Six selected articles (6 of 56, 10.7%) examine the acceptability of artificial intelligence in EFL education in China. For instance, An et al. (2022) investigated the viewpoints, knowledge, and intentions of middle school English as a Foreign Language (EFL) teachers regarding the integration of AI into their teaching practices. Similarly,

Mei (2024) performed a qualitative study to examine the adoption of the Chinese AI-assisted pronunciation training application "Clip" among 11 pre-service EFL teachers. In addition, Zou et al. (2023) examined EFL learners' perceptions and acceptance of an AI speech evaluation system for English speaking practice. Moreover, Hsu (2024) explored EFL learners' perceptions of incorporating virtual reality (VR) into EFL learning. Meanwhile, Liu et al. (2024) investigated the extent to which L2 learners utilized large language model platforms (e.g., ChatGPT, Bing Chat) for informal digital English learning (IDLE). Lastly, Wen et al. (2024) investigated AI anxiety in secondary school students and its correlation with their behavioral intention regarding the use of AI EFL learning tools.

1. Models and frameworks used

As shown in Table 2.9, four technology acceptance models, including the unified theory of acceptance and use of technology (UTAUT), the technological pedagogical and content knowledge (TPACK) framework, the technology adoption model (TAM), and the hedonic motivation system adoption model (HMSAM), were used to investigate AI acceptance in EFL education in China.

The most often used model to examine the acceptance of artificial intelligence technologies in the Chinese EFL context was the TAM model. Specifically, three chosen publications (Liu et al., 2024; Mei 2024; Zou et al., 2023) applied the TAM model; Liu et al. (2024) used TAM3 that developed and validated by Venkatesh and Bala (2008); Mei (2024) used the generic TAM model (Davis, 1989), and Zou et al. (2023) extended the TAM with "perceived enjoyment" (PE). Following this, the UTAUT model was used by two articles (An et al., 2022; Wen et al., 2024). An et al. (2022) innovatively combined the UTAUT model with three AI-TPACK constructs: AI language technological knowledge (AIL-TK), AI technological pedagogical knowledge (AI-TPK), and AI technological pedagogical content knowledge (AI-TPACK). Similarly, Wen et al. (2024) employed an extended UTAUT model by incorporating additional variables, including AI learning anxiety, job replacement anxiety, sociotechnical blindness anxiety, and AI configuration anxiety. In contrast, the HMSAM model was only used by Hsu (2024). Overall, the TPACK framework and the HMSAM model were the least frequently used models, used by one selected article each (An et al., 2022; Hsu, 2024). This indicates a potential gap in the literature, as

limited attention has been given to frameworks that emphasize pedagogical knowledge integration (TPACK) or hedonic motivation (HMSAM), both of which could offer richer insights into teachers' engagement with AI-driven learning technologies.

2. Factors influencing AI in EFL education.

Liu et al. (2024) found that the perceived ease of use (PEOU) and perceived usefulness (PU) of GPT technologies influence language learners' intentions to use the new AI tools. Intention to use could predict the actual use of GPT technologies for AI-mediated informal digital learning of English (AI-IDLE). Mei (2024) discovered that the adoption of AI-assisted foreign language teaching among research participants exhibits a complex pattern. They acknowledge the usefulness and ease of use of AI in EFL education; nonetheless, they maintain a degree of reservation in their attitudes and intentions. The reserved attitudes and intentions stemmed from uncertainties regarding the effectiveness of artificial intelligence technology in enhancing students' pronunciation skills, underdeveloped technology, inadequate resources and curriculum integration, insufficient equipment, and a lack of comprehension regarding the integration of AI into teaching pronunciation. Similarly, Zou et al. (2023) found that most participants thought the AI program was useful, pleasant, and easy to use. They exhibited a strong intention to continue their usage; perceived usefulness (PU) and perceived enjoyment (PE) are significant predictors of behavioral intention (BI) to use. At the same time, issues with user interface design, the precision of automated feedback, and particularly the absence of in-person interaction were noted. In addition, An et al. (2022) found that performance expectancy (PE), social influence (SI), AIL-TK, and AI-TPACK had significant positive predictive power on behavioral intention (BI), and effort expectancy (EE), facilitating conditions (FC), and AI-TPK had indirect effects on BI. Moreover, Wen et al. (2024) concluded that PE, EE, SI, and FC could all positively predict BI to different degrees, and SI had the strongest effect; AI learning anxiety and job replacement anxiety might indirectly and negatively predict BI through intermediate variables. Lastly, Hsu (2024) discovered a notable correlation between perceived usefulness and control and perceived ease of use. The behavioral intentions of EFL learners for adopting VR for English learning were much influenced by perceived usefulness rather than joy. Furthermore, greatly affecting their degree of immersion were the joy EFL students felt and their sense of control in virtual

reality (VR) settings; Control has a greater impact than joy. Curiosity showed a clear relationship with behavioral intention; its influence on immersion was not significant, though. English as a Foreign Language students' behavioral intention to interact with VR-based language learning is much improved by the immersive experience that virtual reality offers. The models used and factors discussed were concluded in Table 2.9.

Table 2.9 Models and Factors

Authors and Years	The UTAUT Model	The TAM Model	The TPACK Framework	The HMSAM Model	Extended factors	Influencing factors
An et al. (2022)	Performance expectancy (PE), Effort expectancy (EE), Social influence (SI), Facilitating conditions (FC), Behavioral intention (BI)		AI language technological knowledge (AIL-TK), AI technological pedagogical knowledge (AI-TPK), AI Technological Pedagogical Content Knowledge (AI-TPACK)			performance expectancy (PE), social influence (SI), AIL-TK, and AI-TPACK
Mei (2024)		Perceived ease of use (PEU), Perceived usefulness (PU), Attitude, Intention to use (IU)				
Zou et al. (2023)		Perceived usefulness (PU), Perceived Ease of Use (PEOU), Behavioral intention to use (BI)			Perceived enjoyment (PE)	perceived usefulness (PU) and perceived enjoyment (PE)
Liu et al. (2024)		Perceived Ease of Use (PEU), Perceived Usefulness (PU), Intention to Use (IU), Actual Use (AU)				perceived ease of use (PEOU) and perceived usefulness (PU)

Table 2.9 (continued)

Authors and Years	The UTAUT Model	The TAM Model	The TPACK Framework	The HMSAM Model	Extended factors	Influencing factors
Wen et al. (2024)	Performance expectancy (PE), Effort expectancy (EE), Social influence (SI), Facilitating conditions (FC)					Performance expectancy (PE), Effort expectancy (EE), Social influence (SI), and facilitating conditions (FC) are positive predictors. AI learning anxiety and job replacement anxiety are negative predictors.
Hsu (2024)				perceived ease of use, perceived usefulness, curiosity, joy, control, behavioral intention to use, and immersion.		

2.6.4 Discussion and Research Gaps

This review has highlighted several important patterns and gaps in the application of artificial intelligence in English as a Foreign Language (EFL) education in China between 2015 and 2024. First, most studies tended to concentrate on specific topics such as design and evaluation of AI-based systems and platforms and language skills, while comparatively little attention was given to other areas such as adaptive and personalized learning, gamification, and intelligent learning tools, as well as the policy and socio-cultural impacts of AI in EFL. Second, research designs were largely dominated by mixed-methods studies and experimental studies, leaving a shortage of qualitative studies, especially in experimental studies. Furthermore, although the period

under review has witnessed rapid technological advances from early speech recognition and adaptive systems to the emergence of generative AI and large language models, this trend has not been fully mirrored in the literature. Third, gaps in AI's role in EFL education in China were identified. While many studies focused on English skills enhancement, much less is known about AI's role in areas such as admissions and scheduling, academic monitoring, collaborative learning facilitation, engagement monitoring, personalized recommendations, individualized guidance, and knowledge representation. Likewise, challenges of AI in EFL education in China, ethical and security challenges, psychological and emotional challenges, and policy and regulatory challenges were rarely considered, even though they are becoming increasingly critical in the age of generative AI. Finally, very few studies have systematically examined how contextual and systemic factors, such as curriculum alignment, institutional readiness, or regional disparities, influence the effective adoption of AI in EFL classrooms.

The analysis of the six studies that examined the acceptance of AI in EFL education demonstrates both the diversity and the limitations of current theoretical approaches. While the Technology Acceptance Model (TAM) was most frequently applied, it often appeared in extended forms (e.g., TAM3, TAM with perceived enjoyment), suggesting that the generic TAM framework alone may be insufficient to fully capture the complex interplay of technological, pedagogical, and affective variables in AI-enhanced language learning. The Unified Theory of Acceptance and Use of Technology (UTAUT) was also employed, with extensions that incorporated anxiety, contextual, and pedagogical constructs. This indicates a growing recognition that learner and teacher acceptance of AI cannot be explained solely by technological factors such as perceived usefulness and ease of use but also requires attention to socio-psychological elements such as anxiety, social influence, and pedagogical knowledge. However, the overall picture remains fragmented. Few studies combined technology acceptance models with pedagogical knowledge frameworks such as TPACK, and only isolated efforts attempted to integrate affective or contextual factors systematically. As a result, current findings on the determinants of behavioral intention to adopt AI in EFL contexts remain dispersed, with limited explanatory power across different learning groups (e.g., pre-service teachers versus learners). This fragmentation underscores the need for a more comprehensive theoretical framework that unites technological,

pedagogical, and affective perspectives to better explain adoption behavior in EFL education. To address the theoretical limitations and gaps, the present study combined the UTAUT model and AI-TPACK framework to explore the internal and external factors that influence Chinese pre-service EFL teachers' behavioral intention to use AI-based educational technologies. Additionally, interviews were conducted to explore possible contextual and cultural factors that are beyond the two theoretical frameworks. In this way, the study not only integrates teachers' technological acceptance and professional competence into a unified analytical model but also captures the situated, culturally embedded, and policy-sensitive dimensions of AI adoption in EFL teacher education, thereby providing a more comprehensive and context-responsive understanding of AI integration in EFL teaching in the Chinese context.

In summary, these findings suggest that the current body of research, while growing, remains somewhat fragmented and narrow in scope. Future studies should broaden the range of participant groups to include pre-service and in-service teachers, younger learners, and students from disadvantaged or minority backgrounds. They should also expand the thematic scope to address underexplored areas such as ethics, equity, teacher-AI collaboration, and learner well-being. Methodological rigor needs to be enhanced through longitudinal, qualitative methods, and multi-site designs, which can more fully capture the complexity of AI integration. At the same time, researchers should pay closer attention to emerging AI technologies, including large language models and multimodal systems. Finally, future research must situate AI within broader educational ecosystems, examining how institutional, policy, and socio-cultural factors shape both adoption and effectiveness.

2.7 Theoretical Models and the Research Model

This section introduces the theoretical framework and proposes a research model for the current study. Subsection 2.7.1. Focus on The Unified Theory of Acceptance and Use of Technology (UTAUT). Subsection 2.7.2. mainly discusses the Technology, Pedagogy, and Content Knowledge (TPACK) Framework. Subsequently, Subsection 2.7.3. focuses on AI-TPACK and intelligent TPACK. Finally, subsection

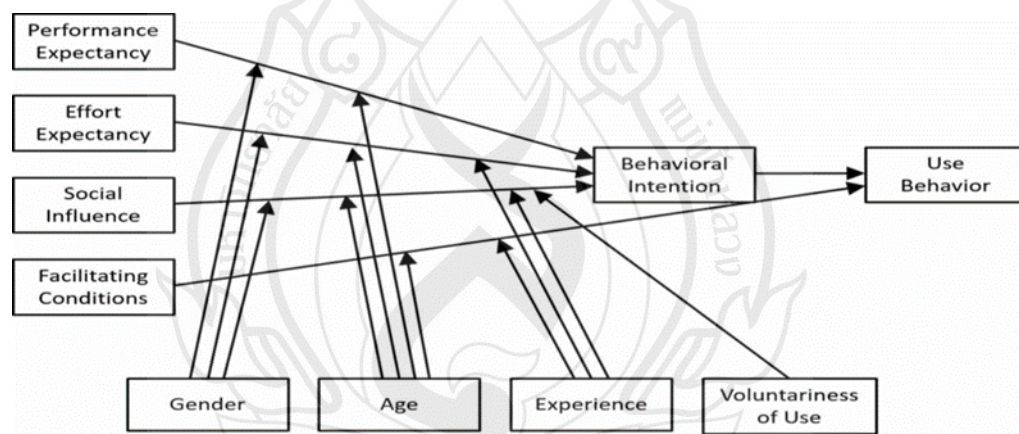
2.7.4. presents hypotheses for the present research and the proposed model.

2.7.1 The Unified Theory of Acceptance and Use of Technology (UTAUT) Model

As a result of Information technology (IT) acceptance research, a variety of compelling technology acceptance models have emerged over the past 40 years. Several models, including the Reasoned Action Theory (Fishbein & Ajzen, 1975), Planned Behavior Theory (1991) (Ajzen, 1991), Technology Acceptance Models (Davis, 1989, 1993; Venkatesh & Davis 2000), the PC Utilization Model (1991), and the Unified Theory of Acceptance and Use of Technology (the UTAUT), have been developed as a result of research on user behavior toward the use of technology. The Planned Action Theory (Ajzen, 1988, 1991) and the Rational Action (Ajzen and Fishbein, 1980) provide the foundation for the Technology Acceptance Model, which has been developed and applied to forecast users' intentions to use new technology (Davis, 1989). The technology adoption model is predicated on the idea that user intentions, which function as predictors of future technology use, can shed light on the adoption of new technologies. An increasing number of researchers are using the Technology Acceptance Model (TAM) to analyze user behavior when utilizing technology, only 40% of the variation in the dependent variables, however, can be accounted for in the TAM model. Venkatesh et al. developed the UTAUT framework in 2003 based on eight prominent models, including the Reasoned Action (TRA), Technology Acceptance Model (TAM), Motivational Model (MM), Theory of Planned Behavior (TPB), Combined TAM and TPB (C-TAM-TPB), Model of PC Utilization (MPCU), Innovation Diffusion Theory (IDT) and Social Cognitive Theory (SCT). After comparing the eight models and their extensions, Venkatesh et al. (2003) developed and empirically validated the UTAUT model that adapted components from eight models. The UTAUT Model was put forth to explain why users in organizational contexts accept technical systems, as a response to the shortcomings of earlier technology acceptance models. The eight models were empirically tested by Venkatesh et al. (2003) and found to account for between 17 and 53 percent of the variation in users' intentions to utilize information technology, based on data collected over six months with three points of assessment from four different organizations, while subsequent testing with the original data revealed that UTAUT performed better than

the eight separate models, accounting for 69% of the variation in users' intentions. Subsequently, UTAUT was validated using data from two other firms, yielding comparable outcomes and accounting for 70% of the variance in users' intentions to utilize IT.

In the UTAUT model, four main factors that affect a user's intention to use technology and their actual usage are Performance Expectancy, Effort Expectancy, Social Influence, and Facilitating Conditions. In this model, the main constructs are affected by intermediary variables like gender, age, experience, and voluntariness of use, while the endogenous variables are behavioral intention and use behavior (as shown in Figure 2.7). The UTAUT framework can explain 70% of the variation in intention to use technology, making it a useful tool for researchers and practitioners in the field of technology adoption. The UTAUT model has become one of the most advanced and comprehensive models for assessing technology acceptance in recent years.



Source Venkatesh et al. (2003, p. 447)

Figure 2.7 The UTAUT Model

As shown in Figure 2.8, Performance Expectancy, Effort Expectancy, Social Influence, and Facilitating Conditions, Behavioral Intention, and Use Behavior are six constructs in the UTAUT model. In the UTAUT model, behavioral intention is influenced directly by performance expectancy, effort expectancy, social influence. And use behavior is influenced directly by facilitating conditions and behavioral intention.

Performance Expectancy (PE): Performance expectancy is defined as the degree to which an individual believes that using technology (the system) will help him or her to attain gains in job performance (adopted from Venkatesh et al. 2003, p 447).

Effort Expectancy (EE): Effort expectancy is defined as the degree of ease associated with the use of technology (the system). (adopted from Venkateshetal. 2003, p 450).

Social Influence: Social influence is defined as the degree to which an Individual perceives that important others believe he or she should use technology (the new system) (adopted from Venkatesh et al., 2003, p. 451).

Facilitating conditions (FC): Facilitating conditions are defined as the degree to which an Individual believe that an organizational and technical infrastructure exists to support the use of technology (the system). (adopted from Venkatesh et al., 2003, p. 453).

Behavioral Intention (BI): The user's plans and decisions to use technology (the system) in the future (Venkatesh et al. 2003).

In the model, age, gender, experience, and voluntariness of use are four moderators of key relationships. These relationships can be derived from the research of Venkatesh et al. (2003). The relationship among variables and moderators is illustrated in Figure 2.8.

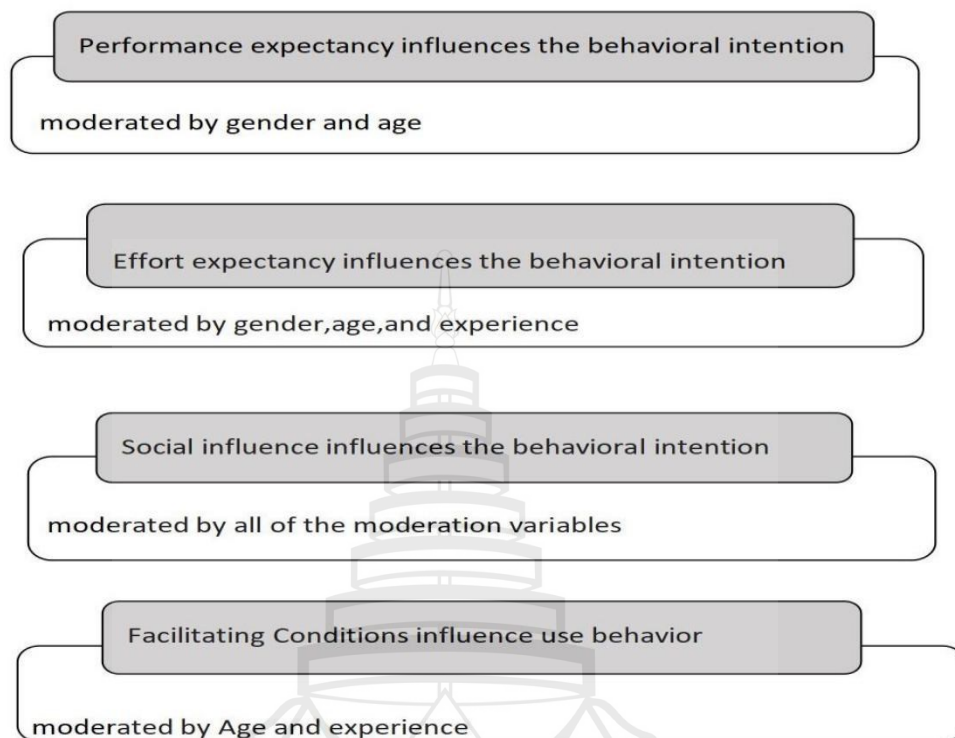


Figure 2.8 Variables and Moderators

The UTAUT framework has been widely applied and tested empirically in various educational contexts around the world since its introduction. Previous studies (Alasmari & Zhang, 2019; Birch & Irvine, 2009; Harmandaoğlu Baz et al., 2019; Koral & Akay, 2017; Önalán and Gökçe, 2020; Wen and Hua, 2020) have all found UTAUT to be a valid explanation for a user's intention and use of technology. These studies suggest that UTAUT is a useful tool for understanding technology adoption in diverse cultural and educational settings.

2.7.2 The Technological Pedagogical Content Knowledge (TPACK) Framework

The TPACK framework (see Figure 2.9) builds on Shulman's concept of pedagogical content knowledge (1986, 1987). Technological Pedagogical Content knowledge (TPACK) seeks to identify the types of knowledge needed by teachers to integrate technology into their instruction, while also addressing the complex, multifaceted, and situational nature of teacher knowledge. The conception of TPACK described below evolved over time and through a series of papers, with Mishra and

Koehler (2006) and Koehler and Mishra (2008) providing the most comprehensive descriptions of the framework. This framework offers the first theoretical concept of integrating technology into teaching (Rosenberg & Koehler, 2015). Since then, it has been widely used to guide research in technology education and teacher professional development (Chai et al., 2013; Nazari et al. (2019)

The Technology, Pedagogy, and Content Knowledge (TPACK) framework emphasizes the significance of three interrelated knowledge domains: content knowledge (CK), pedagogical knowledge (PK), and technology knowledge. These three domains are shown as overlapping circles, with the TPACK located where they intersect. The TAPCK framework is made up of seven components (shown in Figure 3): TK, CK, PK, TCK, PCK, TPK, and TAPCK. Effective technology integration for pedagogy in certain subject areas needs a greater emphasis on the dynamic, transactional link between various components of knowledge situated in varied situations. Individual teachers, grade levels, school-specific circumstances, demography, culture, and other elements distinguish each scenario, and no single combination of material, technology, and pedagogy will be effective for every teacher, course, or teaching philosophy.

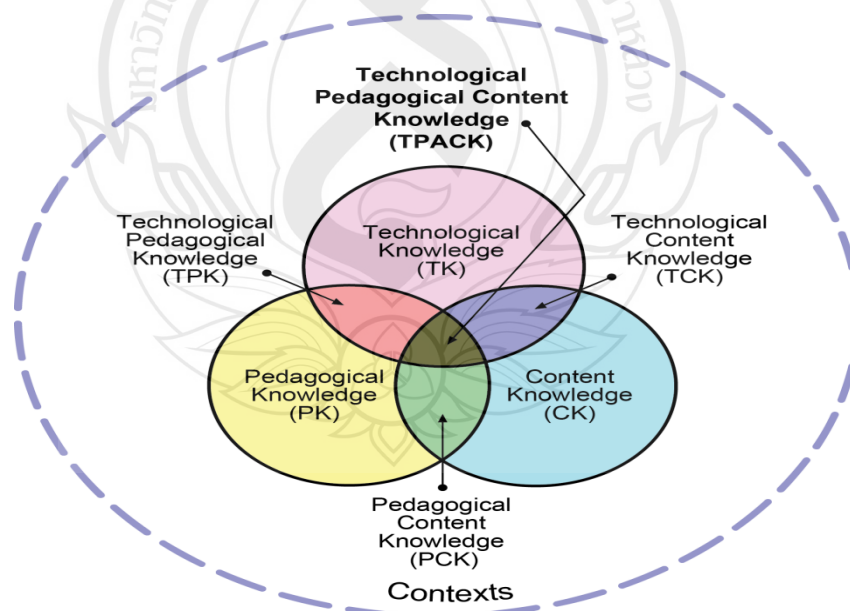


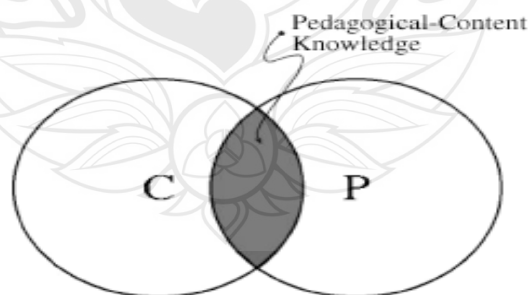
Figure 2.9 Diagram of the TPACK Framework

Technological Knowledge (TK): refers to the knowledge about standard technologies ranging from paper, pencil to the Internet, digital technologies, AI, and other technologies in the context of education. It also involves the skills required to operate technologies and the ability to adapt and learn new technologies, as the development of technology is rapid and ongoing (adapted from Mishra & Koehler, 2006).

Content Knowledge (CK): refers to the “knowledge about actual subject matter that is to be learned or taught” (Mishra & Koehler, 2006, p. 1026). Teachers must have a clear understanding of the content they intend to teach and the different nature of knowledge for the different content areas.

Pedagogical Knowledge (PK): refers to “deep knowledge about the processes and practices or methods of teaching and learning and how it encompasses, among other things, overall educational purposes, values, and aims” (Mishra & Koehler, 2006, p. 1026).

Pedagogical content knowledge (PCK): Pedagogical content knowledge (see Figure 2.10) refers to the “knowledge includes knowing what teaching approaches fit the content, and likewise, knowing how elements of the content can be arranged for better teaching” (Mishra & Koehler, 2006, P.1027). It encompasses the organization, representation, and adaptation of topics, problems, or issues for instruction to meet the diverse interests and abilities of learners with different prior knowledge (Mishra & Koehler, 2006).

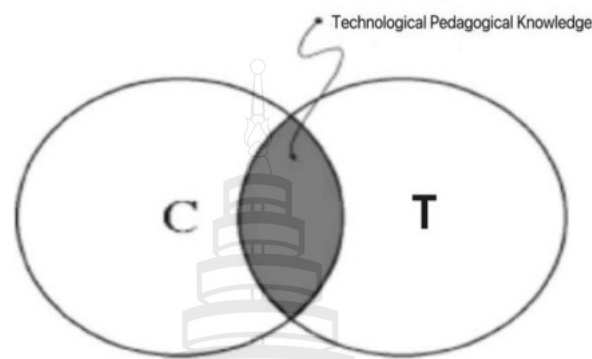


Source Mishra and Koehler (2006)

Figure 2.10 Pedagogical content knowledge (PCK)

Technological Content Knowledge (TCK): Technological Content Knowledge (see Figure 2.11) refers to the intersection of technology and content. This knowledge

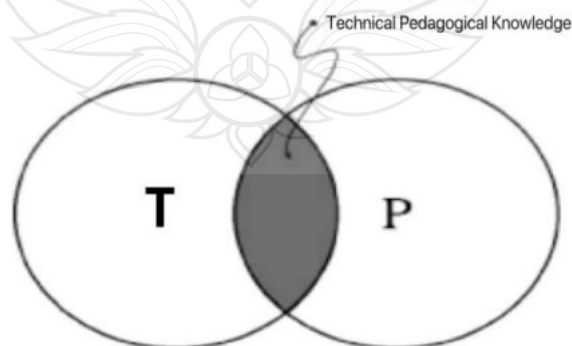
entails comprehending how technology influences our understanding of content knowledge, meanwhile providing new methods of presenting content that were previously unattainable. Technology aids in the creation of new content and offers a novel perspective on existing content (Mishra & Koehler, 2006).



Source Mishra and Koehler (2006)

Figure 2.11 Technological Content Knowledge (TCK)

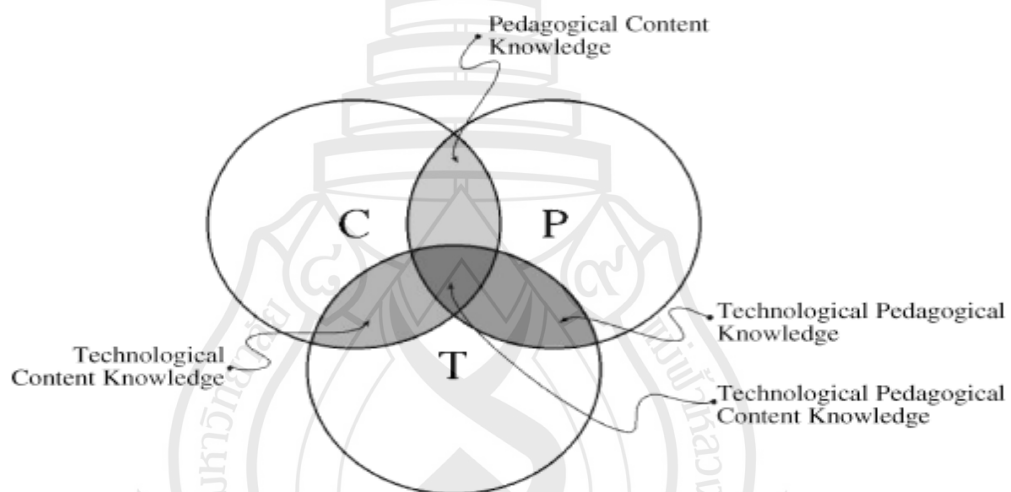
Technological Pedagogical Knowledge (TPK): Technological Pedagogical Knowledge (see Figure 2.12) refers to the knowledge to use various technologies in teaching and learning settings and understand that using technology may alter the teaching methods and approaches. TPK might include teachers' ability to determine the most appropriate technology for a particular teaching task, and to select and use the most suitable equipment based on its compatibility with a particular pedagogical approach. This includes the knowledge of technological tools for grading, checking attendance, and keeping class records (Mishra & Koehler, 2006).



Source Mishra and Koehler (2006)

Figure 2.12 Technological Pedagogical Knowledge (TPK)

Technological pedagogical content knowledge (TPACK): Technological pedagogical content knowledge (see Figure 2.13) refers an understanding of how concepts are represented through technology, pedagogical strategies that use technology to teach content constructively, an understanding of what makes concepts difficult or easy to learn and how technology can help address some of the issues that students face, an understanding of students' prior knowledge and theories of epistemology, and an understanding of how technologies can be used to construct new epistemologies or strengthen old ones (Mishra & Koehler, 2006). Teachers with TPACK can integrate technology, pedagogy, and content to design learning experiences that are appropriate for their students.



Source Mishra and Koehler (2006)

Figure 2.13 Technological pedagogical content knowledge (TPACK)

In recent decades, numerous studies have been conducted on this topic. For example, Pamuk (2012) revealed that among 78 preservice teachers in Turkey, pedagogical content knowledge (PCK) was the strongest predictor of technological integration efforts. Similarly, Hsu (2016) verified the importance of technological pedagogical content knowledge (TPACK) in the adoption of mobile-assisted language learning among 158 in-service English teachers from Taiwan. Joo et al. (2018) investigated the structural relationships between TPACK and the determinants of technological acceptance. Their goal was to identify the factors that influenced the technology usage intentions of 296 pre-service teachers in Korea. The findings showed that TPACK had a direct and positive effect on perceived usefulness and ease of use.

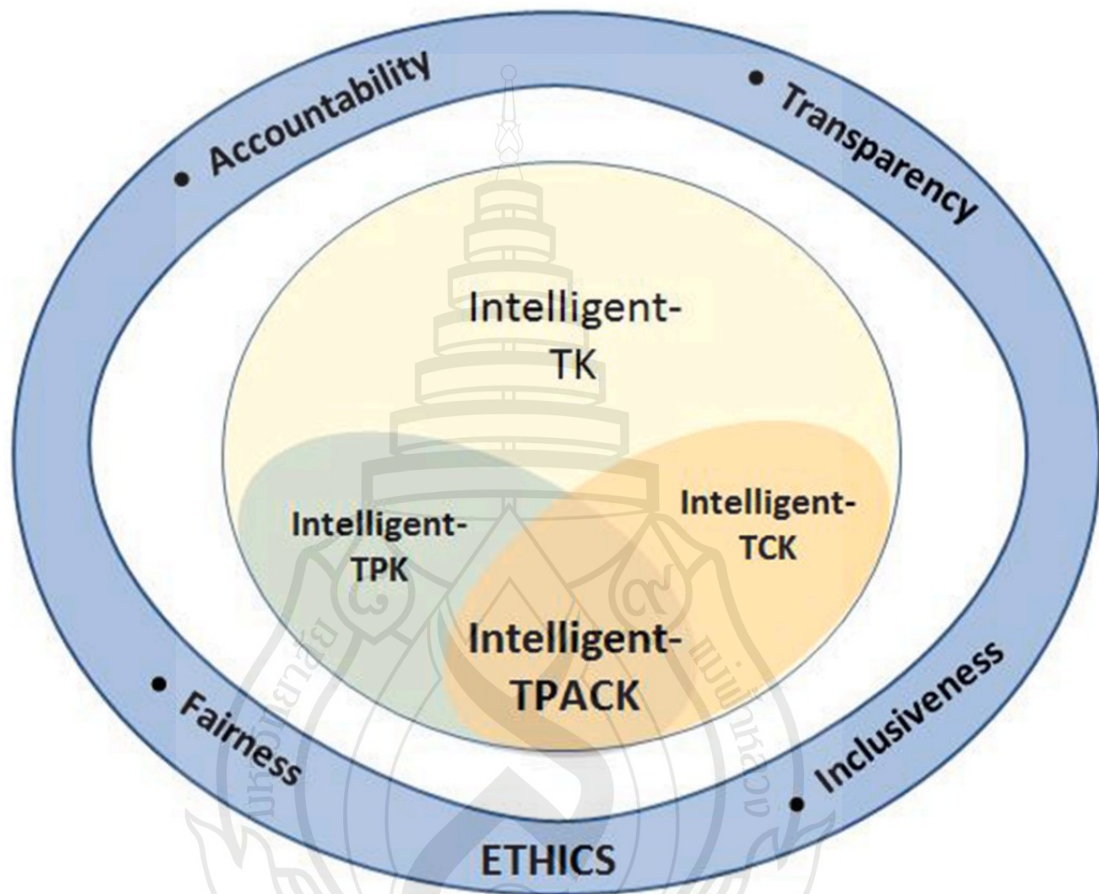
In line with this, Teo et al. (2019) found that TPACK strongly influenced Chinese pre-service teachers' willingness to use Web 2.0 tools in their future teaching methods. Furthermore, Prasojo et al. (2020) discovered a positive association between TPACK and the intention to use Web 2.0 technologies among technical school educators in Indonesia. To fully address the relationship between TPACK and teachers' actual use of technology in instruction, more empirical research is required. As a result, it is critical to investigate the relationship between teachers' TPACK knowledge and their practical use of technology. This initiative will contribute to enriching and expanding the Unified Theory of Acceptance and Use of Technology (UTAUT) model, therefore improving our understanding of how teachers practically adopt technology in their teaching practices.

In general, since its inception, the TPACK framework has received significant acceptance and has been used in a variety of educational settings around the world. Some studies have investigated the impact of TPACK on teacher education and professional development, and they have found that TPACK-based interventions can improve teacher knowledge and teaching practices (Sang et al., 2011; Schmidt et al., 2009). Aside from its role as a tool for assessing English teachers' knowledge, TPACK can also be useful in identifying the competencies and skills required to develop curricula for pre-service English teachers that adhere to the TPACK dimensions and professional development programs for in-service English teachers in the digital age. It impacts the standard of language instruction and the layout of professional development when TPACK instruments are used as a lens for assessing English teachers' knowledge.

2.7.3 Intelligent-TPACK Framework, The DPACK model and AI-TPACK Framework

The integration of artificial intelligence (AI) into education has necessitated a redefinition of teachers' professional knowledge frameworks, leading to the emergence of frameworks such as Intelligent TPACK (Celik, 2023), AI-PACK framework (Lorenz & Romeike, 2023), and AI-TPACK (Ning, 2024). Traditional TPACK (Technological Pedagogical Content Knowledge) underscores the integration of teachers' technological, pedagogical, and content knowledge to facilitate effective technology-enhanced instruction. However, the advent of AI in education requires a more sophisticated understanding of how educators could integrate AI-based tools into their

teaching practices in an ethical, effective, and strategic manner. Recent studies (Celik, 2023; Ning et al., 2024; Lorenz & Romeike, 2023) trace the evolution of the TPACK framework toward AI integration. Though labeled differently, their proposed frameworks essentially embody the same concepts.



Source Celik (2023)

Figure 2.14 The Intelligent-TPACK Framework

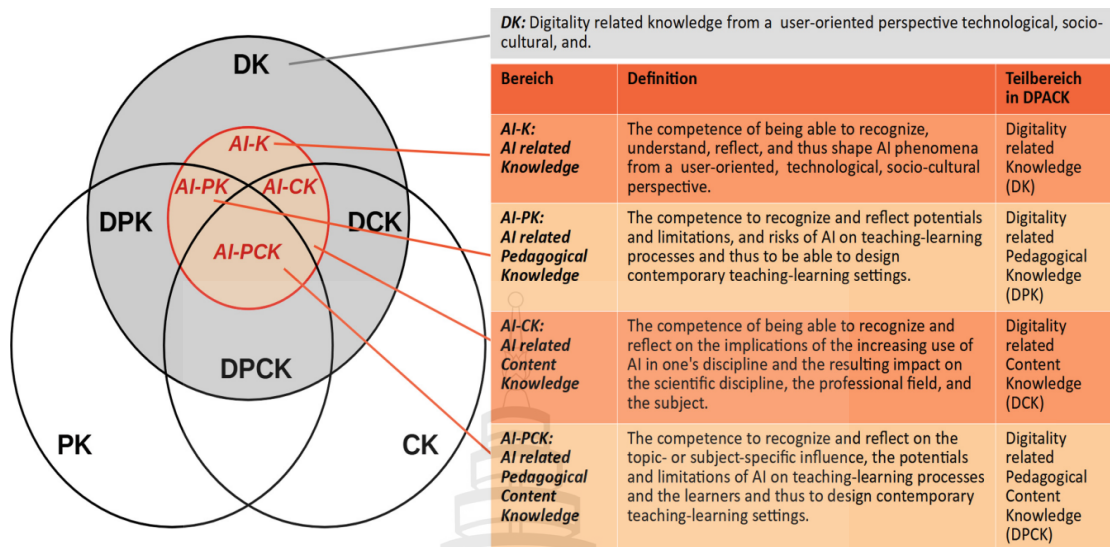
Intelligent-TPACK (see Figure 2.14) proposed by Celik (2023), emphasizes not only the acquisition of AI-related skills but also the ethical and intelligent application of AI tools in educational settings. This approach underscores the importance of teachers' professional judgment in selecting and deploying AI technologies, ensuring that AI supports pedagogical goals, respects ethical considerations, and enhances learning outcomes. In this sense, Intelligent TPACK represents a dynamic, reflective, and context-sensitive conceptualization of AI integration within teachers' professional knowledge. This study demonstrates that TK has a positive influence on TPK and TCK.

TK exhibited a positive correlation with ethics, yet no association was found with TPACK. TPK and TCK exhibited a positive correlation with TPACK. Ethics demonstrated a positive influence on TPK, TCK, and TPACK. The definitions of each constructs was shown in Table 2.10.

Table 2.10 Constructs and Definition of Intelligent-TPACK Framework

Constructs	Definitions
Intelligent-TK	Intelligent-TK refers to the knowledge required to interact with AI-based tools and utilize their basic functions, focusing on teachers' familiarity with the technical capacities of these tools (Celik, 2023).
Intelligent-TCK	Intelligent-TCK refers to the knowledge of subject-specific AI-based tools, measuring how teachers use them to update content knowledge and identify technologies best suited for supporting subject-matter learning (Celik, 2023).
Intelligent-TPK	Intelligent-TPK refers to the knowledge of pedagogical affordances of AI-based tools, such as providing feedback and monitoring learning, and measures teachers' understanding of alerts and message interpretation from these tools (Celik, 2023).
Intelligent-TPACK	Intelligent-TPACK is the core knowledge domain, measuring teachers' ability to select and apply suitable AI-based tools (e.g., intelligent tutoring systems) with appropriate strategies (e.g., monitoring, timely feedback) to achieve instructional goals in a specific domain (Celik, 2023).
Ethics	Ethics refers to teachers' evaluation of AI-based tools in terms of transparency, fairness, accountability, and inclusiveness (Celik, 2023).

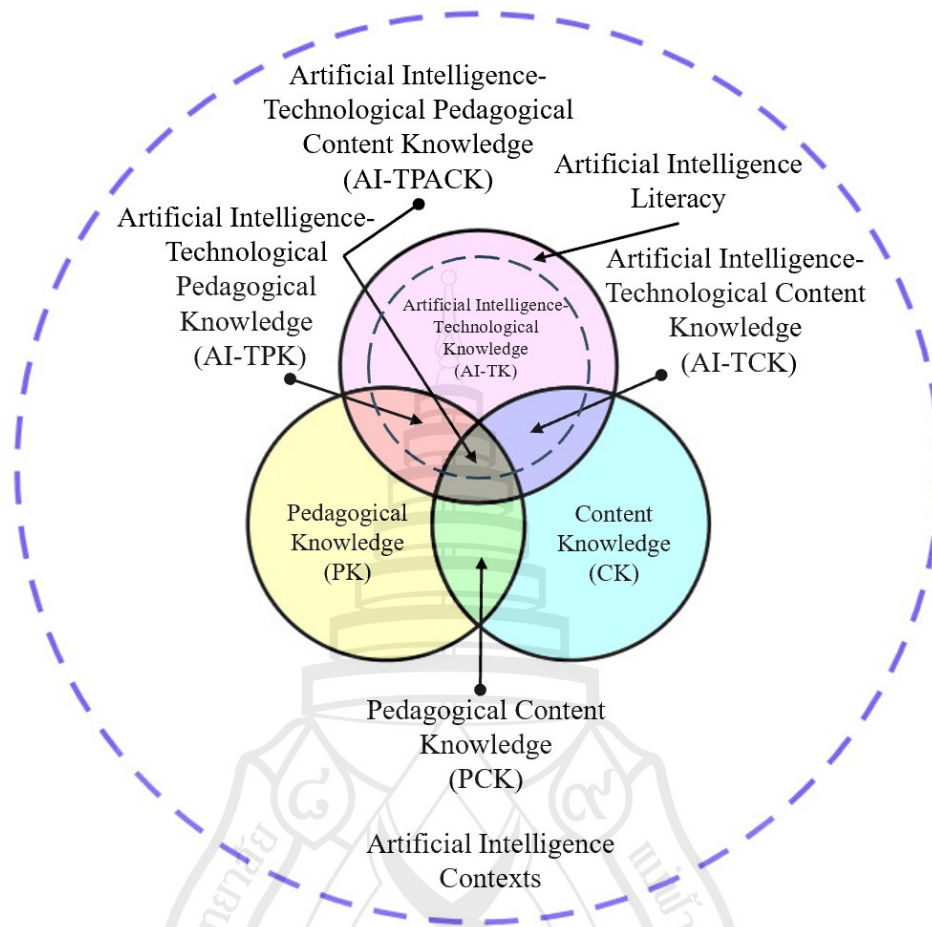
The DPACK model was developed by Lorenz and Romeike (2023), which situated and discussed AI-PACK framework in the DPACK model and defined AI-K, AI-PK, AI-CK and AI-PCK (see Figure 2.15). The AI-PACK framework facilitates the systematic description and examination of the educational requirements for AI teachers.



Source Lorenz and Romeike (2023)

Figure 2.15 The DPACK model

The AI-TPACK (see Figure 2.16) extends the original TPACK framework by explicitly incorporating AI-related knowledge components, recognizing that AI integration requires teachers not only to possess technological skills but also to understand AI functionalities, applications, and implications for pedagogy and subject matter. Ning et al. (2024) introduced AI-TPACK framework (see Figure 2.14) and defined the seven constructs of the framework (shown in Table 2.11).



Source Ning et al. (2024)

Figure 2.16 AI-TPACK Framework

In the AI-TPACK framework, TK transforms AI-TK, TPK develops into AI-TPK, TCK into AI-TCK, and TPACK ultimately transitions into AI-TPACK, which encompasses the cognitive aspects associated with artificial intelligence education, known as AI literacy. The framework can serve as a guide for large-scale assessment, emphasizing the deepening of understanding of the mechanisms that shape teachers' AI-TPACK. The findings of the study indicated that six knowledge elements function as predictive factors for AI-TPACK variables. Different knowledge elements exhibited varying degrees of explanatory power concerning teachers' AI-TPACK. The impact of core knowledge elements (PK, CK, and AI-TK) on AI-TPACK is indirect, mediated by composite knowledge elements (PCK, AI-TCK, and AI-TPK), each fulfilling distinct functions. Non-technical knowledge components exhibit considerably reduced

explanatory power for educators regarding AI-TPACK in comparison to technology-related knowledge components. Content knowledge (C) significantly reduces the explanatory power of pedagogical content knowledge (PCK) and technological pedagogical content knowledge (AI-TCK).

Table 2.11 Constructs and Definition of AI-TPACK Framework

Elements	Connotations
Content Knowledge (CK)	The knowledge applied by educators when delivering instruction in specific subject domains, such as mathematics or scientific knowledge (Ning et al., 2024).
Pedagogical Knowledge (PK)	Knowledge pertaining to the pedagogical process, methodologies, and practices comprised the formulation of instructional plans, the selection of teaching methods, classroom management strategies, assessment of student behavior, and academic performance, among other aspects (Ning et al., 2024).
AI-Technological Knowledge (AI-TK)	Educators' understanding and application of available AI technologies are of critical importance. This consists of the comprehension and familiarity of visible and tangible AI platforms, tools, products, and educational resources. It also includes adopting a pedagogical approach to using AI in educational contexts, such as fostering its literacy (Ning et al., 2024).
Pedagogical Content Knowledge (PCK)	The knowledge required to select appropriate teaching methods and strategies designed to suit specific instructional content also includes the ability to reconfigure and present information to improve pedagogical outcomes (Ning et al., 2024).
AI-Technological Content Knowledge (AI-TCK)	Teachers use AI to provide learners with highly immersive and interactive learning experiences that suit individual knowledge levels, cognitive states, and learning preferences (Ning et al., 2024).
AI-Technological Pedagogical Knowledge (AI-TPK)	An essential aspect is having a dynamic understanding of how the use of AI recognizing the mutual support, provisioning, and constraints between AI technologies and pedagogy, as well as being able to design effective teaching transforms the teaching and learning processes. This understanding includes strategies and activities accordingly (Ning et al., 2024).

Table 2.11 (continued)

Elements	Connotations
AI-Technological Pedagogical Content Knowledge (AI-TPACK)	AI-TPACK comprises specific knowledge related to integrating AI technologies into subject-specific instruction. This knowledge includes the capacity to articulate subject concepts using AI technologies, apply pedagogical skills creatively in teaching with this tool, use AI to address challenges students encounter during concept learning, and use its application to either develop new epistemologies or reinforce existing ones based on established foundations (Ning et al., 2024).

Together, AI-TPACK framework, DPACK model and Intelligent TPACK framework provide a theoretical foundation for understanding teachers' knowledge, skills, and ethical awareness required to use AI in education. They provide crucial frameworks for investigating both the readiness and AI literacy of teachers in AI-enhanced teaching and learning, impacting teacher education, professional development, and curriculum design.

2.7.4 Research Hypotheses and the Proposed Research Model

Building on the findings from the reviewed literature, the present study adopts an integrated theoretical approach by combining the Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh et al., 2003) with the AI-TPACK framework (Ning, 2024). The rationale for this combination is threefold.

First, UTAUT provides a robust and widely validated model for explaining technology adoption, capturing key determinants such as performance expectancy, effort expectancy, social influence, and facilitating conditions. It also allows for the integration of extended constructs such as anxiety and contextual influences, which were shown in Wen et al. (2024) and An et al. (2022) to play a role in AI adoption.

Second, the AI-TPACK framework specifically addresses teachers' technological, pedagogical, and content knowledge in the context of AI-assisted education. Since pre-service EFL teachers are not only technology users but also future implementers in classroom practice, their acceptance of AI requires attention to how AI knowledge interacts with pedagogical and disciplinary expertise. Prior studies (e.g., An et al., 2022) have shown that AI-TPACK dimensions (e.g., AI-TK, AI-TPK, AI-

TPACK) significantly predict behavioral intention, which highlights the necessity of embedding pedagogical knowledge into adoption models.

Third, integrating UTAUT with AI-TPACK creates a more holistic explanatory model. While UTAUT emphasizes general predictors of technology acceptance, AI-TPACK situates adoption within the pedagogical context of EFL teaching. This integration enables the present study to investigate not only whether pre-service EFL teachers intend to use AI, but also how their pedagogical knowledge, teaching context, and professional preparation shape this intention.

Accordingly, the proposed research model incorporates UTAUT constructs (performance expectancy, effort expectancy, social influence, and facilitating conditions) alongside AI-TPACK dimensions (AI-TK, AI-TPK, AI-TCK and AI-TPACK) as key predictors of pre-service EFL teachers' behavioral intention to adopt AI in language teaching. This integrated framework is expected to provide richer insights into the unique factors that shape AI adoption in teacher education contexts, addressing the theoretical and practical gaps identified in the systematic review.

The Unified Theory of Acceptance and Use of Technology model (UTAUT) and Technology, Pedagogy and Content Knowledge (TPACK) are essential theoretical reference models in initial training and teacher professional development programs for the integration of technology. The present study adopted the Unified Theory of Acceptance and Use of Technology (UTAUT) as the theoretical basis for external factors influencing teachers' behavioral intention to use AI, and the AI Technological Pedagogical and Content Knowledge (TPACK) as the theoretical basis for teachers' internal factors related to AI use. The combination of the two models should predict teachers' intention to use AI technology to a large extent (Bardakci & Alkan, 2019). The variables of the present study are presented in Figure 2.17.

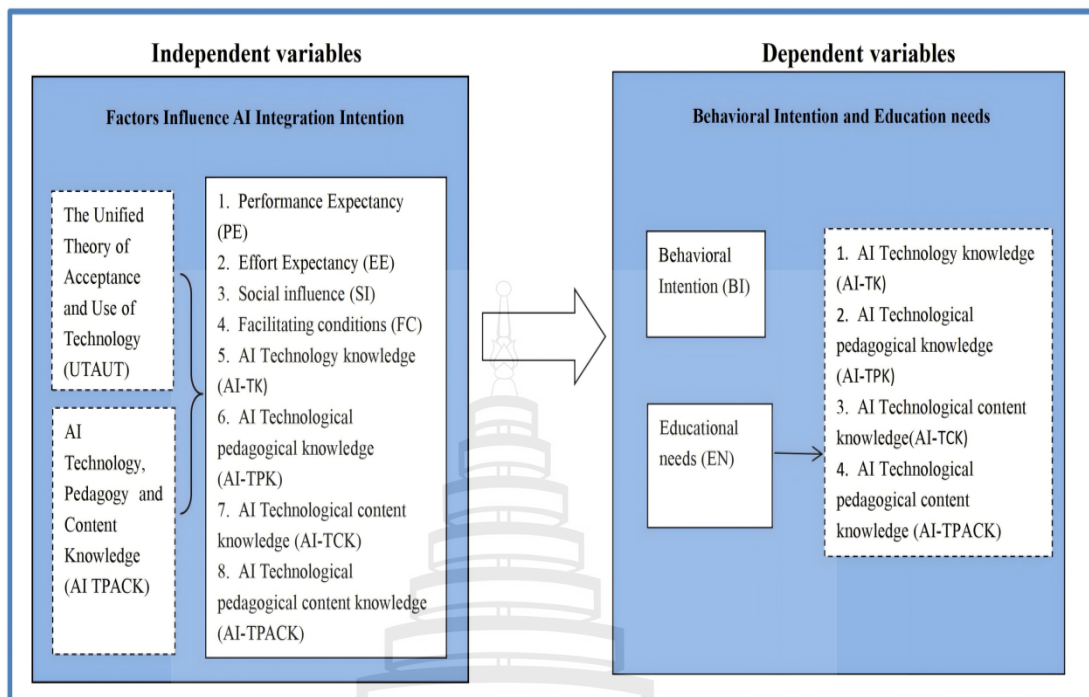


Figure 2.17 The Variables of the Study

Then the following part will present the research hypotheses for this study, along with theoretical and empirical justifications.

2.7.4.1 The UTAUT model

Performance Expectancy (PE): Performance expectancy is defined as the degree to which pre-service EFL teachers believe that using AI-based educational technology (the system) will help him or her to attain gains in teaching performance. (adapted from Venkatesh et al. 2003). In a study involving Chinese EFL teachers' intention to use ICT, Ma et al. (2022) conducted research with 585 in-service teachers across various higher education institutions. The findings of this study revealed that Performance Expectancy had a statistically significant impact on the teachers' behavioral intention to utilize ICT resources. Mohammad-Salehi et al. (2021) found that the behavioral intention (BI) of EFL teachers to use Web 2.0 technologies was positively and directly impacted by performance expectancy (PE). Based on the previous studies, the following hypothesis is formulated.

H1: Performance expectancy influences pre-service EFL teachers' behavioral intention of using AI-based educational technology directly and positively.

Effort Expectancy (EE): Effort expectancy is defined as the degree of ease associated with the use of AI-based educational technology (Adapted from Venkatesh et al., 2003). Venkatesh et al. (2003) and Dwivedi et al. (2019) noted that a consistent positive association often exists between effort expectancy and behavioral intention to use technology. H2 is formed based on the studies of the original model of UTAUT. An et al. conducted a study in 2022, they tested the hypothesis and proved that EFL teachers' effort expectancy could predict their performance expectancy regarding the use of AI. Therefore, H3 is formulated to be tested in the present study.

H2: Effort Expectancy influences pre-service EFL teachers' behavioral intention of using AI-based educational technology directly and positively.

H3: Effort Expectancy influences pre-service EFL teachers' performance expectancy of using AI-based educational technology directly and positively.

Social Influence (SI): Social influence (SI) is defined as the degree to which pre-service EFL teacher perceives that important others believe he or she should use AI-based educational technology (Adapted from Venkatesh et al., 2003). Research findings have consistently demonstrated that SI plays a pivotal role in shaping behavioral intention (Mei et al., 2018; Teo et al., 2019; Mohammad-Salehi et al., 2021). In the most recent study, Mohammad-Salehi et al. (2021) investigated factors that influence EFL teachers' adoption of Web 2.0 Technologies by extending the UTAUT model with TPACK as a construct. The study revealed that the behavioral intention (BI) of EFL teachers to use Web 2.0 technologies was positively and directly impacted by social influence (SI). Consequently, the present study hypothesizes that social connections will influence the intention of preservice EFL teachers to adopt AI-based educational technology.

H4: Social influence influences pre-service EFL teachers' behavioral intention of using AI-based educational technology directly and positively.

Facilitating Condition (FC): Facilitating conditions are defined as the degree to which pre-service EFL teachers believe that an organizational and technical infrastructure exists to support the use of AI-based educational technology. (adapted from Venkatesh et al., 2003). Chatterjee and Bhattacharjee (2020) proved that facilitating condition have a significant and positive impact on Effort Expectancy (EE) regarding the adoption of artificial intelligence in higher education. Based on the

research, H5 is formulated. An et al. (2022) hypothesized that facilitating conditions could predict performance expectancy, although it was not supported. Since the findings varied in different contexts, H6 was formulated to be tested in the present study.

H5: Facilitating condition influences pre-service EFL teachers' Effort Expectancy of using AI-based educational technology directly and positively.

H6: Facilitating condition influences pre-service EFL teachers' performance expectancy of using AI-based educational technology directly and positively.

Behavioral Intention (BI): refers to the pre-service EFL teacher's plans and decisions to use AI-based educational technology in the future (adapted from Venkatesh et al., 2003). In the UTAUT framework, use behavior is influenced directly by behavioral intention.

2.7.4.2 The AI-TPACK Framework

An et al. (2022) found that AIL-TK predicted AI-TPK, while AIL-TK and AI-TPK predicted AI-TPACK. Ning et al. (2024) revealed that AI-TK impacted AI-TCK, and AI-TPK, and AI-TK, AI-TCK, and AI-TPK impacted AI-TPACK. Celik (2023) found a positive relationship between Intelligent-TK and Intelligent-TPK, Intelligent-TK and Intelligent-TCK, Intelligent-TPK and Intelligent-TPACK, Intelligent-TCK and Intelligent-TPACK, while Intelligent-TK was not associated with Intelligent-TPACK. Based on the above studies, H7-H11 was formed.

H7: Pre-service EFL teachers' AI-TK influences AI-TPK directly and positively.

H8: Pre-service EFL teachers' AI-TK influences AI-TPACK directly and positively.

H9: Pre-service EFL teachers' AI-TK influences AI-TCK directly and positively.

H10: Pre-service EFL teachers' AI-TPK influences AI-TPACK directly and positively.

H11: Pre-service EFL teachers' AI-TCK influences AI-TPACK directly and positively.

2.7.4.3 The AI-TPACK and UTAUT

1. AI-TPACK and Behavioral Intention

In a previous study, TPACK was integrated into the UTAUT model. In the study conducted by Bardakci and Alkan (2019), Only Performance Expectancy had a high explanation (0.91) for Behavioral Intention in the study involving pre-service teachers using an interactive whiteboard. However, Lim and Harwati (2021) found that only TPACK would significantly predict Behavioral Intention; Performance Expectancy, Effort Expectancy, and Facilitating Conditions did not predict intention regarding the use of general technology. Mohammad-Salehi et al. (2021) found that TPACK demonstrated a strong impact on EE and PE. Nonetheless, TPACK had a non-significant impact on the Behavioral Intention of Iranian English teachers regarding the use of Web 2.0 technologies. In the study by An et al. (2022), AIL-TK (AI Language Technological Knowledge) and AI-TPACK (AI Technological Pedagogical Content Knowledge) could predict behavioral intention, while AI-TPK (AI Technological Pedagogical Knowledge) could not. Consequently, based on previous research, the hypotheses (H12-15) below were formed:

H12: AI-TK influences pre-service EFL teachers' behavioral intention of using AI-based educational technology directly and positively.

H13: AI-TPK influences pre-service EFL teachers' behavioral intention of using AI-based educational technology directly and positively.

H14: AI-TPACK influences pre-service EFL teachers' behavioral intention of using AI-based educational technology directly and positively.

H15: AI-TCK influences pre-service EFL teachers' behavioral intention of using AI-based educational technology directly and positively.

2. The AI-TPACK, Performance Expectancy and Effort Expectancy

According to Cheung et al. (2016), TPACK was positively connected with Performance Expectancy and Effort Expectancy. Mohammad-Salehi et al (2021) found that TPACK demonstrated a strong impact on Effort Expectancy (EE), AIL-TK, and Performance Expectancy (PE). An et al. (2022) hypothesized that AI-TPACK (AI Technological Pedagogical Content Knowledge), AI-TPK (AI Technological Pedagogical Knowledge), and AIL-TK (AI Language Technological Knowledge) could predict Effort Expectancy (EE), Performance Expectancy (PE). Finally, they found that

AI-TPACK predicted Effort Expectancy, Performance Expectancy, while AIL-TK and AI-TPK only predicted Effort Expectancy. Since the findings varied in different contexts, H16-23 were developed in the present study.

H16: Pre-service EFL teachers' AI-TK influences performance expectancy directly and positively.

H17: Pre-service EFL teachers' AI-TK influences effort expectancy directly and positively.

H18: Pre-service EFL teachers' AI-TPK influences performance expectancy directly and positively.

H19: Pre-service EFL teachers' AI-TPK influences effort expectancy directly and positively.

H20: Pre-service EFL teachers' AI-TPACK influences performance expectancy directly and positively.

H21: Pre-service EFL teachers' AI-TPACK influences effort expectancy directly and positively.

H22: Pre-service EFL teachers' AI-TCK influences performance expectancy directly and positively.

H23: Pre-service EFL teachers' AI-TCK influences effort expectancy directly and positively.

3. Facilitating Condition and the AI-TPACK

Tram (2024) found that facilitation was a significant predictor of AI-TPACK. Lachner et al. (2021) demonstrated that perceived support for technology integration, conceptually like Facilitating Conditions (FC), serves as a predictor of teachers' TPACK. And Parviz and Arthur (2025) discovered that facilitating condition could predict AI-TPACK AIL-TK, and AI-TPK. Consequently, H24-H26 were formulated. Moreover, based on the previous study, we conjecture that the facilitating condition can affect AI-TCK. Therefore, H27 was formed.

H24: Facilitating condition influences pre-service EFL teachers' AI-TK of using AI-based educational technology directly and positively.

H25: Facilitating condition influences pre-service EFL teachers' AI-TPK of using AI-based educational technology directly and positively.

H26: Facilitating condition influences pre-service EFL teachers' AI-

TPACK of using AI-based educational technology directly and positively.

H27: Facilitating condition influences pre-service EFL teachers' AI-TCK of using AI-based educational technology directly and positively.

In the present study, 27 hypotheses are formulated, as shown in Table 2.12.

Table 2.12 Hypotheses of the Present Study

Number	Hypotheses
The UTAUT Model	
H1	Performance expectancy l influences pre-service EFL teachers' behavioral intention of using AI-based educational technology directly and positively.
H2	Effort Expectancy influences pre-service EFL teachers' behavioral intention of using AI-based educational technology directly and positively.
H3	Effort Expectancy influences pre-service EFL teachers' performance expectancy of using AI-based educational technology directly and positively.
H4	Social influence influences pre-service EFL teachers' behavioral intention of using AI-based educational technology directly and positively.
H5	Facilitating condition influences pre-service EFL teachers' Effort Expectancy of using AI-based educational technology directly and positively
H6	Facilitating condition influences pre-service EFL teachers' performance expectancy of using AI-based educational technology directly and positively.
The AI-TPACK Framework	
H7	Pre-service EFL teachers' AI-TK influences AI-TPK directly and positively.
H8	Pre-service EFL teachers' AI-TK influences AI-TPACK directly and positively.
H9	Pre-service EFL teachers' AI-TK influences AI-TCK directly and positively.
H10	Pre-service EFL teachers' AI-TPK influences AI-TPACK directly and positively.
H11	Pre-service EFL teachers' AI-TCK influences AI-TPACK directly and positively.
The UTAUT Model and The AI-TPACK Framework	
H12	AI-TK influences pre-service EFL teachers' behavioral intention of using AI-based educational technology directly and positively.
H13	AI-TPK influences pre-service EFL teachers' behavioral intention of using AI-based educational technology directly and positively.

Table 2.12 (continued)

Number	Hypotheses
H14	AI-TPACK influences pre-service EFL teachers' behavioral intention of using AI-based educational technology directly and positively.
H15	AI-TCK influences pre-service EFL teachers' behavioral intention of using AI-based educational technology directly and positively.
H16	Pre-service EFL teachers' AI-TK influences performance expectancy directly and positively.
H17	Pre-service EFL teachers' AI-TK influences effort expectancy directly and positively.
H18	Pre-service EFL teachers' AI-TPK influences performance expectancy directly and positively.
H19	Pre-service EFL teachers' AI-TPK influences effort expectancy directly and positively.
H20	Pre-service EFL teachers' AI-TPACK influences performance expectancy directly and positively.
H21	Pre-service EFL teachers' AI-TPACK influences effort expectancy directly and positively.
H22	Pre-service EFL teachers' AI-TCK influences performance expectancy directly and positively.
H23	Pre-service EFL teachers' AI-TCK influences effort expectancy directly and positively.
H24	Facilitating condition influences pre-service EFL teachers' AI-TK of using AI-based educational technology directly and positively.
H25	Facilitating condition influences pre-service EFL teachers' AI-TPK of using AI-based educational technology directly and positively.
H26	Facilitating condition influences pre-service EFL teachers' AI-TPACK of using AI-based educational technology directly and positively.
H27	Facilitating condition influences pre-service EFL teachers' AI-TCK of using AI-based educational technology directly and positively.

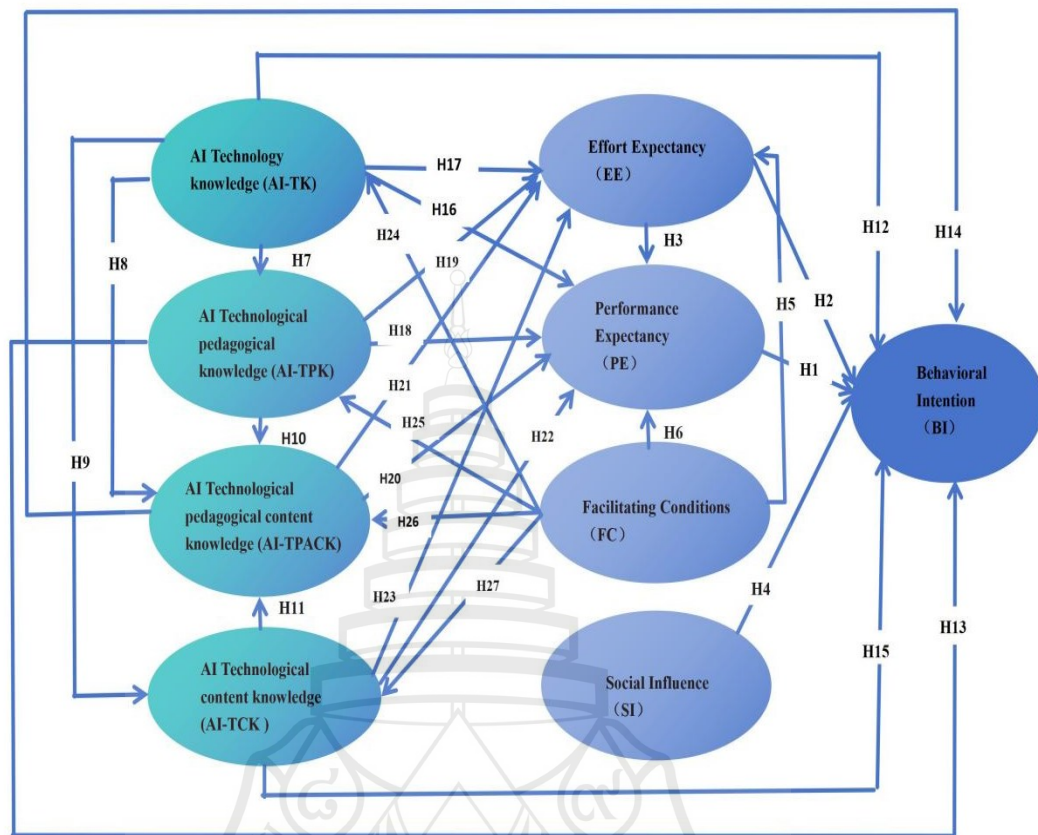


Figure 2.18 The Research Model

The research model (see Figure 2.18) was tested to investigate factors affecting AI-based educational technology acceptance among Chinese EFL teachers by applying the UTAUT model and TPACK frameworks. Nine factors, including PE, EE, SI, FC, and AI-TK, AI-TPK, AI-TCK and AI-TPACK are selected as independent variables, and BI is the dependent variable based on prior research, as illustrated in Figure 2.26. And the definition variables of the present study are concluded in Table 2.13.

Table 2.13 Definitions of the Constructs of the Proposed Model

Constructs	Definition
Performance Expectancy	Performance expectancy is defined as the degree to which pre-service EFL teachers believe that using AI-based educational technology (the system) will help him or her to attain gains in job performance. (adapted from Venkatesh et al., 2003).

Table 2.13 (continued)

Constructs	Definition
Effort Expectancy	Effort expectancy is defined as the degree of ease associated with the use of AI-based educational technology. (Adapted from Venkatesh et al., 2003).
Social Influence	Social influence is defined as the degree to which pre-service EFL teachers perceive that important others believe he or she should use AI-based educational technology. (Adapted from Venkatesh et al, 2003).
Facilitating Conditions	Facilitating conditions are defined as the degree to which pre-service EFL teacher believes that an organizational and technical infrastructure exists to Support the use of AI-based educational technologies. (adapted from Venkatesh et al., 2003).
AI-TK	AI-TK focuses on the knowledge required to interact with AI-based educational technologies and utilize their core functions. It assesses how familiar pre-service EFL teachers are with the technical capabilities of AI-based tools (adapted from Celik, 2023).
AI-TPK	AI-TPK concerns the knowledge of how AI-based educational technologies can support teaching (pedagogical affordances), such as providing personalized feedback or monitoring student progress. It also measures pre-service EFL teachers' ability to interpret alerts and notifications generated by AI tools (adapted from Celik, 2023).
AI-TCK	AI-TCK centers on knowledge of AI-based educational technologies specific to a particular subject area. It measures how pre-service EFL teachers use AI to enhance their content knowledge and their understanding of which AI technologies best support learning objectives within their discipline (adapted from Celik, 2023).
AI-TPACK	AI-TPACK represents the core knowledge domain. It measures the pre-service EFL teachers' professional ability to select and implement appropriate AI-based educational technologies (e.g., intelligent tutors) to execute specific teaching strategies (e.g., monitoring, feedback) and achieve instructional objectives within EFL teaching (adapted from Celik, 2023).

Table 2.13 (continued)

Constructs	Definition
Behavioral Intention	The pre-service EFL teachers' plans and decisions regarding AI-based educational technology in the future. (adapted from Venkatesh et al., 2003).

2.8 Summary of the Chapter

This chapter provides an overview of relevant research on technology adoption and the needs of EFL teachers. It conducts a comprehensive literature review that involves various related fields. In this review, the study is first contextualized in the context of AI policies and developments in China to highlight the growing role of AI-based educational technologies in the country. The literature review is then followed by a review of EFL teacher preparation in the AI age, factors influencing EFL teachers' ICT acceptance, EFL teachers' TPACK-related study, and AI-TPACK needs analysis, and then a systematic review was conducted to review 56 AI in EFL related Chinese studies to examine the gaps and offer valuable insights and findings that contribute to the research's theoretical and methodological foundations.

The Unified Theory of Acceptance and Use of Technology (UTAUT) model is the focus of the literature review because it plays an important role in understanding behavioral intentions related to the adoption of technology, especially in English educational contexts. The Technological Pedagogical Content Knowledge (TPACK) framework, Intelligent-TPACK Framework, the DPACK model, and AI-TPACK Framework are also reviewed, underlining their relevance in the EFL teachers' professional development needs and EFL teacher education, especially concerning AI-based educational technologies. The next chapter presents the research methodology that is used in the present study.

CHAPTER 3

RESEARCH METHODOLOGY

The purpose of this chapter is to present the research design and procedures employed in this study. It is organized into nine main sections. Section 3.1 introduces the research design, while Section 3.2 provides an overview of the research setting, and Section 3.3 focuses on the participants. Section 3.4 describes the research instruments, followed by Section 3.5, which addresses instrument translation and the pilot study. Section 3.6 outlines the data collection procedures, and Section 3.7 explains the data analysis methods. Section 3.8 discusses ethical considerations, and finally, Section 3.9 provides a summary of the chapter.

3.1 Research Design

The study adopts a mixed-method research design to examine the key factors influencing Chinese pre-service EFL teachers' intention to adopt AI-based educational technology, as well as their AI-TPACK based educational needs, with a focus on pre-service EFL teachers at Chuxiong Normal University in Yunnan Province, southwest China. Both questionnaires and interviews were employed to collect quantitative and qualitative data. Equal emphasis was placed on quantitative and qualitative aspects (QUAN-QUAL) by analyzing the factors influencing the intention to use AI-based technology in EFL teaching and the educational needs of pre-service EFL teachers. Quantitative data were gathered through a questionnaire, while qualitative data were collected separately via semi-structured interviews. Interviews with in-service EFL teachers, administrators, and ICT teachers provided multiple perceptions of AI-based educational technologies in EFL instruction and teacher preparation, situating the findings within real teaching contexts. The results are expected to offer valuable evidence and recommendations for integrating AI-based educational technology, enhancing EFL teacher preparation programs, and improving curriculum design in AI-rich teaching environments.

Mixed-method research design combines both quantitative and qualitative research methods to provide a comprehensive understanding of a research topic (Teddie & Tashakkori, 2009). The use of both methods can provide a more complete picture of the research topic and can complement each other's strengths and weaknesses (Borg & Gall, 1989; Bryman, 1988; Dörnyei, 2007). Combining the two methods can enhance the scope, depth, and power of research (Punch, 2005) and increase the trustworthiness of the findings. The purpose of the study is to comprehensively assess the factors that influence the intentions of AI-based educational technologies in EFL teaching and investigate the educational needs of pre-service EFL teachers. The use of a mixed-method design allows for a more complete understanding of the research topic, combining quantitative and qualitative methods to provide a richer datasets and more robust findings.

This study adopted a convergent parallel mixed-methods design (Creswell & Plano Clark, 2017) to enable the triangulation and cross-validation of findings related to Chinese pre-service EFL teachers' behavioral intention to use AI-based educational technologies and their AI-related educational needs. This design was particularly appropriate because the research sought to examine both the structural relationships among key constructs within the UTAUT model and the AI-TPACK framework, including EE, PE, BI, SI, FC, AI-TK, AI-TPK, AI-TCK, and AI-TPACK. as well as the contextualized experiences and perceptions of various stakeholders in the same educational setting. Quantitative and qualitative data were collected simultaneously and analyzed separately, which allowed each dataset to preserve methodological integrity while addressing complementary aspects of the research problem. The quantitative data provided statistical evidence of the relationships between UTAUT and AI-TPACK constructs, while the qualitative data provided detailed explanations of perceived influencing factors, challenges, needed institutional support, and educational needs for AI integration. The two datasets were then integrated using side-by-side comparison and thematic alignment, enabling the identification of convergent, complementary, and divergent results and findings. This convergence strengthened the credibility of the results through cross-validation. It facilitated a more holistic understanding of AI adoption and competency development among pre-service EFL teachers, thereby supporting the generation of evidence-based and actionable recommendations for EFL

quantitative instrument. Following this, the interview schedules, questions, procedures, and the online meeting platform (Tencent Meeting) were also tested through a pilot study.

Stage 2:

In this stage, data was collected. Firstly, quantitative data was collected through the distribution of electronic questionnaire to all the pre-service EFL teachers at CXN University from 18 November to 4 December 2024. Secondly, participants for the interviews were selected, and qualitative data were collected from four groups of participants, including 21 in-service EFL teachers, 12 pre-service EFL teachers, 1 administrator and 3 ICT teachers. One-on-one interviews and focus-group interviews were conducted through Tencent Meeting.

Stage 3:

Both quantitative and qualitative data were analyzed separately and then merged. The research procedure is illustrated in Figure 3.2.

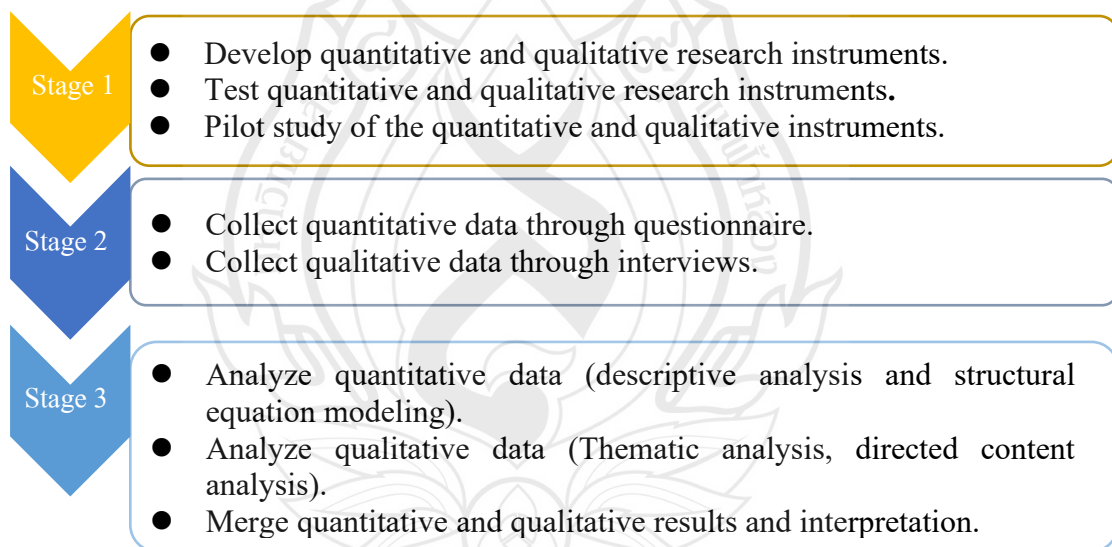


Figure 3.2 Research Procedure

The next sections discuss the convergent parallel design, including the research site, research participants, research instrument design, data collection, and data analysis for the present study.

3.2 Research Site

CXNU is a full-time general undergraduate university in Yunnan Province. It was established in May 2001 with the approval of the Ministry of Education, though its origins can be traced back to the Provincial Zhennan Normal School, founded in 1936. The university is an institution of higher learning with a glorious revolutionary tradition and distinctive characteristics in teacher education.

The university is in Chuxiong City, the capital of Chuxiong Yi Autonomous Prefecture in Yunnan Province, approximately 100 kilometers from Kunming, the provincial capital. The university recruits full-time undergraduate students from 25 provinces (autonomous regions and municipalities) across the country and currently has 15,364 full-time undergraduate students. The word "Normal" originated from the French *École normale supérieure* in Paris (Hardy, 2012, p.132). As implied by the name, a "normal" school is a typical school that sets standards for instruction or teaching norms. Normal universities in mainland China are responsible for training teachers (Hardy, 2012). Furthermore, CXNU is in southwest China's Yunnan province. It is categorized as one of China's medium-developed regions, according to Huang et al. (2019). The university does not rank among the key mainland Chinese universities as determined by the Chinese government's 211 or 985 projects. The strategy of "revitalizing China through developing science and education" (*kejiao xingguo*) was adopted in May 1995 by the CCP and the State Council, the Chinese cabinet, together promulgating the Decision to Speed up the Advancement of Science and Technology (Ngok & Guo, 2008b). In 1995, the State Council initiated the "211 Project" in response to these conditions (Zhou, 2006, p.36).

In May 1998, President Jiang proposed the establishment of a world-class university, a policy that later became known as the "985 Scheme." The primary objective of the "985 Scheme" was to develop a number of elite universities in China. According to Jiang Zemin, the 985 Scheme aims to establish a few top-tier Chinese universities in preparation for China's modernization (Ngok & Guo, 2008a). However, CXNU is a standard regional university funded by Yunnan province, which can serve as a representative example of general universities in China's medium-developed

regions, since most Chinese universities are non-key or general universities. The EFL program at this university dates to 1978, giving it a rich history. The English major enrolled two-year college students from 1978 to 1983, three-year college students from 1984 to 2000, and undergraduate students since 2001.

In 2017, the university began admitting its first cohort of undergraduate students. Records from the School of Foreign Languages indicate that more than 5,700 English teachers have been trained there since 1978. Furthermore, Yunnan Province relies heavily on CXNU as a source of EFL teachers. Currently, the national entrance examination for higher education, or Gaokao, is used to admit about 150 pre-service EFL teachers per year to the EFL teacher-training program. Currently, 646 pre-service EFL teachers preparing to teach English to non-native speakers are trained by the university. In the graduation requirements for teaching skills, the school-level training plan clearly states that EFL teachers need to have the awareness and ability to proactively adapt to new technological changes, such as informatization and artificial intelligence, to carry out middle school English education and teaching actively and effectively.

The rationales for selecting CXNU as a research site are listed as follows: Firstly, Ulriksen and Dadalauri (2016) contend that rigorous research designs and carefully chosen case studies can support the testing and modification of strong theoretical frameworks, providing significant empirical leverage and insightful conclusions. In addition, CXN University in southwest China was selected as the research site, given the theory-testing nature of the research. Furthermore, regarding the integration of AI in education, Pedro et al. (2019) argued that a decentralized and localized analysis of what is happening in classrooms is necessary. Research that is locally focused and well-focused can help to distinguish teachers as active participants as opposed to merely consumers or providers of pre-made technology solutions. Lastly, the researcher has full institutional support, as she is a lecturer at the university. To reduce the risk of insider bias, which could potentially result in tainted or favorable responses (Costley, Elliott, & Gibbs, 2010), the researcher's status as a research student who is neither the participants' teacher nor someone with any influence over their grades or academic performances was emphasized before conducting the research.

3.3 Research Participants

3.3.1 Pre-service EFL Teacher

Approximately 646 pre-service EFL teachers at CXNU are the population of the present study. Rather than using sampling, the present study used A census approach, and questionnaires were distributed to the entire population of 646 pre-service English teachers at CXNU. A total of 617 questionnaires were returned. After data cleaning, 576 valid responses were included in the final analysis (see section 3.7.1.1.3). The final sample covered more than 89% of the target population, which is considered adequate for SEM analysis and reasonably representative of the population. The participants for the focus group semi-structured interview were the participants who expressed interest in participating in a follow-up interview when completing the electronic questionnaire. The sampling method, sample size, and related instruments are shown in Table 3.1. The study utilized purposive sampling to choose interview participants. Purposive sampling involves selecting participants based on the characteristics of the target group or the researcher's judgment (Cohen et al., 2000). In this study, two criteria guided the selection of interviewees: first, they must have at least one year of experience using technology; and second, they must have a minimum of three months of experience using artificial intelligence applications and systems. The applications and systems were listed as follows, but not limited to: TikTok, Squirrel AI, Youdao Translation, Baidu Translation, Liulishuo, BaiCiZhan, Shanbay English, Chaoxing Xuexitong Platform, Seewo Whiteboard, etc. The sample size was decided by the number of pre-service teachers who volunteered to participate in the interview. As suggested by Bolderston (2012), a phenomenological study may involve around 10 participants. In the present study, however, 21 participants took part in the interviews.

Table 3.1 Sampling Method and Sample Size 1

Population	Criteria	Sampling method	Number of participants	Instruments
All Pre-service EFL teachers in Chuxiong Normal University (n=646)	Pre-service teachers who are currently enrolled at Chuxiong Normal University and majoring in English	A census approach	617	Questionnaire
All Pre-service EFL teachers in Chuxiong Normal University who participate in the questionnaire survey (n=617)	The participants who meet the criteria: have at least 1 year of internet usage experience and have at least three months of artificial intelligence applications and systems usage experience. And expressed interest in participating in a follow-up interview when completing the electronic questionnaire	Purposive sampling	21	Semi-structured interview (focus group)

3.3.2 In-service EFL teachers

In the present study, in-service secondary school EFL teachers were also included to examine their perceptions and the factors influencing their intentions to use AI-based educational technology, as well as their perceived professional development needs. This inclusion aimed to further understand EFL teachers' intentions to adopt AI-based EdTech by contextualizing them within practical teaching conditions. The results provide informative evidence and suggestions for improving the EFL teacher preparation program and EFL teacher curriculum design. As Palvia et al. (2003) noted, the importance of qualitative research has increased due to the constantly evolving nature of information technology and management information system. Accordingly, a qualitative approach was employed to gain insights from in-service EFL teachers.

Purposive sampling with maximum variation was used to select in-service EFL teacher participants with diverse levels of AI experience and teaching practice backgrounds. Purposive sampling is a common method used in qualitative research to

produce "insight and in-depth understanding" (Patton, 2002, p 230) of the subject matter. Choosing data cases (participants, texts) for purposeful sampling assumes that they will be able to supply "information-rich" (Patton, 2002, p.230) data for analysis. And two criteria are formulated for selecting in-service EFL teachers: Firstly, in-service secondary school EFL teachers who majored in English and graduated from CXNU within five years ranging from 2020 to 2024; Secondly, Based on the first criterion, the in-service EFL teachers who show proficiency in the use of technology to support teaching and learning, especially show proficiency in using AI-based educational technology. Twelve in-service EFL teachers currently teaching in secondary schools were selected and interviewed in individual semi-structured interviews. The sample size of twelve determined by data saturation in qualitative research rather than by population proportion. According to previous research, the studies commonly reach saturation with approximately 5-25 participants, depending on the research design and methodology (Creswell, 1998; Guest et al.,2006; Kuzel,1992). In the present phenomenological study, twelve samples were selected purposively and data collection continued until no new themes emerged, indicating that data saturation was attained. The population, criteria, sampling method, sample size, and related instruments are shown in Table 3.2.

Table 3.2 Sampling Method and Sample Size 2

Population	Criteria	Sampling method	Number of participants	Instruments
All in-service EFL teachers graduated from Chuxiong Normal University within five years. (n=312)	1. In-service secondary school EFL teachers who majored in English and graduated from Chuxiong Normal University within five years ranging from 2020 to 2024. 2. Based on the first criteria, the In-service teachers who show proficiency in the use of technology to support teaching and learning, especially show proficiency in using AI-based educational technology.	Purposive sampling	12	Semi-structured interview protocol (individual)

3.3.3 Administrator

The Administrator, who is responsible for the curriculum design and training plan for EFL teacher education in CXNU, was interviewed. One administrator is responsible for the curriculum design and training plan for the EFL teacher program at CXNU. The interview aimed to explore the administrator's perspectives, strategies, and initiatives related to AI integration in EFL education and EFL teacher preparation, with the overarching goal of enhancing the quality, relevance, and adaptability of EFL teacher education programs at CXNU.

The purposive sampling method was used, as Tongco (2007) suggested that information is held by only certain members of the community, and purposive sampling should be employed. In the present study, the required information was held by the vice dean of the School of Foreign Languages, who is responsible for curriculum design and the training plan for the EFL teacher program.

3.3.4 ICT Teachers

Two ICT courses and one practical activity are provided for pre-service EFL teachers at CXNU. The first is a general compulsory course, University Computer Basics (2 credits), offered by the School of Mathematics and Computer Science for all normal and non-normal majors, including English, Chinese, mathematics, chemistry, music, and others. The instructors for this course are computer technology specialists, so the focus is on basic computer knowledge.

Another course is the compulsory modern educational technology course (2 credits) within the teacher education curriculum, titled Informatization Teaching Design and Practice. This course is offered by the School of Education for students majoring in teacher education. It aims to equip pre-service teachers with foundational knowledge and skills in teaching design and practice within an information-based environment prior to their internships, thereby laying a solid foundation for both educational internships and future teaching work. The instructors are professionals with expertise in both computer technology and education. Key teaching content includes an overview of informatization teaching, informatization teaching environments, informatization teaching design and case studies, acquisition and integration of informatization teaching resources, design of informatization teaching plans, and informatization teaching practice. Notably, the course does not include content

specifically related to English teaching. The modules of commonly used teaching software (e.g., Geometry Sketchpad, Simulated Chemistry Laboratory, NB Physics Experiment, Science Word) indicate that the course content is primarily focused on science majors.

The third offering is a practical modern educational technology skills training activity (2 credits), which is an elective organized by the School of Mathematics and Computer Science for all university students.

The four-year EFL teacher program requires a total of 213 credits for graduation, with 6 credits allocated to ICT courses, accounting for only 2.82% of the total credits. An examination of the curriculum and ICT courses for pre-service EFL teachers at CXNU indicates that few ICT courses are offered, and those available are general in nature, without specific connections to the EFL teaching context. In a survey of more than 3,000 primary and secondary school teachers across ten Chinese provinces, Yang et al. (2004) found that the ICT requirements of schools were not adequately met by the technology courses offered in teacher education programs. Nearly twenty years later, ICT courses in EFL pre-service teacher education in China remain underdeveloped.

In this context, Five ICT teachers are teaching ICT courses for Pre-service EFL teachers at CXNU. And three ICT course teachers were interviewed to investigate teaching practices, challenges, and their suggestions for preparing EFL teachers for AI-assisted English language teaching. The rationale for using purposive sampling method was the same as discussed in above section (section 3.3.1, 3.3.2, 3.3.3). The population, selection criteria, sampling method, sample size, and related instruments are summarized in Table 3.3.

Table 3.3 Sampling Method and Sample Size 3

Population	Criteria	Sampling method	Number of participants	Instruments
ICT teachers who teach ICT courses for Pre-service Teachers. (n=5).	The ICT teachers teach ICT courses for pre-service Teachers.	Purposive sampling	3	Semi-structured interview protocol (individual)

3.4 Research Instruments

This study employed a mixed-methods design, utilizing different instruments to collect data both quantitatively and qualitatively. Two types of research instruments, an electronic questionnaire and four semi-structured interview questions, were used for data collection. The following section presented detailed information about these instruments.

3.4.1 Electronic Questionnaire

A multiple-item questionnaire with three parts was designed to collect quantitative data on factors influencing pre-service EFL teachers' intentions to adopt AI-based educational technology and the educational needs of pre-service EFL teachers. According to the UTAUT model, gender, age, and experience are important moderators of technology acceptance (see Figure 2.17). Therefore, Part A collected demographic data, including gender, age, grade, experience in technology use, and experience with AI tools (see Table 3.4).

Table 3.4 Demographics for Pre-service EFL Teacher Respondents

Questionnaire Terms	Category	N of Items
Gender	Male	3
	Female	
	Other	
Grade	Freshman	4
	Sophomore	
	Junior	
	Senior	
Age	Filling blank	1
Experience in using any of the following technologies (Internet, computer, laptop, smartphone, tablet, etc.) or applications (WeChat, QQ, blog, Tiktok ect.): _____.	Less than 1 year	4
	1-2 years	
	3-4 years	
	More than 5 years	

Table 3.4 (continued)

Questionnaire Terms	Category	N of Items
Experience in using any of the following AI tools (ChatGPT, Kimi, Wenxin Yiyan, Tongyi Qianwen, iFlytek Mars, Doubao, iFlytek, Squirrel AI, Youdao Translation, Baidu Translation, Liulishuo, BaiCiZhan, Shanbay English, Chaoxing Xuexitong Platform, Seewo Whiteboard, etc.): _____	Less than 3 months 1-2 years 3-4 years More than 5 years	4
Total		16

Part B contains 19 items related to five variables derived from the UTAUT model. four PE items (Venkatesh et al., 2003), four EE items (Venkatesh et al., 2003), four SI items (Venkatesh et al., 2003), four FC items (Venkatesh et al., 2003), and four BI items (Venkatesh et al., 2003) was formulated based on a review of the previous studies. This part was divided into five subsections. The terminology of “the system” was replaced by “AI-based educational technologies” . The overview of Part B was illustrated in Table 3.5.

Table 3.5 Questionnaire Items 1

Section	Variables	Number of Items	Adaption sources	Cronbach's Alpha of the original Scale
1	Performance Expectancy (PE)	4	Venkatesh et al. (2003)	0.83
2	Effort Expectancy (EE)	4		0.85
3	Social Influence (SI)	4		0.84
4	Facilitating Conditions (FC)	4		0.81
5	Behavioral Intention (BI)	3		0.84
Total		19		

Part C collected information about Chinese pre-service EFL teachers' perceptions of their AI-TPACK. Four AI-TPACK constructs (AI-TK, AI-TCK, AI-TPK, AI-TPACK) were included in the questionnaire. The author of the present study

adapted the items on the four constructs from the intelligent-TPACK scale developed by Celik (2023). Table 3.6 presents the details of the questionnaire items. The terminology of “AI tools” was replaced by “AI-based educational technologies”. The overview of Part C is illustrated in Table 3.6.

Table 3.6 Questionnaire Items 2

Section	Variables	Number of Items	Adaption sources	Cronbach's Alpha of the original scale
1	AI Technological Knowledge (AI-TK)	5	Celik (2023)	0.856
2	AI Technological Content Knowledge (AI-TCK)	4		0.868
3	AI Technological Pedagogical Knowledge (AI-TPK)	6		0.858
4	AI Technological pedagogical content knowledge (AI-TPACK)	7		0.858
Total		22		

The questionnaire was designed with a five-point Likert scale. The five-point Likert scale includes five descriptors: Strongly Disagree, Disagree, neither agree nor disagree, Agree, Strongly Agree. The total scale of this questionnaire was illustrated in Table 3.7. As Ghauri and Gronhaug (2005) mentioned, validity describes how effectively the obtained data covers the actual area of investigation. To ensure content validity, the judgmental technique to establish content validity includes literature reviews followed by examination by professional judges or panels (Taherdoost, 2016). Therefore, three experts in the EFL education field with educational technology research experience reviewed the quality and relevance of the questionnaire items, and the results were included in Appendix C, D, E, F, G. Then, a pilot study was conducted to test the validity and reliability of the questionnaire, and the results were presented in the pilot study section (Section 3.5).

Table 3.7 Behavioral Intention and AI -TPACK Education Needs Pre-service EFL Teacher Survey

Behavioral Intention and AI -TPACK Education Needs Pre-service EFL Teacher Survey				
Questionnaire	Source	Number of items	Likert-scale	Components
Part A: Demographic Information		16		gender, age, grade, experience in technology use, and experience in AI tools usage
Part B: Factors influencing behavioral intentions	Adapted from Venkatesh et al. (2003)	19	5 Likert scale 1 = strongly disagree 2 = disagree 3 = not sure 4 = agree 5 = strongly agree	Performance Expectancy (PE) Effort Expectancy (EE) Policy Influence (PI) Facilitating Conditions (FC) Behavioral Intention (BI)
Part C AI-TPACK	Adapted from Celik (2023)	22	5 Likert scale 1 = strongly disagree 2 = disagree 3 = not sure 4 = agree 5 = strongly agree	AI Technological knowledge (AI-TK) AI Technological content knowledge (AI-TCK) AI Technological pedagogical knowledge (AI-TPK) AI Technological content knowledge (AI-TPACK)
Total		57		

Upon completion of the electronic questionnaire, participants had the opportunity to indicate their willingness to engage in additional data gathering endeavors for the present research. Individuals who expressed a desire to take part in the follow-up semi-structured interviews and met the selection criteria were invited to participate in the interviews.

3.4.2 Semi-structured Interview

Stuckey (2013) categorizes interviews into structured and semi-structured

interviews. In structured interviews, questions strictly dictate the information respondents provide. On the other hand, semi-structured interviews involve the researcher outlining the subjects and their sequence, while allowing the interviewee's responses to shape the direction of the interview. For intra-professional issues, when decisions are made about future practice priorities, budgeting, strategic planning, educational curriculum development, and many other areas, qualitative approaches are ideal for examining the perspectives and experiences of educators, managers, clinicians, rural practitioners, and users of various technologies and broader disciplines (Adams & Smith, 2003). In the present study, semi-structured interviews were conducted to collect information from pre-service EFL teachers, in-service EFL teachers, administrators, and ICT teachers to probe multi-perspective views on integrating AI-based educational technology in English language teaching and EFL teacher preparation.

The interview were divided into three sections to guide the conversation. The initial section aimed to introduce the project, followed by a section outlining the purpose of the interview, the implications, data handling, duration, and recording methods. The third section consisted of open-ended questions categorized into different segments. Lastly, Ending of the interview and showing appreciation to the participants. The structure of the semi-structured interview is shown in Table 3.8.

Table 3.8 The Structure of Interviews

Interviews	
Structure	Purpose
Part 1	Introducing the research
Part 2	Outlining the purpose of the interview, implications, data handling, duration, and recording methods
Part 3	Interviewing using open-ended questions
Part 4	Ending the interview and showing appreciation.

Galletta and Cross (2013) suggested that Semi-structured interviews use both open-ended and theoretically driven questions to elicit data based on the participant's experience as well as data guided by existing constructs in the discipline in which the

study was being conducted. All the semi-structured interview protocols consisted of two types of questions: open-ended questions on general information, and questions guided by the UTAUT model and TPACK framework.

3.4.2.1 Interview questions for Pre-service EFL Teachers

Galletta and Cross (2013) stated that semi-structured interviews provided a variety of options. It is well-structured to cover certain areas relating to the phenomenon under investigation, while also allowing participants to contribute new insights. The Interview questions created by the researcher answered the research questions regarding the factors that influence AI-based educational technology adoption and their educational needs based on AI-TPACK. The interviewees were pre-service EFL teachers who expressed interest and met the selection criteria in participating in the follow-up interview when completing the electronic questionnaire.

According to Galletta and Cross (2013), semi-structured interviews can be divided into segments, progressing from open-ended questions to more theoretical topics. The grounded data, which is collected early on, give background for investigating participants' comprehension of the phenomenon under inquiry. One of the significant advantages of the semi-structured interview is its emphasis on lived experience while also addressing theoretically driven factors of interest. Consequently, the interview questions in the protocol were divided into three sections. The first section collected basic data such as participants' names, ages, English learning experience, and AI usage experience. The second section was centered on the UTAUT model and is divided into eight themes: performance expectancy, effort expectancy, social impact, facilitating conditions, behavioral intentions, barriers and concerns, education needs, and future perspectives. The third section was founded on the TPACK framework, and eight themes were developed, which include AI-TK (Technological Knowledge), AI-TCK (Technological Content Knowledge), AI-TPK (Technological Pedagogical Knowledge), AI-TPACK (Technological Pedagogical Content Knowledge), education needs, preparation for AI integration, and an ending question.

The interview was intended to provide pertinent information for policy, practice, EFL teacher training programs, and professional development activities in EFL education. The justification (see Table 3.9) for interview questions in each segment was presented.

Table 3.9 Structure and Development Rationale 1

Structure	Segments	Rationale
Basic information	Basic information	Collect important background information. set the scene for the following discussion.
Factors influencing intentions	Factors influencing intentions	Explore both facilitators and hinders that influence intention.
Part A: Behavioral Intentions Based on the UTAUT Model	Performance Expectancy (PE)	Assess the perceived benefits and importance of using AI-based educational technology.
	Effort Expectancy (EE)	Explore the perceived ease of using AI technology in teaching English.
	Social Influence (SI)	Investigate the impact of social influence on teacher decision-making processes.
	Facilitating Conditions (FC)	Explore the resources, support, and conditions needed to facilitate the integration of AI-based educational technology into EFL teaching.
	Behavioral Intentions (BI)	Understanding teachers' intentions can predict their actual adoption behavior.
	Barriers and Concerns	Address potential barriers and concerns associated with AI integration, aiming to identify challenges that may hinder adoption and implementation.
	Education needs	Assess the interviewee's preparedness and training needs.
	Future Perspectives	Explore the interviewee's vision for the future of AI in EFL education helps anticipate trends and potential challenges or opportunities.

Table 3.9 (continued)

Structure	Segments	Rationale
Part B Perceptions on AI-TPACK	AI-TK (Technological Knowledge)	Provide insights into pre-service EFL teachers' technological proficiency and capacity for adopting new tools.
	AI-TCK (Technological Content Knowledge)	Focus on how AI technology can improve understanding of English and specific language skills.
	AI-TPK (Technological Pedagogical Knowledge)	Assess the pre-service EFL teacher's understanding of how AI tools or platforms can be practically applied in the classroom
	AI-TPACK (Technological Pedagogical Content Knowledge)	Aim to assess the interviewee's understanding of AI-TPACK components and their importance.
	Education Needs	Explore areas where teachers feel the least confident to identify needs.
	Preparation for AI Integration	Identify specific areas where pre-service teacher education programs can improve to better prepare future EFL teachers for the integration of AI-based technology.
Ending Question	Ending Question	Provide an opportunity for per-service EFL teachers to share any additional insights, concerns, or reflections not covered in the interview protocol.

3.4.2.2 Interview Questions for in-service EFL Teachers

The interview for in-service EFL teachers shared some questions with the protocol for pre-service EFL teachers. The questions were designed to elicit detailed responses from in-service teachers regarding their attitudes, perceptions, experiences, professional development needs, and suggestions for EFL teacher education concerning AI integration in EFL teaching. The interview questions were structured based on the UTAUT model, which provides a theoretical foundation for studying technology adoption behavior, and were also informed by the AI-TPACK framework.

The interview questions were structured into four parts. The first part collected general information about the informants, including their schools, names, ages, teaching experience, and experience using AI. The second part was designed based on the UTAUT model and organized into eight themes: performance expectancy, effort expectancy, social influence, facilitating conditions, behavioral intentions, barriers and concerns, professional development, and future perspectives. The third part was informed by the TPACK framework, with eight themes formulated: AI-TK (Technological Knowledge), AI-TCK (Technological Content Knowledge), AI-TPK (Technological Pedagogical Knowledge), AI-TPACK (Technological Pedagogical Content Knowledge), professional development needs, preparation for AI integration, suggestions for EFL teacher education, and an ending question.

In general, the interview aimed to provide insights for policy, practice, and the EFL teacher program. The rationale for each segment of interview questions was provided (see Table 3.10).

Table 3.10 Structure and Development Rationale 2

Structure	Segments	Rationale
Basic information	Basic information	Collect vital background information. set the backdrop for the following discussion.
Factors influencing intentions	Factors influencing intentions	Explore both facilitators and hinders that influence intention.
Part A: Behavioral Intentions Based on the UTAUT Model	Performance Expectancy (PE)	Assess the perceived benefits and importance of using AI-based educational technology.
	Effort Expectancy (EE)	Explore the perceived ease of using AI technology in teaching English
	Social Influence (SI)	Investigate the impact of social influence in teacher decision-making processes
	Facilitating Conditions (FC)	Explore the resources, support, and conditions needed to facilitate the integration of AI-based educational technology into EFL teaching.
	Behavioral Intentions (BI)	Understanding teachers' intentions can predict their actual adoption behavior.

Table 3.10 (continued)

Structure	Segments	Rationale
Part B: Perceptions on AI-TPACK	Barriers and Concerns	Address potential barriers and concerns associated with AI integration, aiming to identify challenges that may hinder adoption and implementation.
	Professional Development Needs	Assess the interviewee's preparedness and training needs.
	Future Perspectives	Explore the interviewee's vision for the future of AI in EFL education to help anticipate trends and potential challenges or opportunities.
	AI-TK (Technological Knowledge)	Provide insights into in-service EFL teachers' technological proficiency and capacity for adopting new tools.
	AI-TCK (Technological Content Knowledge)	Focus on how AI technology can improve understanding of English and specific language skills.
	AI-TPK (Technological Pedagogical Knowledge)	Assess the in-service EFL teacher's understanding of how AI tools or platforms can be practically applied in the classroom.
	AI-TPACK (Technological Pedagogical Content Knowledge)	Assess the interviewee's understanding of AI-TPACK components and their importance.
	Professional Development Needs	Explore areas where teachers feel the least confident to identify needs.
	Preparation for AI Integration	Identify specific areas where in-service teacher education programs can improve to better prepare future EFL teachers for the integration of AI-based technology.

Table 3.10 (continued)

Structure	Segments	Rationale
	Suggestions for EFL teacher education	Collect firsthand suggestions directly from the interviewee.
Ending Question	Ending Question	Provide an opportunity for in-service EFL teachers to share any additional insights, concerns, or reflections not covered in the interview protocol.

3.4.2.3 Interview Questions for Administrator

The interview questions covered various aspects, including the administrator's perspective on AI in education, the importance of preparing pre-service EFL teachers for AI-assisted teaching, challenges in integration, teacher preparation methods, necessary skills, adaptability of the program, and measures of curriculum relevance. The structure and development rationale was presented in Table 3.11.

Table 3.11 Structure and Development Rationale 3

Segments	Rationale
General information	Collect vital background information. set the backdrop for the following discussion.
General Perspective on AI in EFL Education	Explore the administrator's perspective on AI in English language education
Challenges and Concerns	Identify the challenges perceived by the administrator in preparing pre-service EFL teachers to integrate AI in their teaching practice
Teacher Preparation for AI Integration	Examine how the administrator prepares pre-service EFL teachers to use AI in their future classrooms
Adaptability and Flexibility	Investigate how the administrator assures adaptation and flexibility in the EFL teacher program in response to changes in AI and language education trends
Future Vision	Examine the administrator's vision for AI's involvement in EFL education over the next 5-10 years.

Table 3.11 (continued)

Segments	Rationale
Suggestions	Solicit administrator suggestions for preparing pre-service EFL teachers for AI-assisted English teaching.
Ending Question	The ending question provides an opportunity for the administrator to share any additional insights, concerns, or reflections not covered in the interview protocol.

3.4.2.4 Interview Questions for ICT Teachers

The interview for ICT teachers shared some questions with that for the administrators. The interview questions addressed key aspects of integrating AI into EFL instruction and preparing EFL teachers for an AI-rich context, which effectively probed the teachers' perspectives, strategies, challenges, and outlook regarding AI in education. The structure and rationale for development were listed in Table 3.12.

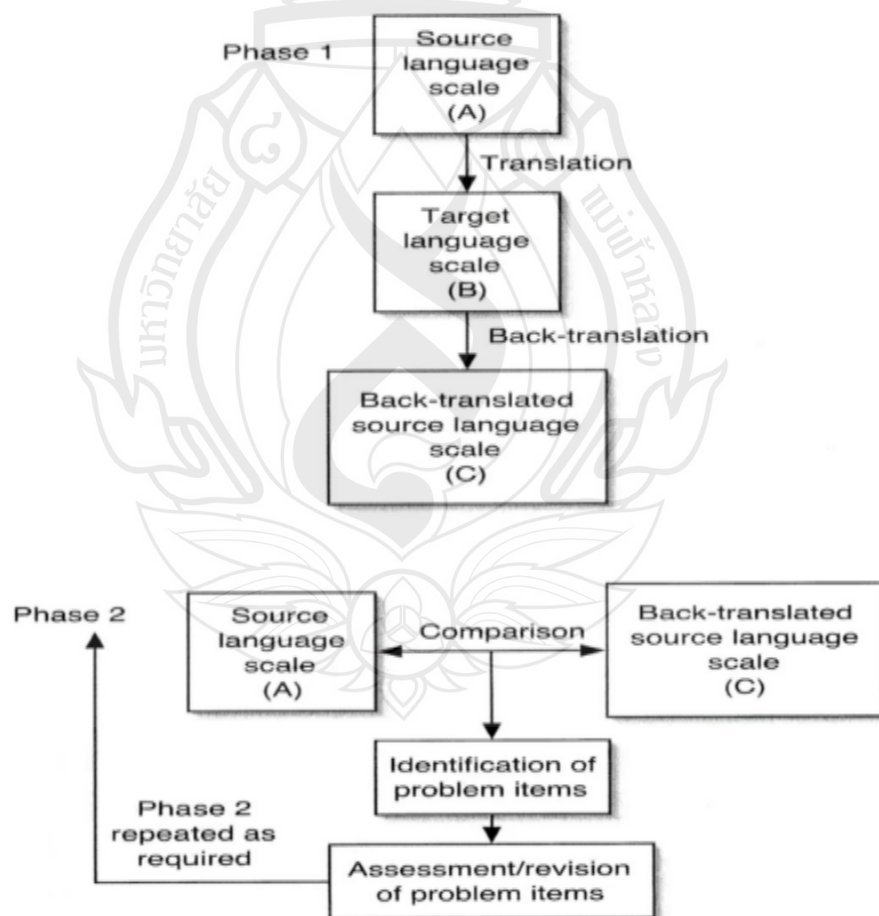
Table 3.12 Structure and Development Rationale 4

Segments	Rationale
General information	Gather basic information about the ICT teacher's current courses and their experiences teaching ICT.
General Perspective on AI in Education	Explore the teacher's views on AI in education and the importance of preparing pre-service teachers for AI-assisted teaching.
Teacher Preparation for AI Integration	Inquire about how the ICT teacher prepares pre-service teachers for using AI in their future classrooms and the skills needed for effective AI use
Challenges and Concerns	Address the challenges faced in preparing pre-service teachers, particularly EFL teachers, for AI-assisted teaching.
Adaptability and Flexibility	Focus on how the ICT course adapts to changes in AI and education trends and ensures curriculum relevance
Future Vision and cooperation	Explore the teacher's perspective on the future of AI in education and collaboration with other educators is essential for informed planning.
Suggestions	Collect the teacher's suggestions for preparing pre-service EFL teachers for AI-assisted English teaching.
Ending Question	Provide an opportunity for the ICT teacher to share any additional thoughts or insights not covered in the interview.

3.5 Research Instruments Translation and Pilot Study

3.5.1 Research Instruments Translation

According to Harzing et al. (2012), the survey language should be determined primarily by the participants' language proficiency. Therefore, the questionnaire for the current study was translated into Chinese, as the target participants were Chinese pre-service EFL teachers with varying levels of English proficiency. Sperber (2004) emphasized the importance of translating and validating study instruments for cross-cultural research and recommended a two-phase translation and validation process based on the back-translation technique. This method, illustrated in Figure 3.3, was employed in the present study to ensure a reliable Chinese version of the questionnaire.



Source Sperber (2004)

Figure 3.3 Flow Diagram of the Translation (phrase 1) and Validation (phrase 2)

In the first phase, a professional translator was paid to translate the English version 1 of the questionnaire from English to Chinese. Chinese Version 1 of the questionnaire was produced. A team of three teachers then reviewed the Chinese Version 1 and compared it with the English Version 1 of the questionnaire to assess the faithfulness of the translation and the suitability of the wording in the Chinese language, using a rating form adapted from Mei (2016). Among the three teachers, one is a translation course teacher at CXNU, one is a Chinese language teacher at CXNU, and the researcher of the present study is also in the team. All three teachers are fluent in both English and Chinese. After submitting the rating form, an online meeting was held to discuss, and a final consensus was achieved on minor modifications. A Chinese version 2 of the questionnaire was then produced. After that, another professional translator was paid to translate the Chinese version 2 of the questionnaire into English, and the Back-translated English version 2 of the questionnaire was formulated.

In the second phase, the validation phase, an English native speaker expert was invited to compare source language scale (the English version 1 of the questionnaire) and the back-translated source language scale (the Back-translated English version 2) to assess semantic and conceptual equivalence of the two English versions through a rating form based on the guideline of van de Vijver and Hambleton (1996). The results of the assessment showed that the translation achieved a high degree of semantic and conceptual equivalence. There were very minimal changes in phrasing, with the bulk of comparisons scoring 4 or 5, indicating complete or high equivalence. The ranks had dropped to 3 only when the concept or specificity had slightly altered; nonetheless, most of these changes did not damage the general conceptual integrity. Thus, semantic and conceptual equivalence were well achieved throughout the questionnaire items. The validation assessment indicated that the Chinese Version 2 (see Appendix H) of the questionnaire was suitable for use in data collection for the present study.

The four semi-structured interview question lists were translated from English to Chinese by a professional translator and assessed by the researcher of the present study to validate them before interviews were conducted. The English and Chinese version of the research question listed was presented in Appendix I, Appendix J, Appendix K, Appendix L.

3.5.2 Pilot Study

According to Dornyei (2016), it is crucial to pilot research instruments and procedures before commencing a study, particularly in quantitative research. Neglecting or downplaying the piloting stage can significantly compromise the psychometric integrity of the studies. A pilot study with 443 participants was conducted at Yunnan Normal University (YNNU) to check the appropriateness and estimate internal consistency reliability (Polit & Beck, 2011; Teijlingen & Hundley, 2001) of the questionnaire. YNNU, a teachers' university in Yunnan, China, was selected as the research site for the pilot study, as participants who took part in the pilot study could not be included in the main study. The pilot study was conducted from 21 October to 13 December 2024. Carmines and Zeller (1979) define reliability as the extent to which a measurement of a phenomenon yields repeatable and consistent results. Testing for reliability is critical, as it refers to the consistency of the components within a measuring instrument (Huck, 2007). The Cronbach Alpha coefficient is the most widely used internal consistency measurement (Hinton et al., 2014; Taherdoost, 2016). After collecting data through a pilot Study, Cronbach's Alpha coefficient was utilized to test the reliability of the questionnaire. Hinton et al. (2014) proposed four cut-off points: excellent reliability (0.90 and above), high reliability (0.70-0.90), moderate reliability (0.50-0.70), and low reliability (0.50 and below). The results of the Cronbach's Alpha coefficient were presented in Table 3.13.

Table 3.13 Variables and Cronbach's Alpha

	Variables	Number of Items	Adaption sources	Cronbach's Alpha	Cronbach's Alpha
1	Performance Expectancy (PE)	4	adapted from Venkatesh et al. (2003)	0.803	0.969
2	Effort Expectancy (EE)	4	adapted from Venkatesh et al. (2003)	0.852	

Table 3.13 (continued)

	Variables	Number of Items	Adaption sources	Cronbach's Alpha	Cronbach's Alpha
3	Social Influence (SI)	4	adapted from Venkatesh et al. (2003)	0.842	
4	Facilitating Conditions (FC)	4	adapted from Venkatesh et al. (2003)	0.809	
5	Behavioral Intention (BI)	3	adapted from Venkatesh et al. (2003)	0.841	
6	AI Technological Knowledge (AI- TK)	5	Celik (2023)	0.877	
7	AI Technological Content Knowledge (AI- TCK)	4	Celik (2023)	0.807	
8	AI Technological pedagogical Knowledge (AI- TPK)	6	Celik (2023)	0.891	

Table 3.13 (continued)

	Variables	Number of Items	Adaption sources	Cronbach's Alpha	Cronbach's Alpha
9	AI Technological pedagogical content knowledge (AI-TPACK)	7	Celik (2023)	0.922	
	Total	41			

Exploratory Factor Analysis (EFA) was then conducted to test and refine the questionnaire design. DeVellis (2017) suggested rewording, adding, or removing items before the full-scale study. In the present study, following EFA, six survey participants were interviewed via WeChat messages to assess cross-loading and poorly loading questionnaire items; the results are presented in Table 3.14.

Table 3.14 Results of Questionnaire Item Revision

Variables	Questionnaire Items	Reasons for rewording	Interview Results
Performance Expectancy (PE)	PE4	Factor loading <0.5	No revision (Clear and easy to understand)
Effort Expectancy (EE)	EE1	Factor loading <0.5	No revision (Clear and easy to understand)
Facilitating Conditions (FC)	FC3	Factor loading <0.5	No revision (Clear and easy to understand)
	FC4	Cross-loading with SI	No revision (Clear and easy to understand)

Table 3.14 (continued)

Variables	Questionnaire Items	Reasons for rewording	Interview Results
AI Technological Knowledge (AI- TK)	AI-TK4	Factor loading <0.5	Rewording 我具备足够的知识使用AI教育技术(I have sufficient knowledge to use AI-based educational technologies.) was reworded as 我具备一定的知识使用AI教育技术(I have some knowledge to use AI-based educational technologies.).
	AI-TK5	Cross-loading with AI-TPK	Rewording 我对AI教育技术及其技术性能很熟悉(I am familiar with AI-based educational technologies and its technical capacities.) was reworded as 我对AI教育技术及其技术性能有一定了解(I have a basic understanding of AI-based educational technologies and its technical capacities.).

Table 3.14 (continued)

Variables	Questionnaire Items	Reasons for rewording	Interview Results
AI Technological Pedagogical Knowledge (AI- TPK)	AI-TPK 1, AI- TPK2	Loading a new factor	No revision (Clear and easy to understand)
	AI-TPK3	Factor loading <0.5	No revision (Clear and easy to understand)
AI Technological Content Knowledge (AI- TCK)	AI-TCK 1,3	Factor loading <0.5	No revision (Clear and easy to understand)
	AI-TCK 2	Factor loading <0.5	Rewording 我了解多种在英语教 学中由专业人士使用 的AI教育技术(I am aware of various AI- based educational technologies which are used by professionals in English teaching.) was reworded as 我了解一 些可以在英语教学中 使用的AI教育技术(I am aware of some AI- based educational technologies that can be used in English teaching.).

Table 3.14 (continued)

Variables	Questionnaire Items	Reasons for rewording	Interview Results
	AI-TCK 4	Cross-loading with AI- TPACK	Rewording 我知道如何应用专业 领域内的AI教育技术 (例如智能英语辅导 、对话机器人等) (I know how to utilize my field-specific AI-based educational technologies (e.g., intelligent tutor for English, Chatbox).) was reworded as 我知道如 何应用专业领域内的 AI教育技术 (例如, 百度翻译, 有道词典 , 智能英语辅导等) (I know how to utilize my field-specific AI-based educational technologies (e.g., Baidu Translate, Youdao Dictionary, intelligent English tutoring systems, etc.))

As stated by Seidman (2019), a pilot test with a small sample size should always be conducted before the interview. This improves the process's authenticity by allowing for the reword of any unclear or badly phrased questions. In the present study, pilot studies of the interview schedules were conducted to test the research questions, the interview schedules, and the technical equipment. Semi-structured interviews were conducted via Tencent Meeting (a popular video conferencing platform in China), ranging from 32 to 60 minutes in duration. As a backup, the iFLYTEK Recording Pen was used to record the interviews simultaneously. Five pre-service EFL teachers were interviewed in a focus group, while one administrator, four in-service EFL teachers,

and one ICT teacher were interviewed individually. The results of the pilot interviews indicated that the research questions and interview schedules were appropriate. The technical tools, such as Tencent Meeting and the iFLYTEK Recording Pen, proved stable and reliable. Regarding the interview duration, it generally lasted longer than expected but varied depending on the participants.

3.6 Data Collection

To obtain data from various sources, several steps were taken. Quantitative data was collected over seventeen days from 18 November to 4 December 2024, the electronic questionnaire was distributed to all the pre-service EFL teachers at CXN University. Coordinators obtained the pre-service EFL teachers' voluntary participation by visiting their classes and explaining the study's purpose, along with the instructions, privacy measures, and confidentiality procedures. The electronic questionnaire Wenjuan Xing, a popular web-based survey tool in China (Zhang et al., 2020), links (<https://www.wjx.cn/>) and posters were then created and sent to the pre-service teachers' email addresses, Wechat, and QQ (popular social media APPs in China) to speed up response time and save costs. The pre-service EFL teacher participants completed the questionnaire and returned their responses online. A total of 646 questionnaires were distributed, and 617 were returned, resulting in a response rate of 95.5%. Of the returned questionnaires, 576 were valid, yielding an effective rate of 89.2%. The strong participation and data reliability laid a solid foundation for further analysis.

For qualitative data collection, the researcher of the present study conducted interviews with those who met the necessary criteria and were willing to participate. Twenty-two pre-service EFL teacher participants were interviewed in four focus groups. One Administrator, three ICT teachers, and twelve in-service EFL teachers were interviewed individually.

The individual interviews lasted 23-60 minutes with each participant. The interviews lasted approximately 76-149 minutes for each group and were recorded via online meeting software (Tencent Meeting) and the iFLYTEK recording pen with the

participants' consent. Before the interviews, the participants were informed about the purpose of the interview. The interviewer assured each respondent that the recorded video and data would only be used for academic and educational purposes in the present study. Respondents had the right to refuse to answer any questions that made them feel uncomfortable, and they had the right to terminate the interview at any time. The interviews were anonymous, and their performance during the interview would not affect their academic grades. Finally, the researcher coded and transcribed the interviews for data analysis.

3.7 Data Analysis

Statistical information obtained from the questionnaires was imported into the SPSS AMOS v. 27.0 and the Statistical Package for the Social Sciences (SPSS v. 25.0). As indicated in Table 3.15, a variety of statistical analyses, including descriptive statistics, structural equation modeling (SEM) technique, and content analysis were carried out to meet the research objectives and respond to the research questions. Three steps were involved in the data analysis of the present study: firstly, descriptive statistics, i.e., mean, standard deviation, and percentage, were presented. Secondly, inferential analyses (e.g., t-test, ANOVA and post-hoc tests) were performed. Thirdly, structural equation modeling (SEM) was conducted to test the model and the hypothesis. Lastly, the data collected from semi-structured interviews were analyzed qualitatively using thematic analysis and direct content analysis.

Table 3.15 Data Analysis

Research Objectives	Research questions	Research instruments	Data Analysis
1.To identify the factors that influence Chinese pre-service EFL teachers' behavioral intention to adopt AI-based educational technology in their future EFL teaching Practice.	1. What are the factors that influence Chinese pre-service EFL teachers' behavioral intentions to use AI-based educational technologies in their future EFL teaching practice?	Questionnaire Part A Part B Part C	Quantitative data analysis: 1. Descriptive statistics, i.e., mean, standard deviation, and percentage were presented. 2. Structural equation modeling (SEM) was conducted to test the model and the hypothesis.
2.To explore the degree of influence and correlations among the identified factors..	2. What are the degrees of influence and correlations of these factors?	Semi-structured Interview questions for pre-service EFL teachers Questionnaire Part B Part C	Qualitative data analysis: Content Analysis Quantitative data analysis: Structural equation Modeling (SEM)

Table 3.15 (continued)

Research Objectives	Research questions	Research instruments	Data Analysis
3.To identify pre-service EFL teachers' AI-TPACK educational needs and examine stakeholders' perceptions to inform effective EFL teacher preparation for AI-assisted EFL teaching and learning.	RQ 3. How to prepare pre-service EFL teachers for AI-assisted EFL teaching and learning?	Questionnaire Part C	Quantitative data analysis: Mean, the independent samples t-test, one-way ANOVA
	SRQ3.1. What are the AI-TPACK educational needs of Chinese pre-service EFL teachers?	Semi-structured Interview questions for pre-service EFL teachers	Qualitative data analysis: Direct Content analysis Thematic analysis
	SQR3.2. What are the perceptions of administrators, ICT teachers, and in-service EFL teachers toward the use of AI-based educational technologies in EFL teaching and teacher preparation?	Semi-structured Interview questions for in-service EFL teachers	Qualitative data analysis: Direct Content analysis Thematic analysis was conducted to analyze the qualitative data.
		Semi-structured Interview questions for administrator	
		Semi-structured Interview protocol for ICT teachers	

3.7.1 Quantitative Data Analysis

3.7.1.1 Structural Equation Modeling (SEM)

1. Analytical Strategy Selection. Structural Equation Modeling (SEM) was selected as the primary analytical framework due to its unique capacity to simultaneously assess measurement relationships (between latent constructs and their indicators) and structural relationships (among the constructs themselves) (Bollen,

1989; Kline, 2023). This dual functionality is critical for the current study due to three main reasons: firstly, the latent variable modeling of the current study. Key constructs (e.g., AI-TPACK, Performance Expectancy, Behavioral Intention) are inherently unobservable and must be operationalized through multiple indicators. Unlike traditional regression, SEM accounts for measurement errors in latent variables (Hair et al., 2021). Secondly, complex path analysis. The hypothesized model involves mediation effects (e.g., AI-TPACK→Performance Expectancy→Behavioral Intention), which SEM can efficiently test in a single, unified framework (Hayes, 2018). Lastly, model flexibility. SEM permits comparison of alternative theoretical models (e.g., full mediation vs. partial mediation) through fit indices and nested model testing (Byrne, 2001). The advantages over alternative methods are listed in Table 3.16.

Table 3.16 Methods Comparison

SEM		Alternative Methods	Advantages
Structural Equation Modeling (SEM)	VS.	Regression	SEM avoids biased parameter estimates by modeling measurement error and correlated residuals (Weston & Gore, 2006).
		ANOVA/MANOVA	SEM handles continuous latent variables and indirect effects, which ANOVA cannot (Tabachnick & Fidell, 2019).
		Factor Analysis (EFA/CFA)	SEM integrates CFA with path analysis to test theory-driven structural hypotheses (Brown, 2015).

2. Introduction to Structural Equation Modeling

1) Sample Size Requirement

A comprehensive statistical method, structural equation modeling (SEM), offers researchers opportunities to investigate complex relationships between observed and latent variables. Sample size, which directly affects the stability and power of the estimates, is important in SEM. Although basic models require a minimum

of 100-150 observations (Kline, 2023), stricter guidelines recommend 10 observations per estimated parameter (Bentler & Chou, 1987) or at least 200 observations for consistent outcomes (Hair et al., 2019). Research on power analysis by MacCallum et al. (1996) further suggests that about 200 observations are required to find a close-fitting model ($RMSEA \leq 0.05$) with sufficient statistical power. Given SEM's simultaneous estimation of measurement and structural models, which requires sufficient data to generate stable parameter estimates and prevent convergence issues, sample size is particularly important. In this study, the original questionnaire included 41 parameters, and the final sample size was 617. With more than 10 observations per parameter, the statistical power of the research is ensured.

2) Estimate Method

In SEM, the choice of estimation method is primarily driven by the data characteristics and research objectives. While robust maximum likelihood (ML) adjustments are recommended for handling modest violations of normality (Satorra & Bentler, 2001), ML estimation remains the most common method when the data meet multivariate normality assumptions (Bollen, 1989). Weighted least squares with mean and variance adjustment (WLSMV) gives more accurate estimates for ordinal or categorical data (Muthén & Asparouhov, 2012). On the other hand, partial least squares SEM (PLS-SEM) is especially appropriate for predictive research settings with smaller sample sizes (Hair et al., 2022). Every estimating technique has assumptions regarding measurement scales and data distributions. Maximum likelihood estimation with robust corrections (MLR) was used in this research based on the results of the normality check (See Table 4.5).

3) Model Fit Indices

Evaluating model fit requires examination of multiple indices to assess different aspects of the model's correspondence with the observed data. Traditional chi-square tests are supplemented with practical fit indices, including the comparative fit index (CFI) and Tucker-Lewis index (TLI), where values above 0.90 indicate acceptable model fit (Hu & Bentler, 1999). The root mean square error of approximation (RMSEA), with a recommended threshold below 0.06 (Browne & Cudeck, 1993), provides information about the error of approximation in the population. Additionally, the standardized root mean square residual (SRMR) reflects

the average magnitude of standardized residuals, with values less than 0.08 suggesting a good fit (Shi, Maydeu-Olivares, & DiStefano, 2018). Contemporary practice emphasizes reporting multiple fit indices to provide a comprehensive assessment of model adequacy (McDonald & Ho, 2002). Model fit indices were illustrated in Table 3.17.

Table 3.17 Model Fit Indices

Index	Threshold	Interpretation	References
χ^2/df	<3	Absolute fit	Kline (2016)
CFI/TLI	>0.90	Incremental fit	Hu and Bentler (1999)
RMSEA	<0.06	Error of approximation	Browne and Cudeck (1993)
SRMR	<0.08	Standardized residual	Shi Maydeu-Olivares and DiStefano (2018)

4) Measurement Model and Structural Model Tests

Model specification in SEM should be theoretically based (Jöreskog, 1993) and usually proceeds via sequential stages. Requiring factor loadings above 0.5 (Hair et al., 2019), the measurement model assessment verifies the correlations between latent constructs and their indicators, together with acceptable composite reliability ($CR > 0.7$) and average variance extracted ($AVE > 0.5$) values (Fornell & Larcker, 1981). Regarding both statistical significance ($p < 0.05$) and practical impact sizes (β values), subsequent structural model testing investigates the hypothesized paths among constructs. Researchers should avoid overfitting (MacCallum et al., 1993) and resist making unreasonable changes depending only on statistical criteria (Chou & Bentler, 2002) during this time. The whole modeling process should strike a balance between theoretical coherence and empirical adequacy; any changes should be transparently documented and theoretically supported.

3.7.1.2 Data Processing and Preparation

The study collected 617 survey responses, which were screened for validity

before analysis following established methodological guidelines (Huang et al., 2012; Kline, 2023; Meade & Craig, 2012). Due to strict questionnaire design (e.g., forced-response items), the datasets contained no missing values, ensuring complete and high-quality data. 41 responses (6.6%) were removed based on the following exclusion criteria: Firstly, Patterned responses: Cases showing straight-lining (identical responses across items) or alternating extreme values (e.g., 1-5-1-5 patterns) were excluded, indicating non-engaged responding (Meade & Craig, 2012). Secondly, Implausible response times: Surveys completed in <1 minute (for a 6-minute instrument) were excluded, suggesting inattentiveness (Huang et al., 2012).

576 valid responses ($576 \div 646 \approx 89.2\%$) were retained as the final datasets. Minimal pre-processing was conducted since the study employed the following strategies: forced-response items (preventing missing data), time validation checks (filtering rushed responses), pattern detection (removing non-serious responses). Therefore, additional data cleaning (e.g., imputation, outlier correction) was unnecessary, aligning with best practices for high-integrity datasets (Kline, 2023).

Before conducting structural model testing, the study conducted Mahalanobis distance (D^2) for multivariate outlier detection. This process identified four multivariate outlier samples ($D^2 > 100$), which were subsequently excluded to enhance the robustness of model estimation. Consequently, the final valid sample size for structural equation modeling analysis was 572. Details regarding the multivariate outlier analysis procedure and its impact on model fit are elaborated in Section 4.1.5.1.

3.7.1.3 Needs Analysis

Under the framework of needs analysis, the present study examined participants' current AI-TPACK competencies through a present situation analysis (Richterich & Chancerel, 1978). To further explore their educational needs, a deficiency analysis was conducted (Hutchinson & Waters, 1987; West, 1994), complemented by semi-structured interviews that offered qualitative insights through learning needs analysis.

Based on recent empirical research in China, the researcher adopted cut-off values grounded in local data to interpret mean scores from a 5-point Likert scale assessing AI-TPACK competencies. For example, in Ye et al. (2025), among Chinese pre-service EFL teachers, mean scores below 3.6 were identified as weaker dimensions.

However, in the study of Chan and Tang (2025) on pre-service English teachers in Hong Kong, items with mean scores below 3.9 were interpreted as areas needing improvement. The difference in the threshold of needs analysis was determined based on the actual distribution of item mean scores obtained from the participants. In the present study, all mean scores ranged from 3.37 to 3.91, indicating a tendency of participants to prefer moderate categories over extreme ones, a phenomenon commonly referred to as central tendency bias (Douven, 2018). Closer inspection shows that most item means fell between 3.50 and 3.69 (e.g., AI-TK1 = 3.53, AI-TK3 = 3.73, AI-TPK2 = 3.68, AI-TCK3 = 3.67, AI-TPACK3 = 3.69), which corresponds closely to the overall grand mean of approximately 3.65. When considering the dispersion of item means ($SD \approx 0.13\text{--}0.15$), this range can be interpreted as the core concentration zone of participant responses (i.e., grand mean ± 1 SD). To account for this tendency and accurately distinguish between different levels of training needs, the score range was divided into five levels: Excellent, High, Good, Fair, and Weak. Each level corresponds to a specific need category, from Lowest need to Highest need, with finer segmentation in the 3.60–3.99 range to differentiate moderate from high training priorities. This data-driven approach ensures that areas requiring priority professional development are clearly identified, while also reflecting the relative competency levels of the participants (Kusmaryono et al, 2022). Therefore, in the present study, the researcher defined the following thresholds (on a 1-5 scale) to determine training needs:

≥ 4.0 : Very good / Excellent — minimal training needed.

3.61 to < 4.0 : Good — some enhancement/training advisable, especially where variability is high.

3.0 to ≤ 3.6 : fair, which is identified as a training need dimension.

< 3.0 : Low / Weak, which has high priority for training, likely requires foundational support

Dimensions with means that fall in the “high need” or “low/weak” categories are flagged as areas for teacher professional development. Table 4.25 presents the interpretation criteria for mean scores on the AI-TPACK scale. Dimensions with mean scores equal to or below 3.60 (≤ 3.60) were identified as areas requiring training. The mean range and needs level are shown in Table 3.18.

Table 3.18 Interpretation of Mean Scores on AI-TPACK Competence and Educational Needs

Mean Range	Competence Level	Needs level	Educational Needs Implication
4.21 – 5.00	Excellent	The lowest need	No immediate training required; may consider advanced or enrichment programs
4.00 – 4.20	High	Low need	Minimal training need; optional enhancement workshops
3.61 – 3.99	Good	Moderate need	Some training advisable, particularly if variability is high across participants
3.01 – 3.60	Fair	High need	Clear training need; systematic professional development should be provided
1.00 – 3.00	Low/Weak	The highest need	Strong training need; priority area for capacity building and foundational training

The independent samples t-test compares the means of two groups. It shows whether the difference between them is significant (Field, 2024; Gravetter & Wallnau, 2021). Before the test, Levene's test was used to check if the two groups had equal variances. This step ensures the correct t-test formula is chosen (Cohen, 1988). The analysis examined whether males and females differed in their AI-TPACK competence. The results help reveal gender patterns in AI integration skills. Moreover, A one-way

ANOVA was used to test group differences. It examined whether AI-TPACK competencies differed by study year, technology experience, and AI tools experience. One-way ANOVA compares the means of more than two groups on one variable (Field, 2024; Tabachnick & Fidell, 2019). It checks if the differences in group means are significant while controlling for variation within groups (Gravetter & Wallnau, 2021).

3.7.2 Qualitative Data Analysis

Qualitative data analysis in the study involved four groups of participants: pre-service EFL teachers (Focus Groups, N=21, divided by grades: Year 1 to Year 4), in-service EFL teachers (One-on-one interviews, N=12), Administrator (One-on-one interview, N=1), and ICT teachers (One-on-one interviews, N=3).

Considering the theory-based yet exploratory nature of the research, a mixed qualitative approach was employed, combining thematic analysis (Braun & Clarke, 2006) for inductive theme discovery and directed content analysis (Hsieh & Shannon, 2005) for deductive validation of existing frameworks (the UTAUT and AI-TPACK). This dual approach provided both flexibility in capturing emerging themes and rigor in aligning the findings with established theoretical constructs.

Thematic analysis (TA) was selected as the primary analytical method due to its flexibility in identifying patterns across diverse participant groups (Braun & Clarke, 2006). Given that AI integration in EFL education and pre-service EFL teachers' intentions are evolving fields, TA allowed for exploration of unanticipated themes (e.g., ethical concerns, parental resistance), Cross-group comparisons (e.g., differences between pre-service and in-service teachers, gender, study years, technology use experience, and AI tools use experience), and deep interpretation of lived experiences (Nowell et al., 2017). The detailed procedures, including familiarization, initial coding, theme generation, and theme refinement, are illustrated in Figure 3.4.

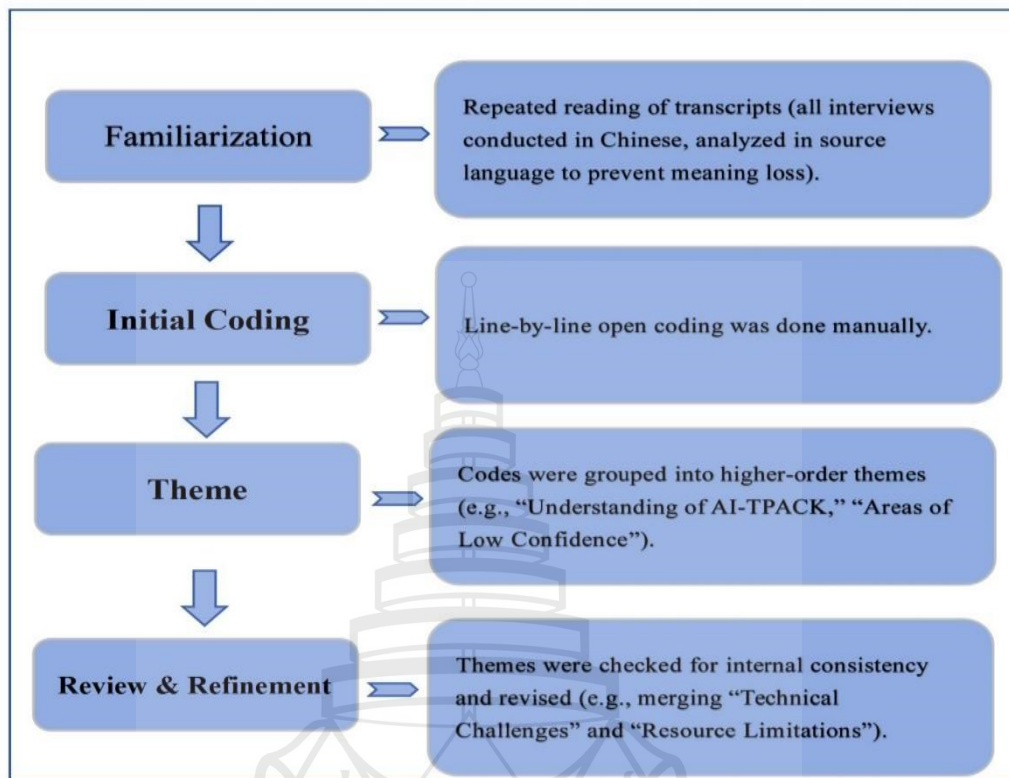


Figure 3.4 The Procedures of Thematic Analysis

While TA captured emergent themes, directed content analysis (DCA) (Hsieh & Shannon, 2005) was used to examine how well the data aligned with two key frameworks: the Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh et al., 2003): Performance expectancy, effort expectancy, social influence, facilitating conditions. AI-TPACK (AI Technological Pedagogical Content Knowledge): AI-specific adaptations of AI-TK, AI-TCK, AI-TPK, and AI-TPACK (Koehler & Mishra, 2009). The procedures of directed content analysis, including initial codebook, deductive coding, sub-coding and quantitative supplement are shown in Figure 3.5.

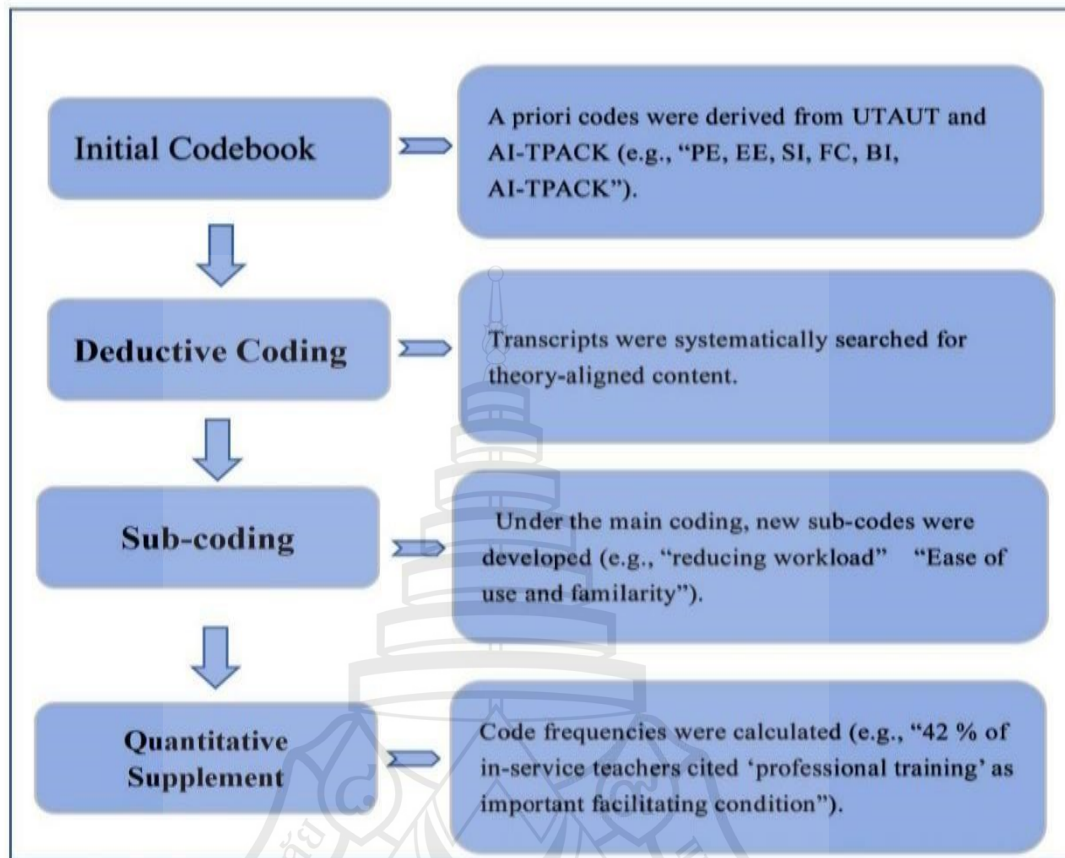


Figure 3.5 The Procedures of Directed Content Analysis

Data analysis was conducted by participant group as follows:

1. Pre-service EFL Teachers (Focus Groups)

TA Focus: Differences across year groups (e.g., freshmen prioritized “AI-TK” while seniors prioritized “AI-TPACK, AI-TPK”).

DCA Focus: How UTAUT’s “social influence” (student’s feedback, parental support) shaped adoption intention.

2. In-service EFL Teachers (One-on-One Interviews)

TA Focus: Real-world barriers (e.g., curriculum rigidity, assessment misalignment).

DCA Focus: understanding of “AI-TPACK” (e.g., what AI-TPACK is).

3. EFL teacher Program Administrator (Single Interview)

TA Focus: Institutional support (e.g., budget, policy lag).

4. ICT Teachers (Interviews)

TA Focus: ICT Teachers' Strategies for Preparing Pre-service Teachers (e.g., "AI teaching is still exploratory", "integrates AI into pedagogy").

To ensure trustworthiness and minimize researcher biases, member checking was used (Lincoln & Guba, 1985). Participants reviewed transcript excerpts and thematic summaries to confirm the accuracy of interpretation (Birt et al., 2016). Creswell and Poth (2018) pointed out that stratified member checking ensured representation across stakeholder groups. The researcher sent 20% transcripts, key themes, and preliminary findings to 6 volunteers (stratified by group: 2 pre-service, 2 in-service, 1 ICT teacher, and 1 administrator) for verification. No disagreement was received.

This mixed approach enabled both discovery and validation, providing a comprehensive understanding of AI integration in EFL education and EFL teachers' intentions. Thematic analysis revealed context-specific barriers, while directed content analysis strengthened theoretical contributions.

3.8 Ethical Consideration

Before conducting the study, the researcher obtained approval from the MFU Research Ethics Committee. Permission to access and collect data at CX Normal University was then obtained from the university president.

At the stage of collecting quantitative data, project information was provided with the questionnaire to inform participants of the objective of the study, the time duration, and the contributions they were to make. The participants were informed that the survey was voluntary and anonymous, and their privacy and confidentiality would be protected. And they had the right to withdraw from the study at any time. The data collected would only be used in the present study and carefully stored to prevent unauthorized access. Electronic data was stored in a USB, which was password-protected and locked in a cabinet; only the researcher has access to it.

At the stage of collecting qualitative data, the semi-structured interviews were conducted with the interviewees' consent. Before conducting the interviews, the aims of the project and the ethical rules were explained to participants. The consent form was

distributed to each participant for signature. The participants were informed that they had the right to withdraw from the interview and not to answer any specific question during the interview.

After data collection, all the data was stored securely. The report of the data was transparent and honest. All the documents and participants' information were protected to prevent release and unauthorized access.

3.9 Summary of the Chapter

This chapter presents the research design and methodological processes used in the investigation. It begins by introducing the research design, then goes on to describe the research site and participants. The research instruments are then introduced, with special emphasis placed on development, translation, and pilot testing to assure validity and reliability. Subsequently, the approaches to data gathering and analysis are then thoroughly explained. Ethical issues of the study are also examined to ensure compliance with academic and professional norms. This chapter provides a detailed description of the methodological framework that guided the investigation, laying the foundation for the presentation of the results in the subsequent chapter.

CHAPTER 4

RESULTS

This chapter presents the results related to the three research objectives of the present study. The research objectives are as follows:

RO1. To identify the factors that influence Chinese pre-service EFL teachers' behavioral intention to use AI-based educational technologies in their future EFL teaching practice.

RO2. To explore the degree of influence and correlations among the identified factors.

RO3. To identify pre-service EFL teachers' AI-TPACK educational needs and examine stakeholders' perceptions to inform effective EFL teacher preparation for AI-assisted EFL teaching and learning.

4.1 Results One and Results Two: Influencing Factors and the Degree of Influence and Correlations Among the Factors

To achieve Research Objectives 1 and 2, two main research questions were formulated. The research objectives are as follows:

RQ1: What are the factors that influence Chinese pre-service EFL teachers' behavioral intentions to use AI-based educational technologies in their future EFL teaching practice?

RQ2: What are the degrees of influence and correlations of these factors?

These questions were addressed using results derived from questionnaire data and semi-structured interview data.

4.1.1 Demographics of the Questionnaire Participants

A total of 617 pre-service English teachers participated in the study. After data screening, 576 valid responses were retained for factor analyses, and 572 responses were used in the final structural model. The demographic information presented in this section is calculated from the complete sample ($n = 617$). Among these participants,

89.4% (n=552) were female, and 10.5% (n=65) were male; The imbalance between the distribution of male and female EFL teachers is typical in China. Previous research on Chinese EFL teachers (Mei, 2016; Yang, 2022; Zhang & Chen, 2025) in general demonstrates a notable gender imbalance in the EFL teaching profession in China, characterized by a predominance of female educators. In mainland China, the historical tradition of a greater number of female students selecting EFL teaching as their major for their future career may have influenced this trend (Research Team of National Teacher Education Institution Surveys, 2014). Among the participants, 23.7% (n=146) were in their first year of study, 16.2% (n=100) were in their second year of study, and the majority were in their third or fourth year of study, with 29.3% (n=181) and 30.8% (n=190) respectively. Table 4.1 summarizes the demographics of the study participants.

Table 4.1 Demographics of the Participants

		Number	Percentage
Gender	Male	65	10.5%
	Female	552	89.4%
Year of Study	Freshman	146	23.7%
	Sophomore	100	16.2%
	Junior	181	29.3%
	Senior	190	30.8%

Regarding experience with technologies such as the Internet, computers, laptops, smartphones, tablets, etc., and applications like WeChat, QQ, blogs, TikTok, etc., in educational settings, approximately 69.9% (n = 431) had more than five years prior experience, and 23.5% (n = 145) had 3–4 years prior experience, only 1.94% (n = 12) reported less than one year experience as shown in Table 4.2.

Table 4.2 Pre-Service EFL Teachers' Experience with Technologies and Applications

Experience	Number	Percentage	Technologies and Applications
Less than 1 year	12	1.94%	the Internet, computers, laptops,
1–2 years	29	4.7%	smartphones, tablets, WeChat,
3–4 years	145	23.5%	QQ, blogs, TikTok, etc
5 years or more	431	69.9%	

Considering experience with AI tools, including ChatGPT, Kimi, Wenxin Yiyan, Tongyi Qianwen, iFlytek Mars, Doubao, iFlytek, Squirrel AI, Youdao Translation, Baidu Translation, Liulishuo, BaiCiZhan, Shanbay English, Chaoxing Xuexitong Platform, Seewo Whiteboard, etc., 12.2% (n=75) reported more than five years, 31.8% (n=196) had 3-4 year experience, and 42% (n=259) had 1-2 year experience with AI tools, while only 14.1% (n=87) reported less than three months experience with these AI tools, as is shown in Table 4.3.

Table 4.3 Pre-Service EFL Teachers' Experience with AI Tools

Experience	Number	Percentage	AI tools
Less than 3 months	87	14.1%	ChatGPT, Kimi, Wenxin Yiyan, Tongyi Qianwen, iFlytek Mars, Doubao, iFlytek, Squirrel AI, Youdao Translation, Baidu Translation, Liulishuo, BaiCiZhan, Shanbay English, Chaoxing Xuexitong Platform, Seewo Whiteboard, etc.
1–2 years	259	42%	
3–4 years	196	31.8%	
5 years or more	75	12.2%	

4.1.2 Factor Structure Refining and Measurement Model Development

When integrating the scale, adjusting the terminologies of the original items from "the system" (Venkatesh et al., 2003) and "AI-based tools" (Celik, 2023) to "AI-based educational technologies" constitutes a contextual specification of item content, which involves modifications to the operational definition of the construct (Borsboom et al., 2021). Such revisions, while improving contextual relevance (Gehlbach & Brinkworth, 2011), may alter respondents' cognitive processing of items (Tourangeau et al., 2000) and consequently affect the latent variable structure (Haynes et al., 1995). This necessitates revalidation even for previously established scales, as minor wording changes can significantly impact psychometric properties (Podsakoff et al., 2016). The combined use of Exploratory Factor Analysis (EFA) and back-translation (Behling & Law, 2000) provides robust evidence for the adjusted scale's construct validity (Floyd & Widaman, 1995) and cross-cultural equivalence (van de Vijver & Leung, 2021), ultimately enhancing its reliability and contextual fit (DeVellis, 2017; Boateng et al., 2018). Therefore, Exploratory Factor Analysis (EFA) was conducted to refine the factor

structure and revise the measurement model. As Fabrigar and Wegener (2012) discussed, using the same sample for both EFA and CFA risked fitting the model to idiosyncratic features of the data rather than uncovering a true underlying structure. Hence, a split-sample approach was used to divide the dataset ($n = 576$) into two parts—one for EFA and another for CFA (Byrne, 2016). Randomly splitting the data in SPSS 25, 50% is for EFA ($n = 288$), and another 50% is for CFA ($n = 288$). Using different samples for EFA and CFA can also ensure greater stability and generalizability of factor structure (Marsh et al., 2014).

Harman's single-factor test (Podsakoff et al., 2003) was conducted to assess the risk of Common Method Variance (CMV). All measurement items were included in an unrotated principal component analysis to determine whether a single factor dominated the total variance. The results revealed that the first factor accounted for only 40.303% of the total variance, which was well below the widely accepted threshold of 50% for identifying substantial CMV issues (Fuller et al., 2016; Malhotra et al., 2006). Therefore, it can be concluded that CMV is unlikely to introduce substantial bias to the findings of this study.

After confirming that common method variance was not a major concern, exploratory factor analysis (EFA) was conducted to refine the structure and develop the measurement model. Varimax rotation and the principal components method were used to extract the factors, and components were extracted with a fixed number of factors ($n = 9$). A total of nine factors and 30 items were obtained. The loadings of each item on the factor were between 0.59 and 0.86 (see Table 4.4). The EFA item selection process entailed: (a) removing items with loadings < 0.5 , (b) excluding items exhibiting significant cross-loadings (i.e., similar high loadings on ≥ 2 factors), (c) eliminating items inconsistent with theoretical constructs, and (d) iteratively refining the model through repeated EFA until achieving a stable factor structure (Costello & Osborne, 2005; Deng et al., 2017; Ferguson & Cox 1993). The reasons for removing the 11 items were as follows: PE4, EE1, and FC3 were removed because their factor loadings were below 0.5. FC4 was removed because it loaded on AI-TPK. AI-TK4 and AI-TK5 were deleted because they were misclassified as AI-TCK. AI-TCK4 was deleted to ensure that AI-TCK1, AI-TCK2, and AI-TCK3 loaded together to measure AI-TCK. AI-TPK1 and AI-TPK4 were deleted because their factor loadings were below 0.5. AI-TPACK1

was deleted because its factor loading was below 0.5, and AI-TPACK2 was deleted because it cross-loaded on AI-TCK.

Table 4.4 Factor and Factor Loading

Items	Factor and Factor Loading								
	AI-TPACK	SI	EE	AI-TPK	PE	AI-TK	BI	AI-TCK	FC
PE1					0.703				
PE2					0.763				
PE3					0.777				
EE2			0.787						
EE3			0.857						
EE4			0.718						
SI1		0.792							
SI2		0.748							
SI3		0.742							
SI4		0.635							
FC1									0.693
FC2									0.683
BI1							0.594		
BI2							0.756		
BI3							0.641		
AI-TK1						0.612			
AI-TK2						0.728			
AI-TK3						0.663			
AI-TPK2				0.603					
AI-TPK3				0.783					
AI-TPK5				0.612					
AI-TPK6				0.525					
AI-TCK1								0.654	
AI-TCK2								0.602	
AI-TCK3								0.614	
AI-TPACK3	0.689								
AI-TPACK4	0.721								
AI-TPACK5	0.728								
AI-TPACK6	0.681								

Table 4.4 (continued)

Items	Factor and Factor Loading								
	AI-TPACK	SI	EE	AI-TPK	PE	AI-TK	BI	AI-TCK	FC
AI-TPACK7	0.675								
Eigenvalue	12.025	2.364	1.830	1.297	1.080	1.023	0.901	0.745	0.688
Explained Variance (%)	40.082	7.879	6.098	4.323	3.600	3.409	3.005	2.484	2.292
Cumulative Variance (%)	40.082	47.961	54.060	58.383	61.983	65.392	68.397	70.881	73.173

The EFA results showed good validity of the scale. The Kaiser-Meyer-Olkin measure value was 0.94 ($p < 0.001$), indicating that it was suitable for factor analysis, and the total explained variance was 73.17%. Despite Factors 7- 9 having eigenvalues below Kaiser's criterion ($\lambda < 1$), all nine factors were retained due to theoretical alignment with BI, AI-TCK, and FC. Together, they explain 73.2% of the variance, with each factor demonstrating distinct and interpretable item loading (see Table 4.4). This decision aligns with recommendations to prioritize substantive theory over rigid statistical thresholds when factors are conceptually meaningful (Costello & Osborne, 2005; Fabrigar et al., 1999). Retaining minor factors is justified when they contribute to cumulative variance ($>70\%$) and reflect hypothesized dimensions (Pett et al., 2003), particularly in applied research where exhaustive construct coverage is critical (Ferguson & Cox, 1993). The measurement model was developed based on nine factors and 30 items. Considering two indicator items compatible with SEM analysis (Bollen, 1989), FC was retained in the measurement model. Figure 4.1 represents the measuring model.

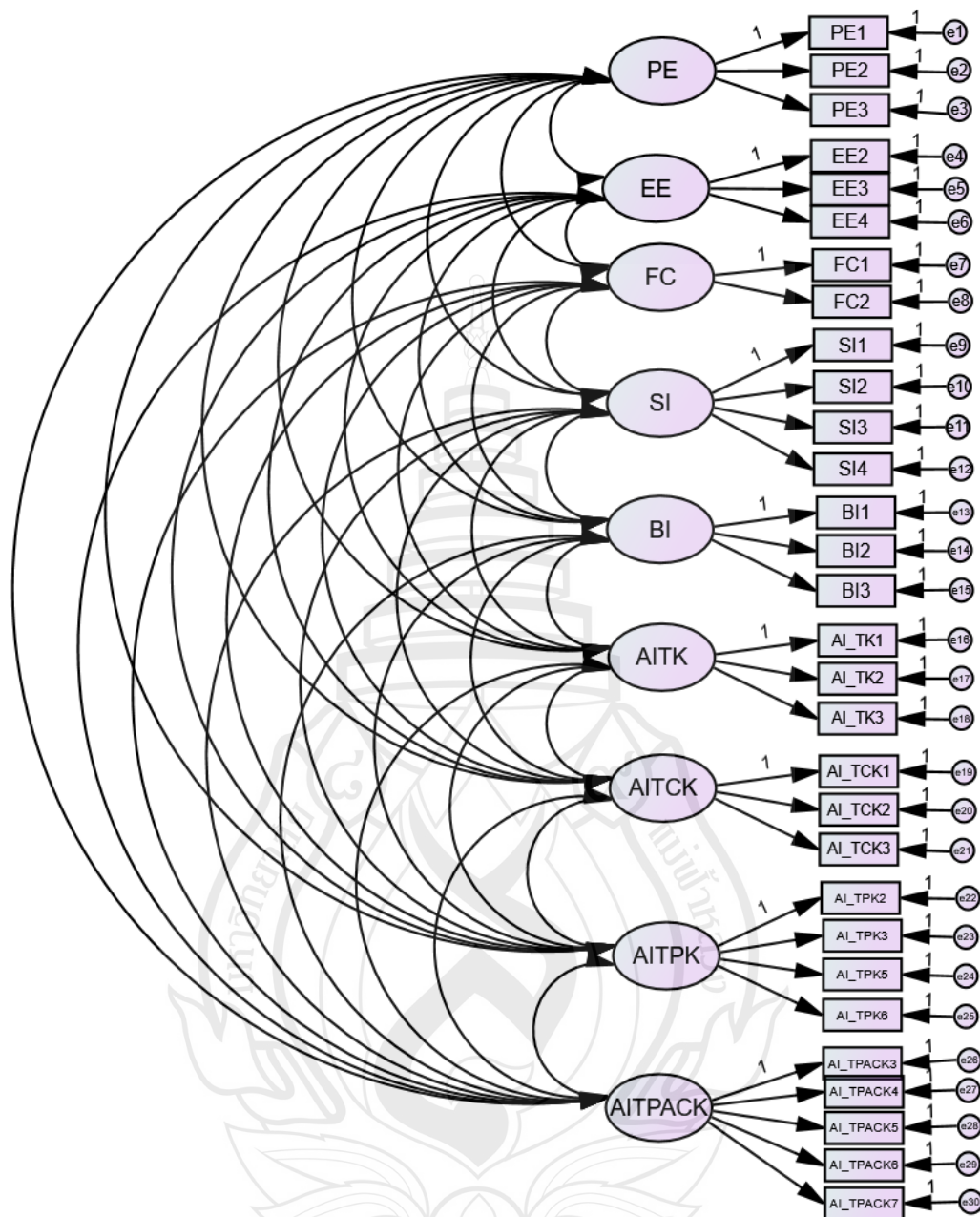


Figure 4.1 The measurement model for the nine latent factors

4.1.3 Descriptive Statistics and Reliability Analysis

After EFA, descriptive statistics and univariate normality tests were conducted for all 30 survey items ($n = 576$) which revealed acceptable distributions for subsequent analyses. As shown in Table 4.5, all items demonstrated skewness values within the recommended range of ± 2 (Byrne, 2016), with values ranging from -1.021 to -0.219, indicating responses clustered toward the positive end of the 5-point Likert scale. While

most items showed acceptable kurtosis (-0.749 to 3.407), two items from the Performance Expectancy (PE1=3.372, PE2=3.407) slightly exceeded the conservative threshold of ± 3 (Kline, 2023), though all values remained within the more lenient ± 7 benchmark for applied research (Finney & DiStefano, 2006). These patterns suggest mild ceiling effects in the PE items but satisfy robustness requirements for maximum likelihood estimation when using appropriate corrections (Satorra & Bentler, 2001). The results support proceeding with factor analysis while employing robust estimators to account for minor deviations, particularly for the Performance Expectancy scale (Hair et al., 2019). No variable transformations were deemed necessary as the observed non-normality was not severe enough to distort parameter estimates (Tabachnick & Fidell, 2019).

Table 4.5 Descriptive Information of Questionnaire Items

Items	Mean	Std. Deviation	Skewness	Kurtosis
PE1	4.04	.668	-.921	3.372
PE2	3.93	.667	-1.021	3.407
PE3	3.95	.696	-.769	2.145
EE2	3.45	.897	-.352	-.447
EE3	3.24	.957	-.240	-.749
EE4	3.38	.928	-.309	-.557
SI1	3.29	.833	-.336	.000
SI2	3.28	.837	-.219	-.108
SI3	3.56	.771	-.616	.642
SI4	3.64	.733	-.522	.653
FC1	3.65	.756	-.758	.598
FC2	3.76	.716	-.837	1.284
BI1	3.88	.701	-.862	2.166
BI2	3.70	.795	-.551	.399
BI3	3.68	.793	-.396	.032
AI-TK1	3.53	.784	-.555	.013
AI-TK2	3.74	.729	-.836	.993
AI-TK3	3.73	.754	-.796	.997

Table 4.5 (continued)

Items	Mean	Std. Deviation	Skewness	Kurtosis
AI-TPK2	3.68	.788	-.701	.559
AI-TPK3	3.73	.764	-.820	1.218
AI-TPK5	3.62	.807	-.631	.340
AI-TPK6	3.59	.816	-.427	-.060
AI-TCK1	3.91	.733	-.717	1.105
AI-TCK2	3.59	.872	-.650	.219
AI-TCK3	3.83	.698	-.777	1.727
AI-TPACK3	3.59	.829	-.503	.012
AI-TPACK4	3.70	.756	-.711	.697
AI-TPACK5	3.69	.783	-.696	.595
AI-TPACK6	3.60	.796	-.566	.224
AI-TPACK7	3.68	.773	-.921	.270

Cronbach's Alpha coefficient was utilized to test the reliability of the 30-item scale. Hinton et al. (2014) proposed four cut-off points: excellent reliability (0.90 and above), high reliability (0.70-0.90), moderate reliability (0.50-0.70), and low reliability (0.50 and below). Facilitating Conditions (FC) achieved moderate reliability ($\alpha = 0.69$), and other factors achieved high reliability. The whole scale achieved excellent reliability ($\alpha = 0.95$). The final factor structure and Cronbach's Alpha values are shown in Table 4.6.

Table 4.6 Cronbach's Alpha Coefficient of the Final Factor Structure

Factors	Original Items	Items after EFA	Cronbach's Alpha for each scale	Cronbach's Alpha for the whole scale
1 Performance Expectancy (PE)	4	3	0.84	0.95
2 Effort Expectancy (EE)	4	3	0.84	
3 Social Influence (SI)	4	4	0.83	

Table 4.6 (continued)

	Factors	Original Items	Items after EFA	Cronbach's Alpha for each scale	Cronbach's Alpha for the whole scale
4	Facilitating Conditions (FC)	4	2	0.69	
5	Behavioral Intention (BI)	3	3	0.82	
6	AI Technological Knowledge (AI-TK)	5	3	0.76	
7	AI Technological Content Knowledge (AI-TCK)	4	3	0.76	
8	AI Technological Pedagogical Knowledge (AI-TPK)	6	4	0.84	
9	AI Technological pedagogical content knowledge (AI-TPACK)	7	5	0.87	
Total		41	30		

4.1.4 Results of Measurement Model Test

Before testing the hypothesized model, the validity of the measurement model for all constructs was assessed through confirmatory factor analysis (CFA). An intercorrelated model consisting of the nine factors and 30 items was tested in AMOS. The schematic figure for this model is presented in Figure 4.2. Following the SEM notation convention, observed variables are characterized by rectangles, and latent factors are depicted with ellipses. Consistent with CFA conventions, each item is loaded solely on the factor it intends to measure, and all measurement errors remain uncorrelated.

The model fit indices of the initial measurement model test revealed that it had a good fit to the sample data ($\chi^2/df = 1.97$; CFI = 0.93; TLI=0.92; RMSEA = .06;

SRMR = 0.03), all factor loadings were above the recommended threshold value of .60 (Kline, 2010) as shown in Figure 4.2.

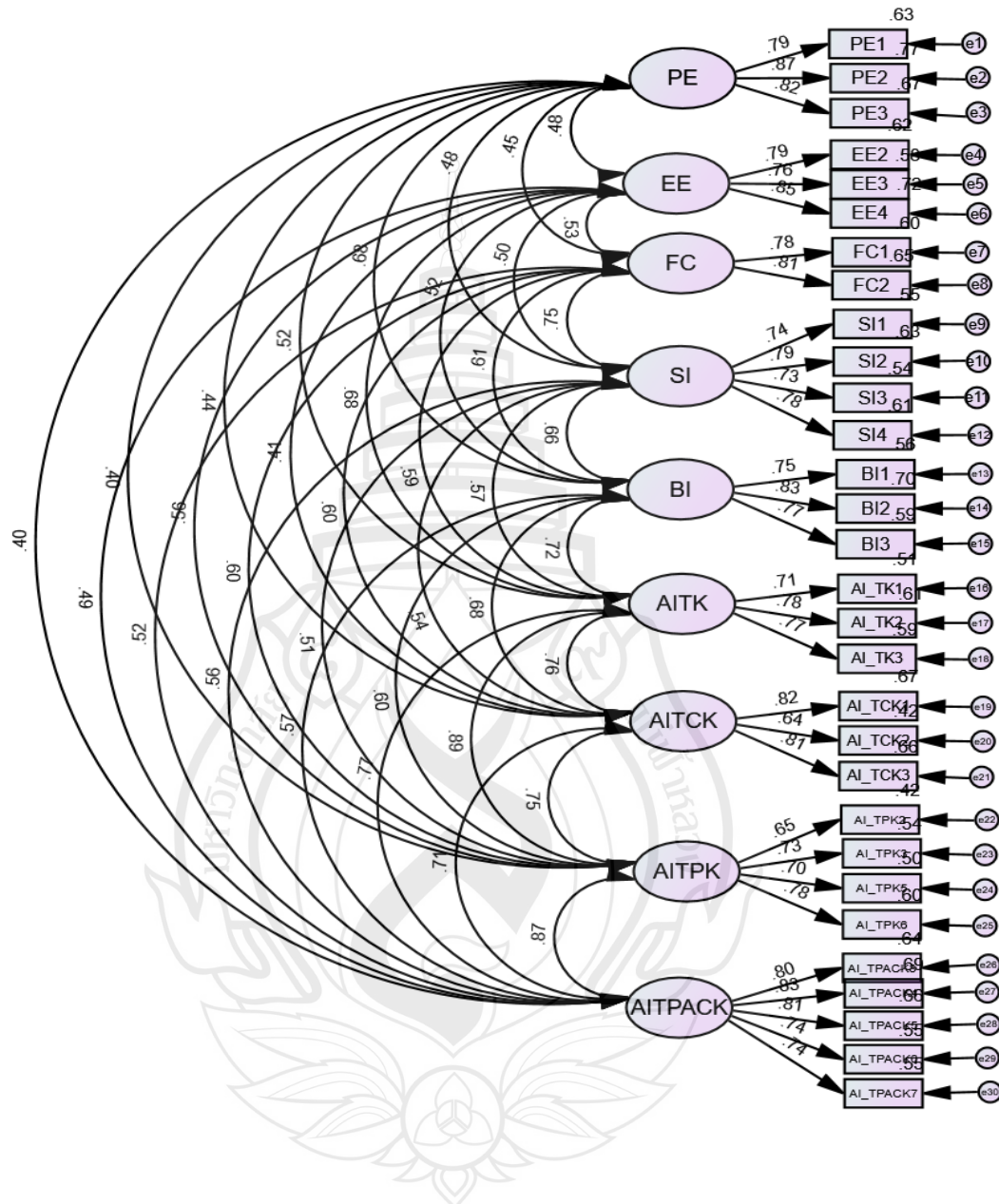


Figure 4.2 Test results of the 30-item measurement model

Next, the factor loading, AVE, and composite reliability (CR) of the nine factors were examined to verify the measurement model's convergent validity (see Table 4.7). Convergent validity was established for this study because all results met the threshold values discussed in Section 3.7.1.1.2.

Table 4.7 Convergent Validity Results

Factors	Items	Standardized factor loading ($\lambda > .60$) *	Composite reliability ($> .70$) *	Average variance extracted ($> .50$) *	$\sqrt{\text{AVE}}$
PE	PE1	.79	0.87	0.69	0.83
	PE2	.86			
	PE3	.82			
EE	EE2	.79	0.84	0.64	0.80
	EE3	.76			
	EE4	.85			
SI	SI1	.74	0.85	0.58	0.76
	SI2	.79			
	SI3	.73			
	SI4	.78			
FC	FC1	.78	0.77	0.62	0.79
	FC2	.81			
BI	BI1	.75	0.83	0.62	0.79
	BI2	.84			
	BI3	.77			
AI-TK	AI-TK1	.72	0.80	0.57	0.76
	AI-TK2	.78			
	AI-TK3	.77			
AI-TPK	AI-TPK2	.65	0.81	0.51	0.72
	AI-TPK3	.73			
	AI-TPK5	.70			
	AI-TPK6	.78			
AI-TCK	AI-TCK1	.82	0.81	0.58	0.76
	AI-TCK2	.65			
	AI-TCK3	.81			

Table 4.7 (continued)

Factors	Items	Standardized factor loading ($\lambda > .60$) *	Composite reliability ($> .70$) *	Average variance extracted ($> .50$) *	$\sqrt{\text{AVE}}$
AI-TPACK	AI-TPACK3	.80	0.98	0.62	0.79
	AI-TPACK4	.83			
	AI-TPACK5	.82			
	AI-TPACK6	.74			
	AI-TPACK7	.74			

Then the discriminant validity was examined. Discriminant validity can be measured by comparing the square roots of AVE to the interconstruct correlation coefficients of each latent variable (Fornell & Larcker 1981). Validity can be verified if the former value is greater than the latter. The outcomes were presented in Table 4.8. The square roots of the AVE for five constructs (BI, SI, FC, EE, and PE) were greater than their corresponding correlation values, while the square roots of the AVE for the remaining three constructs (AI-TPACK, AI-TPK, and AI-TK) were slightly lower than their corresponding correlation values. Therefore, HTMT (Heterotrait-Monotrait Ratio of Correlations) was calculated to further check the discriminant validity.

Table 4.8 Fornell-Larcker Criterion Results

Latent Variables	AI-TPACK	AI-TPK	AI-TCK	AI-TK	BI	SI	FC	EE	PE
AI-TPACK	0.79								
AI-TPK	.87	0.72							
AI-TCK	.71	.75	0.76						
AI-TK	.77	.89	.76	0.76					
BI	.57	.60	.68	.72	0.79				
SI	.56	.510	.54	.57	.66	0.76			
FC	.52	.60	.60	.59	.61	.75	0.79		
EE	.49	.560	.41	.68	.52	.50	.53	0.80	
PE	.40	.40	.44	.52	.68	.48	.45	.48	0.83

Table 4.9 HTMT Results

Latent Variables	AI-TPACK	AI-TPK	AI-TCK	AI-TK	BI	SI	FC	EE	PE
AI-TPK	0.782								
AI-TCK	0.649	0.801							
AI-TK	0.715	0.892	0.745						
BI	0.532	0.588	0.631	0.671					
SI	0.514	0.479	0.506	0.535	0.621				
FC	0.487	0.559	0.575	0.553	0.566	0.726			
EE	0.455	0.524	0.376	0.642	0.482	0.462	0.496		
PE	0.373	0.371	0.401	0.485	0.629	0.445	0.411	0.447	

HTMT Results (see Table 4.9) indicated that six of the constructions (BI, SI, FC, EE, PE, and AI-TCK) HTMT < 0.85, suggesting good discriminant validity. AI-TPK and AI-TK: HTMT = 0.892, slightly lower than the threshold HTMT < 0.90 for conceptually similar constructs (Hair et al., 2022). Additional cross-loading screening was performed according to recommendations in Hair et al. (2013) and Chin (2010), and no cross-loadings were identified, showing each item loaded highly with its measured factor.

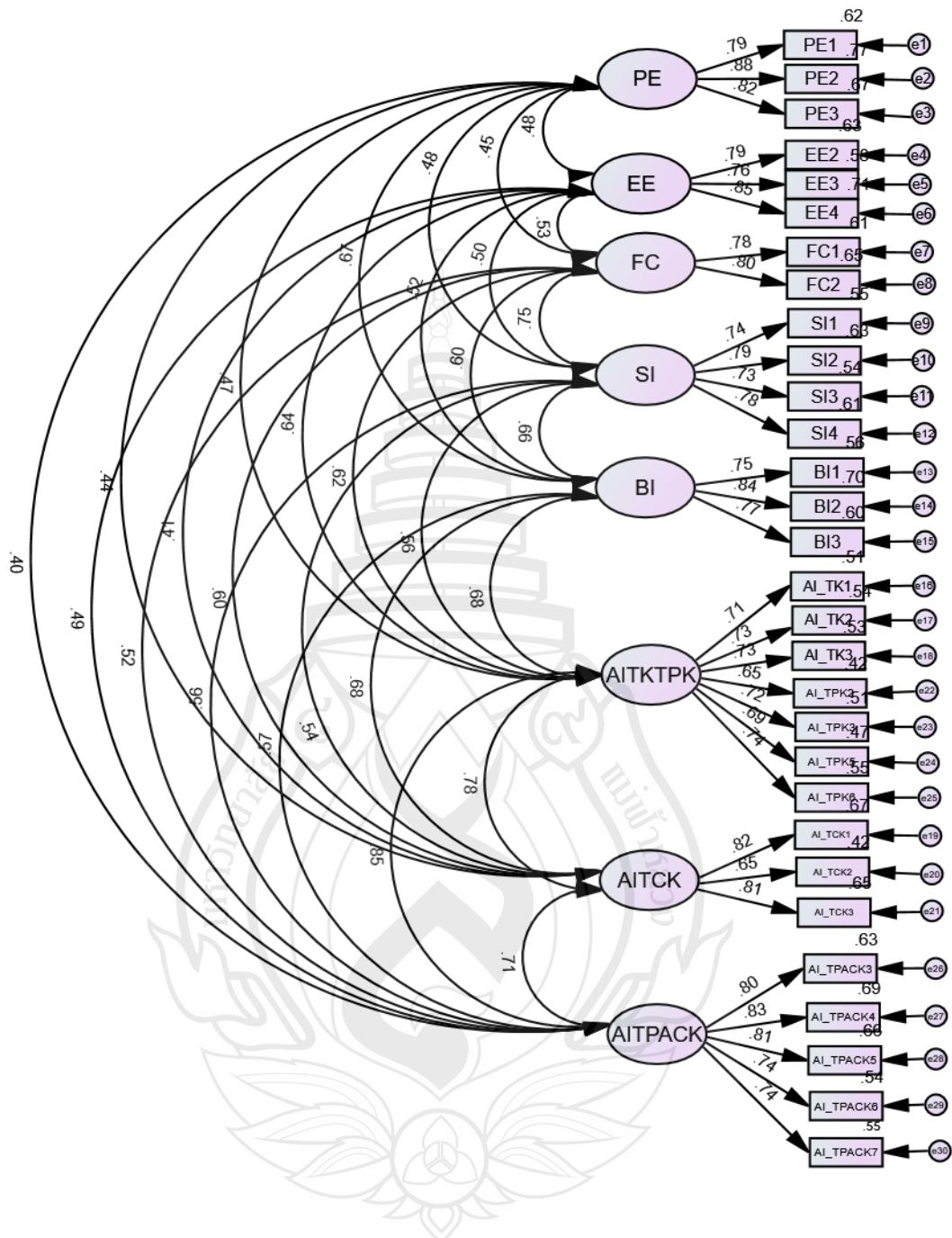


Figure 4.3 8-factor structure

To further assess discriminant validity concerns, a model comparison was conducted between the original 9-factor structure and an alternative model in which two highly correlated constructs (AI-TPK and AI-TK) were merged as AITKTPK (see Figure 4.3). The results (see Table 4.10) demonstrated superior fit indices for the original model (e.g., RMSEA = .058 vs. .060, CFI = .928 vs. .921, AIC = 918.90 vs.

946.81), indicating that the 9-factor model provides a better representation of the data. Although the HTMT value between AI-TPK and AI-TK is close to recommended threshold (0.90), the stronger overall model fit supports retaining them as distinct constructs.

Table 4.10 Comparison of Model Fit Indices Between the 9-Factor Model and the 8-Factor Model

Fit Index	9-Factor Model	8-Factor Model	Preferred Model
Chi-square/df (CMIN/DF)	1.970	2.045	9-Factor
GFI	0.856	0.848	9-Factor
AGFI	0.818	0.813	9-Factor
RMR	0.030	0.031	9-Factor
RMSEA	0.058	0.060	9-Factor
CFI	0.928	0.921	9-Factor
TLI	0.916	0.909	9-Factor
IFI	0.929	0.922	9-Factor
AIC	918.897	946.808	9-Factor
ECVI	3.202	3.299	9-Factor
PCLOSE	0.017	0.003	9-Factor
HOELTER (p = .05)	164	158	9-Factor
HOELTER (p = .01)	172	166	9-Factor

Note Across all fit indices, the 9-factor model consistently shows better model fit than the alternative 8-factor model, supporting its theoretical and empirical validity.

In summary, the measurement model's acceptable model fit indices, as well as the presence of convergent and discriminant validity within the model, justified the subsequent structural model test.

4.1.5 Results of Structural Model Testing

4.1.5.1 Multivariate Outlier Detection and Structural Model Test

Before evaluating the proposed structural model, Mahalanobis distance (D^2) was employed to detect multivariate outliers using 30 observed variables. The critical value at $p < .001$ ($df = 30$) is 59.70. Although over 55 cases exceeded this threshold, in

accordance with the established guidelines for Mahalanobis distance-based outlier detection in multivariate analysis (Kline, 2023), only the four most extreme outliers ($D^2 > 100$) were removed to ensure model robustness while avoiding excessive data cleaning. Following the removal of these samples, the structural model underwent re-estimation utilizing the remaining 572 valid questionnaires.

Before evaluating the structural model, multivariate outlier screening was conducted by using Mahalanobis distance (D^2) across 30 observed variables. The statistical threshold for outlier identification was set at $D^2 > 59.70$ ($p < .001$, $df = 30$). Although 55 cases exceeded this cutoff, we followed established methodological guidelines (Kline, 2023) by removing only the four most extreme outliers ($D^2 > 100$). This conservative approach balanced model robustness with data preservation. Subsequent model estimation was therefore performed on the refined sample of 572 valid questionnaires.

As shown in Table 4.11, a comparison of model fit indices before and after removal demonstrated a significant improvement (e.g., CFI increased from 0.939 to 0.942, GFI rose from 0.898 to 0.901, and RMSEA decreased from 0.052 to 0.050). This indicates that the outliers could have had a significant impact on model estimation. Particularly noteworthy, the model's structural configuration, hypothesized paths, and factor loading remained unchanged, indicating that the model's theoretical interpretability was unaffected.

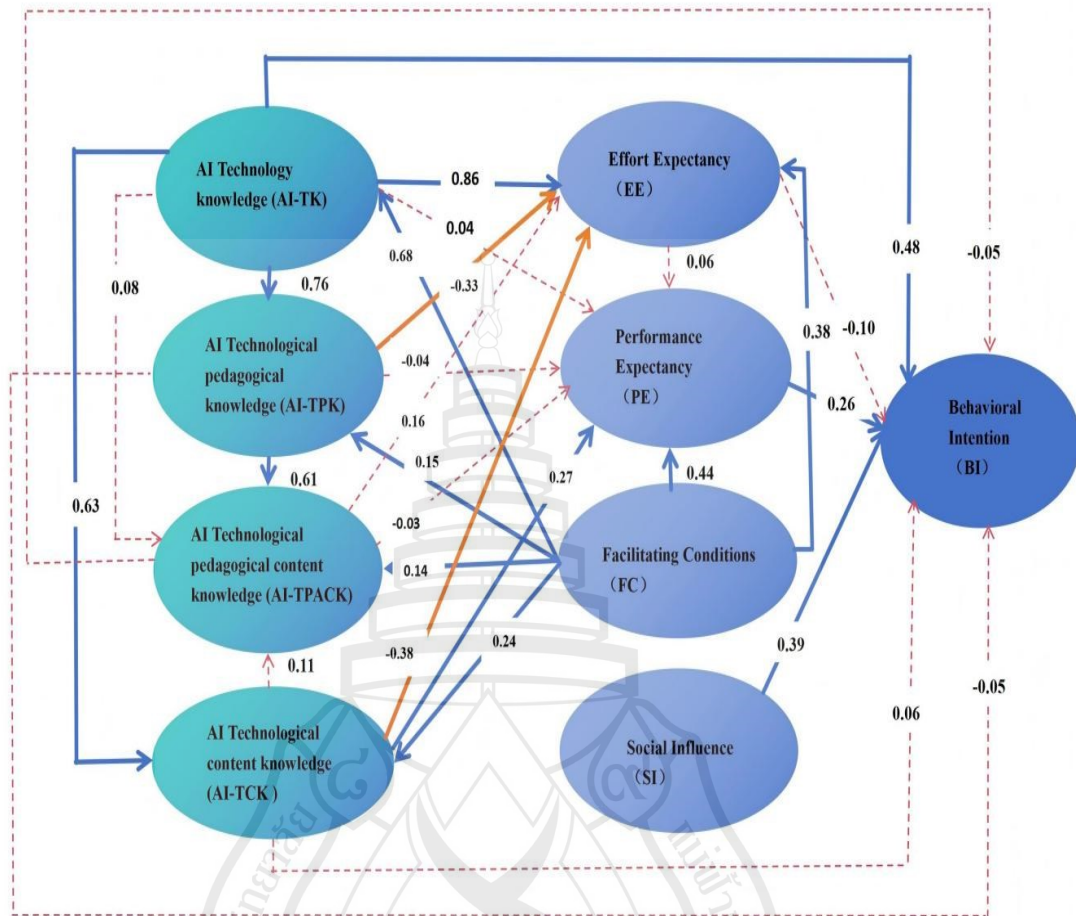
Table 4.11 Comparison of Model Fit Indices before and after Exclusion

Fit Index	Before Deletion	After Deletion	Improvement	Recommended Threshold
Chi-square/df	2.543	2.456	Improved	< 3 (ideal < 2)
GFI	0.898	0.901	Increased	≥ 0.90
NFI	0.903	0.906	Reached Threshold	≥ 0.90
IFI	0.939	0.942	Increased	≥ 0.90
TLI	0.929	0.933	Increased	≥ 0.90
CFI	0.939	0.942	Increased	≥ 0.90
RMSEA	0.052	0.050	Improved	≤ 0.06 (ideal)
PCLOSE	0.229	0.415	Improved	> 0.05

Table 4.11 (continued)

Fit Index	Before Deletion	After Deletion	Improvement	Recommended Threshold
RMR	0.027	0.026	Reduced	< 0.05
AIC	1135.147	1102.279	Reduced	Lower = better
BIC	1514.128	1480.654	Reduced	Lower = better

Given that the influence of these outliers on the previously established factor structure was negligible, Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA) were not re-conducted. The final structural model, comprising 27 hypothesized paths, was modeled using the Maximum Likelihood estimation method in AMOS software. To address potential non-normality, the Bollen-Stine bootstrap resampling method (5000 resamples) was applied. The chi-square was significant ($\chi^2 = 928.279$, $df = 378$, $p < .001$), as expected given the large sample size. The ratio of chi-square to degrees of freedom ($CMIN/df = 2.456$) is within the range of 1 to 3, indicating adequate fit (Kline, 2023). Additionally, CFI = .942, TLI = .933, IFI = .942, and NFI = .906; all of fit indices are above the suggested 0.90 threshold for good fit (Hu & Bentler, 1999). The RMSEA is 0.050, and the PCLOSE value is 0.415, indicating a good fit. Overall, the model offers a theoretically plausible and statistically acceptable representation of the structural relationships among the constructs. The standardized path coefficients and their significance are presented in Table 4.14 (Hypothesis Testing Results), and the final structural path diagram is depicted in Figure 4.4.



Note Blue arrows indicate supported hypotheses with positive effects; orange arrows indicate supported hypotheses with negative effects; and red dashed arrows indicate unsupported hypotheses.

Figure 4.4 Structural Path Diagram

4.1.5.2 Results of Hypotheses Testing

The Squared Multiple Correlations (SMC) value, also known as R^2 , indicates the proportion of variance in each endogenous variable that can be explained by the structural model. According to Chin (1998), Cohen (1988), Hair et al. (2019), and Falk and Miller (1992). The following benchmarks (see Table 4.12) are typically applied for interpreting the magnitude of R^2 values in SEM.

Table 4.12 The Squared Multiple Correlations (SMC) Value Range

R² Value Range	Interpretation	References
$\geq .67$	Substantial	Hair et al. (2019), Chin (1998)
.33 – .66	Moderate	Hair et al. (2019), Chin (1998)
.19 – .32	Weak	Chin (1998), Falk and Miller (1992)
$< .19$	Very weak/Negligible	Chin (1998), Cohen (1988)

In the model, seven endogenous constructs were tested (see Table 4.13). BI was determined by PE, SI, and AI-TK, producing $R^2 = .73$, meaning these three factors explained 73% of the variation in BI, indicating strong predictive power. Similarly, AI-TPACK and AI-TPK demonstrated the highest levels of explained variance, with $R^2 = .744$, suggesting that their predictors accounted for approximately 74.4% of the variation in each construct. AI-TCK also showed a relatively high degree of variance explained ($R^2 = 0.657$), while Effort Expectancy (EE) and AI-TK were moderately predicted by their respective determinants, with R^2 values of 0.558 and 0.4677, respectively. The lowest variance explained among the core constructs was observed in Performance Expectancy (PE) ($R^2 = .455$), though still within the acceptable range of moderate explanatory power.

Table 4.13 Coefficient of Determination (R^2) for Endogenous Constructs

Variable	R²	Interpretation
Endogenous Constructs		
AI-TK	.467	Moderate
AI-TCK	.657	Substantial
AI-TPK	.744	Substantial
AI-TPACK	.744	Substantial
Effort Expectancy (EE)	.558	Moderate
Performance Expectancy (PE)	.455	Moderate
Behavioral Intention (BI)	.732	Substantial

And then the structural model with 27 hypotheses was tested through SEM. According to the statistical significance of standardized path coefficients, 15

hypotheses were supported. Behavioral Intention (BI) was directly and positively predicted by AI-TK ($\beta = .481, p < .001$), Social Influence (SI) ($\beta = .391, p < .001$), and Performance Expectancy (PE) ($\beta = .259, p < .001$). However, Effort Expectancy (EE), AI-TPACK, AI-TPK, and AI-TCK did not significantly influence BI, indicating that Chinese pre-service EFL teachers' behavioral intention to use AI-based educational technologies in their future teaching practice may be more influenced by perceptions of usefulness and social influence than by composite pedagogical-technological knowledge.

In addition, Facilitating Conditions (FC) had a significant and substantial influence on multiple constructs, including AI-TK ($\beta = .683, p < .001$), AI-TPK ($\beta = .145, p < .039$), AI-TCK ($\beta = .240, p < .001$), AI-TPACK ($\beta = .141, p < .012$), PE ($\beta = .441, p < .001$), and EE ($\beta = .381, p < .001$), highlighting its foundational role in shaping Chinese pre-service EFL teachers' AI-TPACK and perceptions of AI-based educational technologies.

Furthermore, AI-TK exerted strong positive effects on AI-TPK ($\beta = .757, p < .001$), AI-TCK ($\beta = .627, p < .001$), EE ($\beta = .863, p < .001$), and BI ($\beta = .481, p = .002$), underscoring its centrality in the technology-related knowledge structure. AI-TPK significantly influenced AI-TPACK ($\beta = .612, p < .001$), while AI-TPK strongly and negatively predicted EE ($\beta = -.326, p = .035$). What's more, AI-TCK had a moderate positive effect on PE ($\beta = .271, p < .008$), while it had a strong negative effect on EE ($\beta = -.379, p < .001$), suggesting complex relationships between AI-TPACK components and perceptions of AI-based educational technologies.

Several paths were not supported, including the effects of AI-TPK, AI-TCK, and AI-TPACK on BI, as well as the effects of AI-TPACK on PE and EE. These results suggest potential mediation effects or alternative pathways that call for further investigation. Overall, the model demonstrates strong explanatory power for key constructs like AI-TK, AI-TPK, AI-TCK, and Behavioral Intention (BI), while revealing complex relationships between AI-TPACK components and Chinese pre-service EFL teachers' perceptions of AI-based educational technologies. Table 4.14 lists the final hypotheses testing results.

Table 4.14 Hypotheses Testing Results

No.	Path (Hypothesis)	Estimate	Std. Estimate	CR	p-value	Result	Interpretation
The UTAUT Model							
H1	PE → BI	.338	.259	4.936	***	Supported	Moderate effect
H2	EE → BI	-.091	-.102	-1.520	.128	Not Supported	Not significant
H3	EE → PE	.037	.055	0.674	.500	Not Supported	Not significant
H4	SI → BI	.417	.391	7.207	***	Supported	Strong effect
H5	FC → EE	.505	.381	4.433	***	Supported	Moderate to strong
H6	FC → PE	.398	.441	4.775	***	Supported	Strong effect
The AI-TPACK Framework							
H7	AI-TK → AI-TPK	.729	.757	9.183	***	Supported	Strong positive effect
H8	AI-TK → AI-TPACK	.089	.077	0.744	.457	Not Supported	Not significant
H9	AI-TK → AI-TCK	.656	.627	8.184	***	Supported	Strong positive effect
H10	AI-TPK → AI-TPACK	.728	.612	6.310	***	Supported	Strong positive effect
H11	AI-TCK → AI-TPACK	.115	.105	1.544	.123	Not Supported	Not significant
The UTAUT Model and The AI-TPACK Framework							
H12	AI-TK → BI	.533	.481	3.056	.002	Supported	Moderate to strong
H13	AI-TPK → BI	-.056	-.049	-0.374	.708	Not Supported	Not significant
H14	AI-TPACK → BI	-.044	-.045	-0.516	.606	Not Supported	Not significant
H15	AI-TCK → BI	.058	.055	0.643	.520	Not Supported	Not significant
H16	AI-TK → PE	.036	.042	0.247	.805	Not Supported	Not significant
H17	AI-TK → EE	1.075	.863	5.212	***	Supported	Strong positive effect
H18	AI-TPK → PE	-.032	-.037	-0.246	.805	Not Supported	Not significant
H19	AI-TPK → EE	-.421	-.326	-2.104	.035	Supported	Significant (neg.) negative
H20	AI-TPACK → PE	-.020	-.027	-0.261	.794	Not Supported	Not significant
H21	AI-TPACK → EE	.176	.162	1.508	.131	Not Supported	Not significant
H22	AI-TCK → PE	.220	.271	2.633	.008	Supported	Moderate effect

Table 4.14 (continued)

No.	Path (Hypothesis)	Estimate	Std. Estimate	CR	p-value	Result	Interpretation
H23	AI-TCK → EE	-.451	-.379	-3.907	***	Supported (neg.)	Significant negative
H24	FC → AI-TK	.728	.683	11.253	***	Supported	Strong positive effect
H25	FC → AI-TPK	.149	.145	2.063	.039	Supported	Weak but significant
H26	FC → AI-TPACK	.172	.141	2.522	.012	Supported	Weak to moderate
H27	FC → AI-TCK	.268	.240	3.351	***	Supported	Moderate effect

Note Performance Expectancy (PE); Effort Expectancy (EE); Social Influence (SI); Facilitating Conditions (FC); Behavioral Intention (BI); AI Technological Knowledge (AI-TK); AI Technological Content Knowledge (AI-TCK); AI Technological Pedagogical Knowledge (AI-TPK); AI Technological pedagogical content knowledge (AI-TPACK). * $p < .05$; ** $p < .01$; *** $p < .001$

Grounded in the UTAUT and AI-TPACK frameworks, this study examined eight potential factors influencing Chinese pre-service EFL teachers' behavioral intention (BI) to adopt AI-based educational technologies. Structural model testing revealed significant positive effects of Performance Expectancy (PE), Social Influence (SI), and AI Technological Knowledge (AI-TK) on Behavioral Intention (BI). The relationships between AI-TPACK components and Chinese pre-service EFL teachers' perceptions of AI-based educational technologies proved complex. To deepen understanding of these dynamics, a complementary qualitative analysis follows in the next section.

4.1.6 Results from Semi-structured Interviews on Influencing Factors

4.1.6.1 Demographics of the Interviewees

A total of 21 pre-service EFL teachers participated in the semi-structured focus group interviews. They grouped based on the year of study. Four focus group interviews were conducted. Among them, 6 were male, and 15 were female. To protect their privacy, they were coded as PSTF1-PSTF5 (PST = pre-service teacher, F=freshman), PSTSO1-PSTSO5 (PST = pre-service teacher, SO=sophomore), PSTJ1-

PSTJ6 (PST = pre-service teacher, J=junior), PSTSE1-PSTSE5 (PST = pre-service teacher, SE=senior). In total, there were 12 in-service EFL teacher who participated in one-on-one semi-structured interviews. They all meet the criteria of graduating from CX Normal University within the past five years and have experience using AI tools. They were coded as IST1-IST12 (IST = in-service teacher). The demographics of these interviewees are provided in Table 4.15.

Table 4.15 The Demographics of the Interviewees

Code	Gender	Age	Year of Study	Years of Teaching
Pre-service EFL teachers interviewees				
PSTF1	female	19	Freshman	
PSTF2	male	19	Freshman	
PSTF3	female	18	Freshman	
PSTF4	female	19	Freshman	
PSTF5	male	18	Freshman	
PSTSO1	male	19	Sophomore	
PSTSO2	female	19	Sophomore	
PSTSO3	female	19	Sophomore	
PSTSO4	male	19	Sophomore	
PSTSO5	female	19	Sophomore	
PSTJ1	female	20	Junior	
PSTJ2	female	19	Junior	
PSTJ3	female	20	Junior	
PSTJ4	female	20	Junior	
PSTJ5	female	21	Junior	
PSTJ6	male	22	Junior	
PSTSE1	female	21	Senior	
PSTSE2	female	21	Senior	
PSTSE3	male	20	Senior	
PSTSE4	female	22	Senior	
PSTSE5	female	22	Senior	

Table 4.15 (continued)

Code	Gender	Age	Year of Study	Years of Teaching
In-service EFL Teacher interviewees				
IST1	male	23		1 year
IST2	female	22		1 year
IST3	female	25		2 years
IST4	female	27		3.5 years
IST5	male	21		0.5 year
IST6	female	24		2.5 years
IST7	female	23		1 year
IST8	female	23		1 year
IST9	female	24		1.5 years
IST10	female	24		1 year 3 months
IST11	female	23		1 year
IST12	female	25		2 years

4.1.6.2 Performance Expectancy (PE)

This section presents the perceptions of pre-service teachers and in-service teachers about performance expectancy, respectively.

1. Pre-service EFL Teachers' Perception of Performance Expectancy

Pre-service EFL teachers shared their views on how using AI-based educational technology could enhance their teaching performance, indicating their performance expectancy (adapted from Venkatesh et al., 2003). Many participants emphasized that AI helps overcome time and space limitations, allowing students to practice English independently and beyond the classroom. For example, AI “helps us query knowledge points we don’t understand in daily learning” (PSTF3) and “enables self-directed oral practice anytime, breaking time constraints” (PSTSO3). It was also noted to provide “personalized learning plans according to each student’s progress, supporting learning flexibility” (PSTSE2).

Teachers highlighted AI’s role in reducing workload. It “automatically grades essays and corrects grammar and word usage” (PSTF1) and “provides timely

feedback and improves teachers' grading efficiency" (PSTF5). AI can also "save time in lesson preparation and help analyze students' learning needs" (PSTSE1) and "point out suitable course frameworks and optimize lesson planning" (PSTSE4).

AI was perceived as enhancing teaching efficiency in lesson preparation, content creation, and classroom delivery. It "enhances teaching efficiency" (PSTF1) and can "fully optimize teaching processes" (PSTSE4). Student engagement and motivation were seen as additional benefits. AI "simulates real language environments, increasing students' learning interest" (PSTF5) and "creates immersive and interactive experiences" (PSTSE2). It was also noted to make learning more fun and encourage active participation (PSTF3; PSTF4).

Individualized learning was frequently cited as a key advantage. AI "provides personalized study materials and learning plans" (PSTF1; PSTF2) and "tailors content to students' learning styles and progress" (PSTSE3). Support for personalized vocabulary and oral practice was also emphasized (PSTF3).

Participants further recognized AI's potential to improve resource accessibility and equity. Its rich materials help expand vocabulary and grammar knowledge (PSTF4), "reduce disparities between urban and rural students" (PSTJ5), and offer "abundant high-quality resources, including texts, audio, and video" (PSTSE3).

Finally, AI was seen as aligned with educational trends, preparing teachers and students for future-oriented, technology-driven English education. It "will inevitably be widely used in the future" (PSTSO4), and its use helps teachers and students adapt to digital teaching environments (PSTSE4; PSTSE5).

In conclusion, pre-service teachers perceived AI as an important tool that enhances efficiency, engagement, and personalized learning, while also preparing them for future educational trends.

2. In-service EFL Teachers' Perception of Performance Expectancy.

In-service EFL teachers emphasized that AI significantly enhances teaching and learning outcomes. They noted that AI can break time and space limitations for students, especially in remote areas. One teacher said, "AI can break students' learning space and time limitations and simulate real language environments, helping students improve their English application ability" (IST1).

Teachers highlighted workload reduction as an important benefit. AI helps teachers identify students' weaknesses and provide targeted instruction. "AI software can analyze students' test data and suggest personalized learning plans," explained one participant (IST2). This allows teachers to address each student's needs, even in large classes.

Improving teaching efficiency was a common theme. Teachers reported that AI assists in lesson preparation and classroom activities. For example, one teacher stated, "I use AI to check my lesson plans and fill in missing content, which makes my classroom run more smoothly" (IST2). Others emphasized that AI supports content creation, such as games, small activities, or multimedia materials. "AI can generate beautiful pictures, videos, and audio for lesson preparation" (IST6).

Enhancing student engagement and learning quality was another benefit. Teachers observed that AI encourages active participation and supports individualized learning. One teacher commented, "AI helps students interact through fun exercises and games, improving oral and listening skills" (IST7). Another noted, "AI can complement traditional teaching, helping to track students' abilities and maximize learning outcomes" (IST8).

Teachers also valued equitable access to resources. AI provides opportunities for students whose parents cannot support learning at home. "AI helps students learn without extra costs and supports families with limited resources" (IST4). Furthermore, teachers acknowledged AI's role in future-oriented education. "This is a major trend, and it is important to guide students to use AI correctly to improve learning efficiency" (IST10).

In conclusion, in-service teachers agreed that AI is highly useful in English teaching. They highlighted its role in efficiency, personalized learning, resource provision, and student engagement. All teachers expressed that AI significantly supports both teaching practice and student learning.

3. Comparative Summary on Performance Expectancy

Both pre-service and in-service EFL teachers recognized the value of AI in English teaching. They agreed that AI can improve teaching efficiency. It can support personalized learning. It can also increase student engagement. Teachers in both groups noted that AI overcomes time and space limitations. AI allows students to practice

independently and supports learning beyond the classroom. Pre-service teachers emphasized AI's role in lesson planning and resource optimization (PSTSE4; PSTSE1), while in-service teachers noted its support in identifying students' weaknesses and providing targeted instruction, even in large classes (IST2).

Workload reduction was another shared benefit. Pre-service teachers appreciated AI for automating grading and providing timely feedback (PSTF1; PSTF5). In-service teachers highlighted AI's role in analyzing student data. They also noted that it generates learning plans (IST2). Both groups saw AI as a tool that saves time. It allows teachers to focus more on instructional quality.

Individualized learning was a key advantage. Student engagement was another important benefit. Pre-service teachers emphasized personalized study plans (PSTF1). They also highlighted interactive learning experiences (PSTSE3). In-service teachers focused on supporting active participation through games, exercises, and multimedia content (IST7; IST6). Both groups noted that AI helps create immersive learning environments and motivates students to engage more deeply.

Equitable access to resources was highlighted by both groups. Pre-service teachers mentioned that AI reduces disparities between urban and rural students and provides high-quality learning materials (PSTJ5; PSTSE3). In-service teachers noted that AI supports students with limited home resources and promotes inclusive learning opportunities (IST4).

Both groups recognized AI's alignment with future educational trends. Pre-service teachers saw it as preparation for technology-driven classrooms (PSTSO4; PSTSE5). In-service teachers emphasized guiding students to use AI effectively. This helps improve learning outcomes (IST10).

In summary, pre-service teachers focused on AI's potential for planning, personalization, and preparing for future teaching contexts. In contrast, in-service teachers highlighted practical classroom applications. They also emphasized student progress monitoring and resource support. In summary, the findings show that AI-based educational technologies are valued across career stages. Its use enhances teaching and learning. Specific expectations and uses may vary with teaching experience

4.1.6.3 Effort Expectancy (EE)

This section presents the perceptions of pre-service teachers and in-service teachers about effort expectancy respectively.

1. Pre-service EFL Teachers' Perceptions of Effort Expectancy

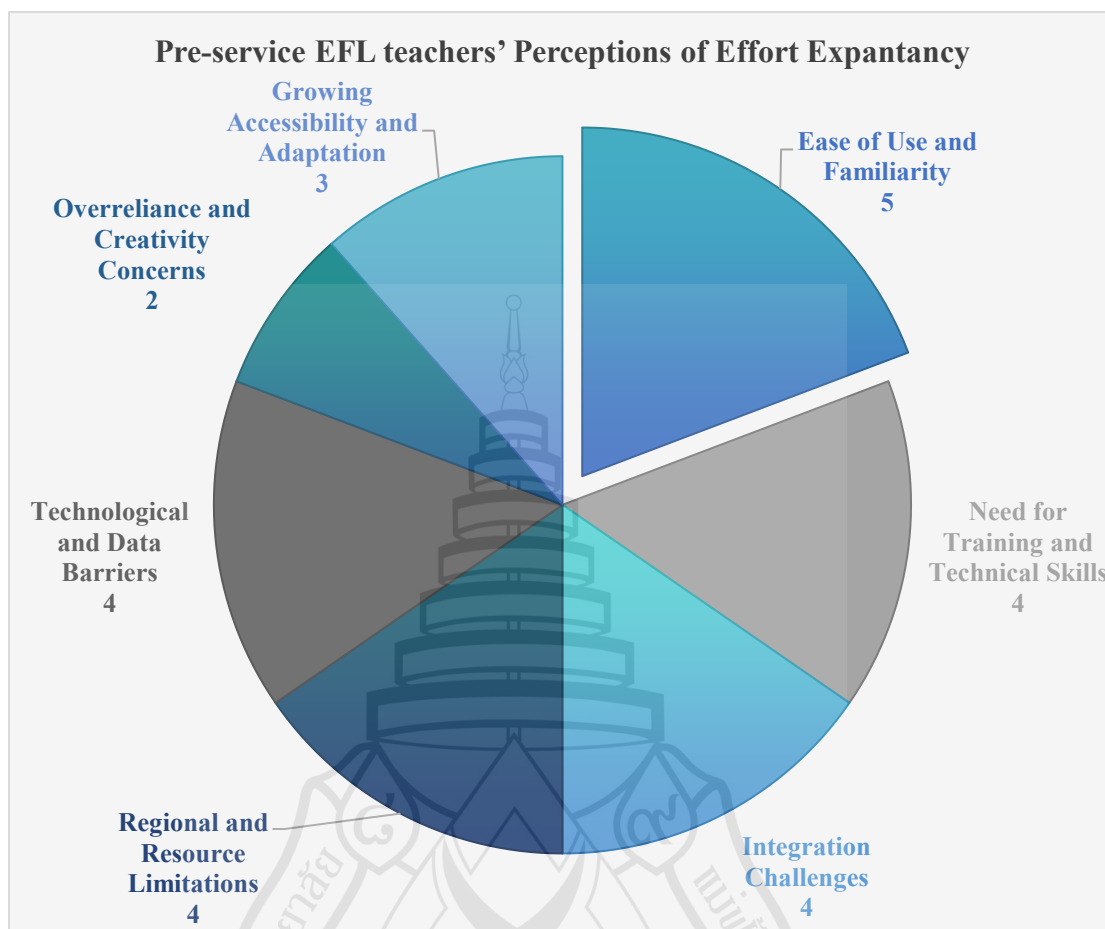
As shown in Figure 4.5, pre-service EFL teachers expressed mixed views on the effort required to integrate AI into English teaching. Many found AI tools easy to use and accessible. For example, AI was described as “very easy to use” and helpful in daily learning tasks (PSTF3). It was also noted that this generation “is familiar with technology and easily adapts to AI tools” (PSTSO5). Similarly, AI platforms were seen as “user-friendly” and suitable for “classroom and after-class vocabulary learning” (PSTJ3).

However, several participants highlighted technical and contextual barriers. Teachers “need training and extra time to learn how to use AI” (PSTF1), and challenges such as “software stability and accuracy” were emphasized (PSTSE2). Regional disparities were also noted, with schools in remote areas often facing “limited funding and weak infrastructure” (PSTF4; PSTSE5). Hardware and internet access remain major obstacles in some regions (PSTSO1; PSTJ1).

Some participants raised pedagogical integration challenges. While AI software may be easy to operate, it can be “difficult to integrate it into lesson content” (PSTF5). Effective use requires “careful instructional design” to fit traditional teaching methods (PSTJ5). Overuse of AI was also a concern, as it might “inhibit creativity and critical thinking” (PSTSO2).

A few teachers noted that AI could become increasingly manageable over time. As “technology becomes more accessible,” integration is expected to “gradually become easier” (PSTSE3).

In conclusion, pre-service teachers found AI generally easy to operate. Most tools were considered simple and user-friendly. However, they were cautious about using AI in real teaching contexts. Many believe integrating AI into lessons requires time and effort. Proper training and technical support were seen as essential. Several participants also emphasized the need for better infrastructure. These factors were viewed as key to making AI use easier and more sustainable.



Note The numbers represent interviewees who mentioned each issue.

Figure 4.5 Pre-service EFL Teachers' Perceptions of Effort Expectancy

2. In-service EFL Teachers' Perceptions of Effort Expectancy

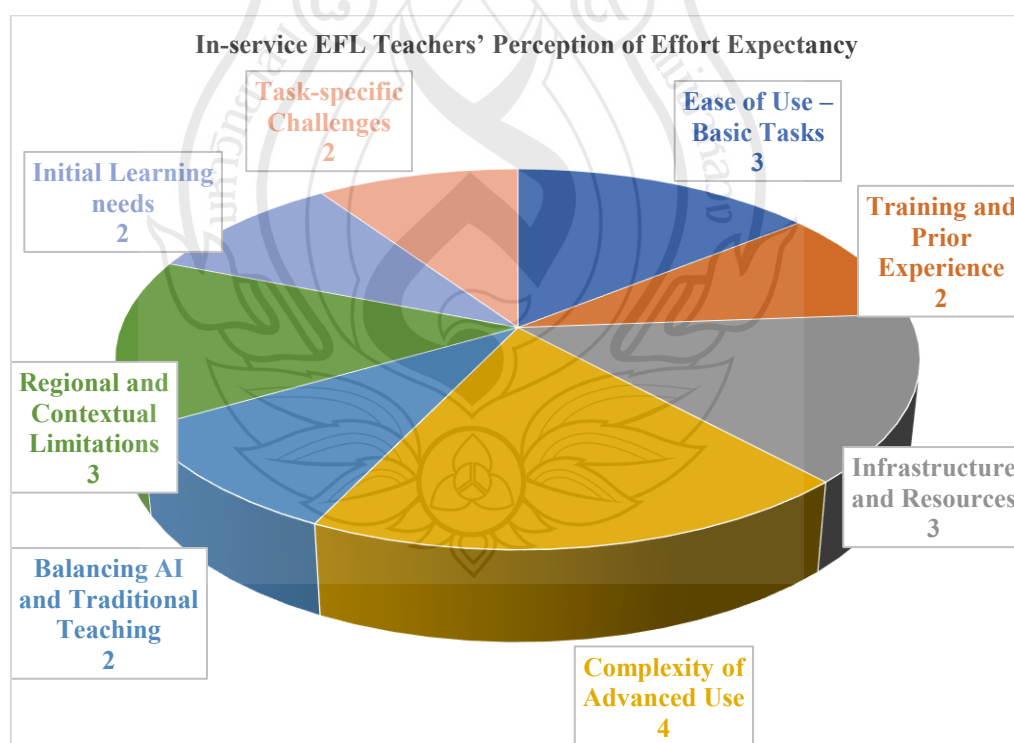
As demonstrated in Figure 4.6, in-service teachers reported mixed experiences regarding the ease of using AI in English teaching. Several teachers found AI relatively easy to use due to prior training and supportive infrastructure. One teacher noted, "We had professional courses in university, including theory and hands-on practice. This laid a solid foundation for AI use" (IST2). Another mentioned, "AI is relatively easy to operate because our classrooms have smart devices for students to use" (IST12). Some teachers highlighted that simple tasks, such as generating exercises or searching for content, were straightforward. "If I use one software to search or generate multiple-choice questions, it is quite easy" (IST11).

However, many teachers experienced difficulties. Several reported challenges with balancing AI and traditional teaching. "It is still difficult to balance

traditional and AI-based teaching to ensure lesson continuity and effectiveness” (IST1). Others cited infrastructure limitations or lack of guidance. “Currently it is not easy. We lack guidance, and even if teachers want to use AI, they don’t know how” (IST10). Some teachers struggled with technical operations and equipment. “Due to old computers or limited resources, using AI can be difficult” (IST9).

Teachers also mentioned the complexity of advanced applications. “For more complex tasks or if AI covers 30-50% of classroom time, it becomes very difficult” (IST11). Regional disparities added another layer of difficulty. “Our region has limited resources. Some AI content does not match the current textbook. Students focus on fun rather than the lesson core, making it hard to use” (IST7). Finally, teachers highlighted the need for long-term training. “Initial use requires training and repeated practice. It takes time to operate smoothly” (IST8).

In summary, teachers agreed that AI use in English teaching has both easy and challenging aspects. Simpler applications are manageable, but advanced or large-scale use requires support, guidance, and training.



Note The numbers represent interviewees who mentioned each issue.

Figure 4.6 In-service EFL Teachers’ Perceptions of Effort Expectancy

3. Comparative Summary on Effort Expectancy

Pre-service and in-service teachers shared similar views on effort expectancy. Both groups said that AI tools were easy to use for basic tasks. They found most platforms simple and accessible. However, both also faced technical and contextual barriers. Pre-service teachers mentioned a lack of training and uneven infrastructure. In-service teachers highlighted outdated equipment and limited support. Both groups agreed that integrating AI into teaching is more difficult than basic operation. They said that lesson design and pedagogical alignment require more effort. Training and guidance were seen as key solutions. Teachers in both groups believed that with better infrastructure and support, AI use would become easier and more sustainable.

4.1.6.4 Social Influence (SI)

This section presents the perceptions of pre-service teachers and in-service teachers about social influence, respectively.

1. Pre-service EFL Teachers' Perceptions of Social Influence

As illustrated in Figure 4.7, Social influence was identified as a key factor shaping pre-service EFL teachers' intention to adopt AI. Teachers emphasized that the opinions and behaviors of multiple groups affect their use. School leadership was frequently mentioned. Supportive leaders increased motivation to use AI. "If school leadership supports AI and provides training, I will use it" (PSTSE4). In contrast, conservative leadership reduced willingness. "If leaders think traditional teaching is better, I may not use AI" (PSTSE4).

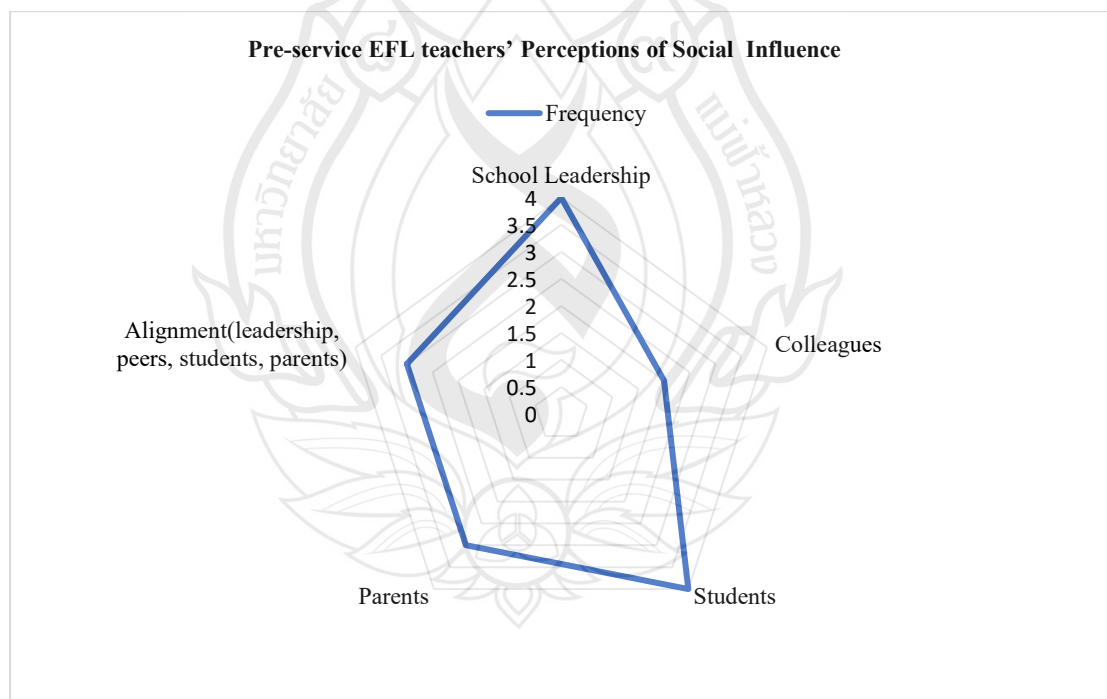
Colleagues also influenced decisions. Teachers noted that observing peers' AI use encourages adoption. "If my colleagues use AI tools and share experiences, I am more likely to try them" (PSTSE3). Resistance from peers led to caution. "If people around me complain about AI, I will wait and gather more information" (PSTSE4).

Student feedback was another important factor. Teachers reported that AI adoption depended on whether students could use it effectively. "If students accept and enjoy AI, it increases my motivation to use it" (PSTSE1). Conversely, poor student adaptation reduced willingness. "If students cannot use the technology or resist it, I may not adopt it" (PSTJ3).

Parental attitudes also affected decisions. Teachers indicated that supportive parents encourage AI use. “If parents understand AI and approve, teachers feel more confident using it” (PSTSE2). Concerns about privacy, screen time, or learning outcomes could limit AI adoption. “Some parents worry about data privacy or excessive screen time, which may affect my decision” (PSTF5).

Teachers emphasized that students are the main beneficiaries and the central factor in AI adoption. “Students are the primary learning subjects; if AI helps them, I will use it” (PSTSO1). Teachers also noted that effective integration requires alignment among leadership, peers, students, and parents. “Support from school leaders, colleagues, and positive student feedback all influence my decision” (PSTSE3).

In conclusion, social influence includes school leadership, colleagues, students, and parents. Supportive attitudes from these groups facilitate AI adoption. Resistance or negative feedback from any group may reduce willingness.



Note Frequency represents the number of interviewees who mentioned each issue.

Figure 4.7 Pre-service EFL Teachers' Perceptions of Social Influence

2. In-service EFL Teachers' Perceptions of Social Influence

As presented in Figure 4.8, in-service EFL teachers described social influence as a key factor shaping their willingness to use AI in teaching. Most teachers emphasized the importance of school management and administrators. They believed that leadership decisions and policies directly affected whether AI could be used. One teacher stated, "School leaders' support and training programs have a positive impact on teachers' use of AI" (IST1). Another added, "Administrators must provide resources; otherwise, even if I want to use AI, I cannot ensure the necessary conditions" (IST2). For some teachers, administrative restrictions even limited AI use. "Our school requires approval from the teaching office before playing any video. This shows that management decisions matter a lot" (IST12).

In-service EFL teachers also recognized the strong influence of education policy. They viewed policy as the "big direction" that determined adoption. "Education policy guides our work. If the policy support is weak, most teachers won't spend time learning AI use" (IST6). Similarly, one teacher mentioned that "policy makers play a decisive role in whether AI can enter classrooms" (IST8).

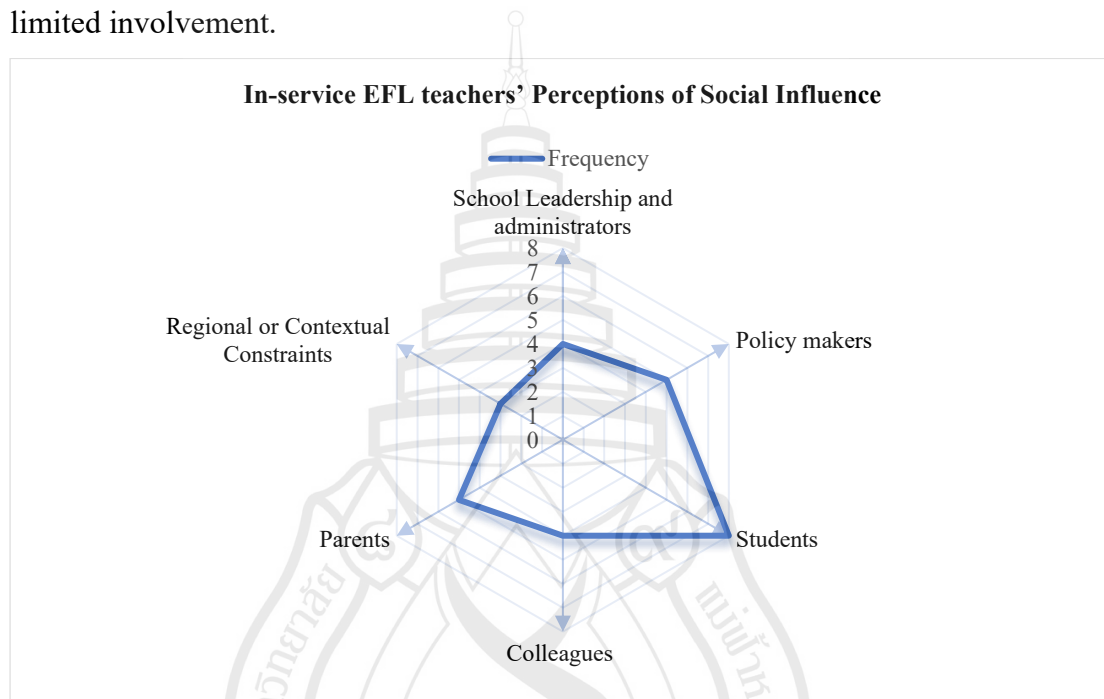
Another major influence came from students' feedback and engagement. In-service EFL teachers consistently said that students' attitudes shape their own decisions. "If students show interest and participate actively, I will continue to use AI" (IST9). Another explained, "Students' feedback tells me whether the method works. If they feel confused, I will reduce AI use" (IST1). For some, student interest determined lesson planning. "When students find AI activities boring, I use less of it. When they are excited, I use it more" (IST4).

Several in-service EFL teachers also mentioned peer influence. They often exchange teaching materials and recommendations. "When colleagues recommend a good AI tool, I will try it in my class" (IST11). One teacher noted, "Through sharing and competition, we push ourselves to update methods and improve teaching" (IST2).

In contrast, parents' influence was relatively small. Most in-service EFL teachers said that parents generally supported new teaching methods but rarely intervened. "Parents usually agree with this approach and think it works well" (IST1).

Only a few teachers mentioned concerns about mobile-based assignments, as some parents misunderstood their purpose (IST3).

In conclusion, in-service EFL teachers viewed students, parents, policy makers, school leadership, administrators, and colleagues as the strongest social forces shaping their AI use. Peer support encouraged experimentation, while parents had limited involvement.



Note Frequency represents the number of interviewees who mentioned each issue

Figure 4.8 In-service EFL Teachers' Perceptions of Social Influence

3. Comparative Summary on Social Influence

Both pre-service and in-service EFL teachers highlighted social influence. It was a key factor in AI adoption. School leadership strongly affected decisions in both groups. Supportive leaders encouraged use, while conservative leaders reduced willingness (PSTSE4; IST1). Colleagues also influenced teachers. Observing peers and sharing experiences increased adoption (PSTSE3; IST11).

Students were central to both groups. Positive feedback and engagement motivated teachers to use AI (PSTSE1; IST9). Poor adaptation or disinterest led to reduced use (PSTJ3; IST1). Parents played a larger role for pre-service teachers, who reported that parental concerns could limit AI use (PSTF5; PSTSE2). In contrast, in-service teachers viewed parents as less influential (IST1; IST3).

Policy and administrative decisions had more impact on in-service EFL teachers. Education policies and school regulations guided adoption and determined available resources (IST6; IST2). Pre-service EFL teachers focused more on immediate classroom and peer influences.

In summary, leadership, peers, and students shaped AI adoption in both groups. Parents influenced pre-service EFL teachers more. Policy and administration influenced in-service EFL teachers more.

4.1.6.5 Facilitating Conditions (FC)

This section presents the perceptions of pre-service teachers and in-service teachers about facilitating conditions respectively.

1. Pre-service EFL Teachers' Perception of Facilitating Conditions

As presented in Figure 4.9, Pre-service EFL teachers emphasized that effective AI integration requires both human and material support. They often described this as “people and things” (PSTJ1; PSTJ2). Human support referred to leaders, parents, and students who show positive attitudes toward AI. Material support included stable hardware, software, and access to quality teaching resources (PSTJ1).

Professional training was frequently mentioned as a key driver. Pre-service EFL teachers believed that “professional training can help teachers master AI applications” (PSTJ4). Many participants expected schools or training institutions to provide AI-related workshops on technical principles, tool operations, and integration with teaching (PSTJ3; PSTSE2; PSTSE3). However, they also noted barriers such as “limited training channels” and “uneven quality” (PSTJ3). To address this, some suggested a “train-the-trainer” model, where selected teachers receive intensive training and later share knowledge with peers (PSTJ3).

Financial and technical support were also central themes. Many participants expressed concerns about “insufficient funding” for equipment and software (PSTJ3; PSTSE1). They viewed investment as essential for purchasing licenses, maintaining systems, and ensuring reliable connectivity. One participant said, “AI integration needs financial and technical support. We must secure funds and reliable platforms” (PSTSE1).

Collaboration with external partners was seen as a solution. Some suggested that “schools cooperate with universities or EdTech companies” to gain

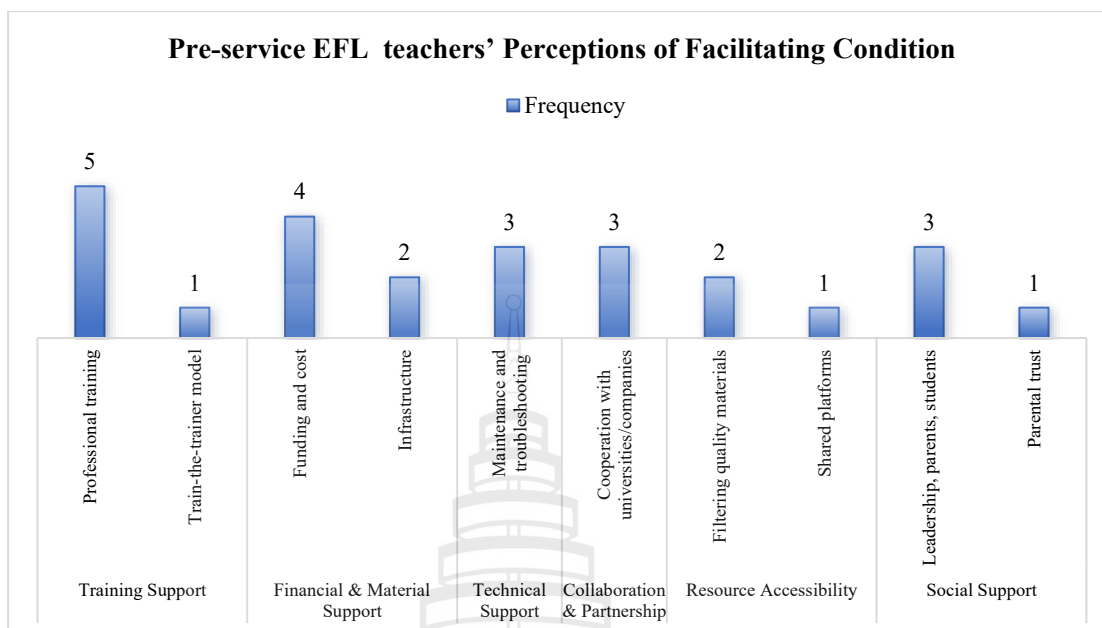
access to updated technologies and professional expertise (PSTSE4; PSTSE5). Others recommended joint training programs or shared AI platforms to reduce costs (PSTSE2; PSTSE5).

Technical maintenance and troubleshooting were also emphasized. Participants reported that system failures or unstable networks “can seriously disrupt teaching” (PSTSE3; PSTSE4). They called for “professional technicians who can respond quickly” (PSTSE4). Regular updates and technical support were viewed as essential for sustainable AI use in education (PSTJ3; PSTSE3).

Several participants mentioned the need for better access to AI teaching materials. They found it “difficult to filter reliable and effective resources” among many online options (PSTJ5; PSTSE3). They proposed creating “school-based resource-sharing platforms or professional forums” to improve efficiency and collaboration (PSTSE3).

Finally, participants recognized that family and community support also affect AI implementation. Some pre-service teachers noted that “parents’ lack of trust in new technologies” may hinder adoption (PSTJ4). They suggested organizing “parent meetings to explain AI and demonstrate its benefits” (PSTJ4).

In conclusion, pre-service EFL teachers viewed facilitating conditions as a combination of training, funding, infrastructure, and social support. They believed that when schools, leaders, and families work together, AI integration becomes practical and sustainable.



Note Frequency represents the number of interviewees who mentioned each issue.

Figure 4.9 Pre-service EFL Teachers' Perceptions of Facilitating Condition

2. In-Service EFL Teachers' Perception of Facilitating Conditions

As demonstrated in Figure 4.10, Teachers consistently emphasized that adequate resources, training, and technical support are essential for effective AI use in teaching. One teacher noted, "Professional training courses, user-friendly AI software, technical support teams, school funding, and service purchases are important guarantees for using AI" (IST1). Several teachers highlighted school and governmental investment. "If schools and the government invest more in equipment and infrastructure, AI use becomes much easier" (IST2). Another added, "Support from policy makers, parents, and administrators can increase investment in technology and network infrastructure" (IST3).

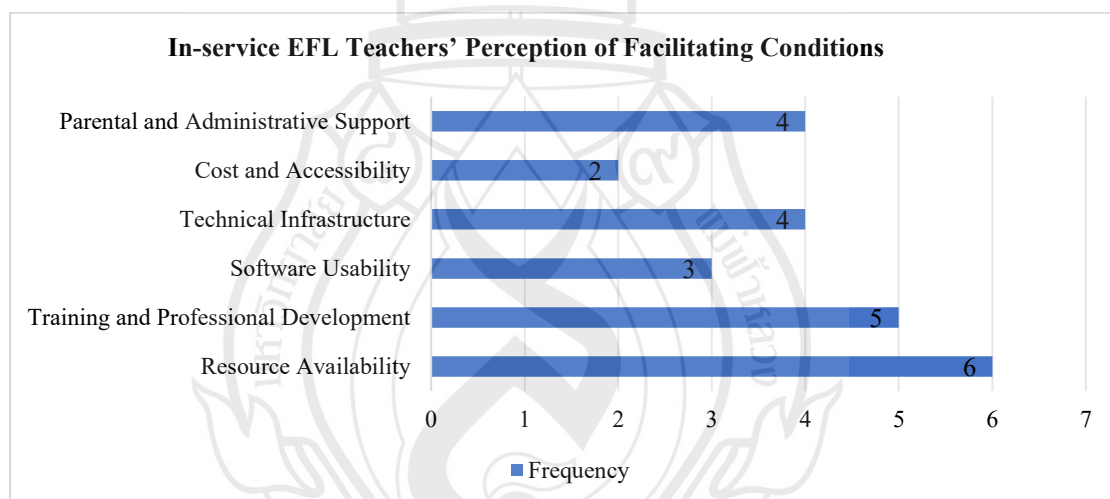
Ease of software use was another recurring theme. Teachers valued simplicity and intuitiveness. "The software should be straightforward and easy to operate. Complex operations increase workload" (IST4). High-quality AI materials were also important. "High-quality AI courseware provides good teaching support" (IST9).

Teachers emphasized technical and operational training. "Professional, hands-on training helps teachers use AI effectively in classroom management, teaching

design, and student feedback” (IST7). Another mentioned, “Training from software providers ensures that we can fully use the product and access rich, curriculum-aligned resources” (IST8).

Hardware and infrastructure support were critical. “Schools provide electronic whiteboards and hardware, which makes AI use much easier” (IST11). Teachers also highlighted low-cost or free resources. “Free or low-cost AI resources are acceptable. If costs are too high, schools cannot afford them, and we may not use them” (IST12).

In summary, teachers agreed that technical resources, administrative support, software usability, training, and affordable access were the most important facilitating conditions for AI adoption in EFL classrooms. These conditions significantly reduce barriers and enhance practical implementation.



Note Frequency represents the number of interviewees who mentioned each issue.

Figure 4.10 In-service EFL Teachers' Perceptions of Facilitating Condition

3. Comparative Summary on Facilitating Conditions

Both pre-service and in-service teachers stressed the need for strong support. Pre-service teachers focused on training, funding, and partnerships. They wanted cooperation with universities and EdTech companies. They also valued school-based resource sharing and family understanding. In-service teachers cared more about daily teaching needs. They emphasized easy-to-use software and reliable technical help. They also mentioned the importance of affordable tools and stable infrastructure. They

believed school and government investment made AI use easier. In general, both groups agreed that solid support is essential. Pre-service teachers focused on learning and preparation. In-service teachers focused on practice and sustainability.

4.1.6.6 Behavioral Intention (BI)

This section presents the perceptions of pre-service teachers and in-service teachers about behavioral intention, respectively.

1. Pre-service EFL Teachers' Behavioral Intention

Pre-service teachers expressed strong willingness to adopt AI tools in future English teaching. Most participants described AI as useful, convenient, and efficient (PSTJ3; PSTJ4; PSTF1). They believed that AI can “save time and improve teaching quality” (PSTF1). Many planned to integrate AI into lesson preparation, class management, and student assessment (PSTJ1; PSTSO2).

AI was viewed as a helpful assistant in both teaching and learning. Teachers mentioned using it for “creating course outlines and PowerPoint slides” and “grading assignments” (PSTJ1; PSTJ3). Some planned to use AI tools for “attendance, homework, and training” (PSTSO2). Others expected to use AI “to design personalized learning plans and improve students’ motivation” (PSTF2; PSTSO5).

Several teachers emphasized data-driven teaching. They intended to “analyze student progress and adjust teaching plans based on data reports” (PSTF3; PSTSO4). One noted, “AI helps me understand students’ trends and plan lessons better” (PSTF3). Another said, “I will use AI more for analyzing students’ performance and managing their learning data” (PSTSO4).

AI’s role in supporting speaking and writing skills was also highlighted. Teachers mentioned “AI pronunciation and dubbing apps” as helpful for improving oral expression (PSTF4). They also expected AI “to check assignments and support vocabulary practice” (PSTSO3).

Several participants discussed long-term adoption plans. Some wanted to “start small-scale experiments” and expand based on outcomes (PSTJ2). Others said they were “very likely to use AI frequently” because “AI will become a trend in education” (PSTSO2; PSTJ6). One teacher shared, “I’m optimistic about using AI in English education. It can improve teaching and students’ learning experience” (PSTJ6).

Teachers also noted possible challenges. A few mentioned “parental concerns about over-reliance on AI” (PSTSO5). Despite this, most agreed that AI use in education is “highly probable and beneficial” (PSTJ5; PSTSO1).

In summary, pre-service teachers showed strong behavioral intention to adopt AI. They viewed it as a tool for efficiency, personalization, and innovation. They planned to apply it to lesson preparation, instruction, and assessment, with high confidence in its future value. The major issue and minor issues are summarized in Table 4.16.

Table 4.16 The Summary of Behavioral Intentions Toward AI Integration of Pre-service EFL Teachers

Major issue	Minor issues	Description	Participant References
Behavioral Intention (BI)	Teaching	AI improves lesson preparation, grading, and class management.	PSTF1, PSTJ1, PSTJ3
	Efficiency		
	Student Learning Support	AI promotes engagement and personalized learning experiences.	PSTF2, PSTSO5
	Data-driven Teaching	AI helps analyze student performance and adjust teaching plans.	PSTF3, PSTSO4
	Practical Classroom Use	AI used for attendance, assignments, and assessment management.	PSTSO2, PSTSO3
	Skill Development	AI supports oral and vocabulary learning through practice tools.	PSTF4, PSTSO3
	Gradual Adoption	Step-by-step piloting and gradual expansion of AI integration.	PSTJ2, PSTJ5
	Optimistic Attitude	Positive and confident expectations for future AI use.	PSTJ4, PSTJ6
	Concerns	Worries about overreliance on AI or parental resistance.	PSTSO5

2. In-service EFL Teachers' Behavioral Intention

Teachers described their plans and intentions for integrating AI into English teaching. Many emphasized gradual adoption and piloting. One teacher explained, "I should first learn various AI educational technologies, then choose tools suitable for my English teaching context. I will pilot them step by step, expand usage, and finally optimize my teaching plan" (IST1). Several teachers highlighted the importance of personalized learning. "AI's greatest advantage is that it can provide personalized learning plans based on each student's needs" (IST2).

Teachers also noted interactive and gamified learning experiences. "In listening and speaking training, we use AI to help students correct pronunciation and improve phonetic skills. We also employ gamified activities to attract students' interest and enhance learning efficiency" (IST3). Another teacher added, "Learning games, animated storybooks, and AI dialogues increase class participation and make lessons more engaging" (IST2).

Teacher skill development was emphasized. "We need to improve our abilities and learn specific software usage methods before we can fully integrate AI into teaching" (IST5). Many teachers discussed customizing exercises and lesson plans. "AI can generate exercises tailored to students' levels, which is especially helpful for differentiated practice" (IST6).

Teachers also highlighted the need to consider students' levels and software limitations. "I first learn the app's functions and limitations, then choose tools suitable for students' proficiency. Finally, I optimize usage based on classroom performance and test scores" (IST7). Some teachers mentioned home use and student engagement. "Students use AI platforms during holidays for listening and speaking practice. Systems can track completion and performance, providing feedback" (IST8).

Other functionalities, such as pronunciation correction and essay grading, were also valued. "AI can recognize and correct pronunciation and grade essays, saving teachers significant time" (IST9). Teachers recognized the need to self-learn AI applications when formal guidance was lacking. "Currently, the school has not provided large-scale training, so we need to search online and check case studies to understand AI applications" (IST10).

Finally, teachers described their future intentions. “Although I don’t have a concrete AI plan yet, I hope to increase its use so students can experience the progress of the times and understand what AI can do” (IST11). They also emphasized content-dependent usage. “The plan depends on teaching content. For exercise classes, AI may not be used. For reading and thematic courses, AI can be applied” (IST12).

In summary, teachers’ behavioral intention toward AI focused on gradual adoption, personalized learning, gamification, skill development, differentiation, student engagement, and self-directed learning. These intentions suggest a positive yet pragmatic approach to AI integration in EFL classrooms. The major issue and minor issues are illustrated in Table 4.17.

Table 4.17 The Summary of Behavioral Intentions Toward AI Integration of In-service Teachers

Major issue	Minor issues	Description	Participant References
Behavioral Intention (BI)	Gradual Adoption	Step-by-step piloting and gradual expansion of AI use.	IST1, IST2, IST12
	Personalized Learning	AI used to create individualized learning plans based on student needs.	IST2, IST6
	Interactive and Gamified Learning	Use of AI for games, dialogues, and storybooks to increase engagement.	IST2, IST3, IST6
	Teacher Skill Development	Teachers’ plans to improve proficiency in AI tools and applications.	IST5, IST7, IST10
	Differentiated Practice	Customizing exercises or lessons for different student proficiency levels.	IST6, IST7
	Student Engagement & Home Use	Using AI to promote student participation and learning outside class.	IST8, IST9

Table 4.17 (continued)

Major issue	Minor issues	Description	Participant References
	Self-directed Learning	Teachers' independent exploration of AI resources and methods.	IST10, IST11
	Content-dependent Application	AI usage varies based on type of lesson or instructional content.	IST12

3. Comparative Summary on Behavioral Intention

Pre-service and in-service EFL teachers both showed strong willingness to use AI. Pre-service teachers focused on saving time and improving lessons. They planned to use AI for preparation, grading, and student analysis. In-service EFL teachers stressed gradual adoption. They preferred to test tools before full use. Both groups valued AI for personalized and engaging learning. Pre-service EFL teachers were more optimistic. In-service EFL teachers were more cautious and practical. Generally, both groups recognized AI as a helpful tool for future English teaching.

4.2 Results Three: Preparation of Pre-service EFL Teachers for AI-assisted EFL Teaching and Learning

This section presents the results regarding research question 3 and research objective 3 of this study. Research question 3 and research objective 3 are as follows:

RQ 3. How to prepare pre-service EFL teachers for AI-assisted EFL teaching and learning?

Sub-Research Question

SRQ3.1. What are the AI-TPACK educational needs of Chinese pre-service EFL teachers?

SQR3.2. What are the perceptions of administrators, ICT teachers, and in-service EFL teachers toward the use of AI-based educational technologies in EFL teaching and teacher preparation?

RO3. To identify pre-service EFL teachers' AI-TPACK educational needs and examine stakeholders' perceptions to inform effective EFL teacher preparation for AI-assisted EFL teaching and learning.

To address Research Questions 3 and Research Objectives 3, the findings drawn from Part C of the questionnaire, together with the semi-structured interviews conducted with Chinese pre-service and in-service EFL teachers, administrators, and ICT teachers, were presented.

4.2.1 Results from Questionnaire on AI-TPACK Educational Needs

The results from the questionnaire on AI-TPACK educational needs are presented in this section addressing research question 3, sub-research question 3.1. The criteria for AI-TPACK competence level and needs level are discussed in section 3.7.1.3.

4.2.1.1 The current Level of AI-TPACK Competence

1. Level of AI-TPACK Competence

To assess participants' self-reported competence in using AI-based educational technologies for English education, descriptive statistics were analyzed for four domains: AI-TK, AI-TPK, AI-TCK, and AI-TPACK. As shown in Table 4.18, participants reported moderately high levels across all domains. AI-TK got the lowest mean ($M = 3.57$, $SD = 0.64$), indicating moderate confidence and fair competence in foundational technological abilities. AI-TPK ($M = 3.65$, $SD = 0.62$) and AI-TPACK ($M = 3.64$, $SD = 0.63$) were slightly higher, showing good competence and high confidence towards mixing technology and pedagogy. AI-TCK scored the highest mean ($M = 3.75$, $SD = 0.64$), implying good competence and higher confidence in applying AI for subject-specific teaching tasks with moderate variation among participants.

In short, teachers felt most confident in applying AI to content-related tasks, while their confidence in basic technological knowledge was slightly lower.

Table 4.18 Overall AI-TPACK Competencies Level by Factors

Factor	Mean	Std. Dev.	CompetenceLevel
AI-TK	3.570	0.639	Fair
AI-TPK	3.65	0.63	Good
AI-TCK	3.753	0.635	Good
AI-TPACK	3.64	0.63	Good

2. Gender Differences in AI-TPACK Competence

An independent samples t-test was conducted to examine gender differences in AI-TPACK competencies: AI-TK, AI-TPK, AI-TCK, and AI-TPACK. Results indicated no significant gender difference in AI-TK, with males ($M = 3.53$, $SD = 0.78$) and females ($M = 3.57$, $SD = 0.62$), $t(574) = -0.48$, $p = 0.63$. Similarly, no significant difference was found for AI-TPACK, with males ($M = 3.53$, $SD = 0.75$) and females ($M = 3.65$, $SD = 0.62$), $t(574) = -1.43$, $p = 0.16$. For AI-TPK, females ($M = 3.67$, $SD = 0.60$) scored significantly higher than males ($M = 3.49$, $SD = 0.77$), $t(574) = -2.06$, $p = 0.04$, indicating that female participants had stronger pedagogical knowledge of AI. In contrast, the gender difference in AI-TCK was not statistically significant when accounting for unequal variances ($t(65.49) = -1.75$, $p = 0.09$), although females had a slightly higher mean ($M = 3.77$) than males ($M = 3.58$).

As a whole, these results (see Table 4.19) suggest that female participants demonstrated significantly higher AI pedagogical knowledge (AI-TPK), while no other significant gender differences were observed in AI technical knowledge (AI-TK), technological-content knowledge (AI-TCK), or integrated AI knowledge (AI-TPACK). For all tests, $p < 0.05$ was considered statistically significant.

Table 4.19 Gender Differences in AI-TPACK Competencies (Independent Samples t-test)

Factor	Gender	N	M	SD	t	p	Mean Difference	95% CI Lower	95% CI Upper
AI-TK	Male	59	3.53	0.78	-0.48	0.63	-0.04	-0.22	0.13
	Female	517	3.57	0.62					
AI-TPK	Male	59	3.49	0.77	-2.06	0.04	-0.18	-0.34	-0.01
	Female	517	3.67	0.60					
AI-TCK	Male	59	3.58	0.82	-1.75*	0.09	-0.19	-0.41	0.03
	Female	517	3.77	0.61					
AI-TPACK	Male	59	3.53	0.75	-1.43	0.16	-0.12	-0.29	0.05
	Female	517	3.65	0.62					

Note N = sample size; M = mean; SD = standard deviation; t = independent samples t-test value; df = degrees of freedom; p = two-tailed significance value, $p < 0.05$ is considered statistically significant. *AI-TCK used unequal variances t-test (Welch's t-test)

3. Year-level Differences in AI-TPACK Competence

One-way ANOVA was conducted to examine grade-level differences in AI-TPACK competencies, specifically AI-TK, AI-TPK, AI-TCK, and AI-TPACK. The results (see Table 4.20) revealed significant effects for all four factors: AI-TK, $F(3, 572) = 9.06$, $p < .001$, $\eta^2 = .045$; AI-TPK, $F(3, 572) = 6.23$, $p < .001$, $\eta^2 = .032$; AI-TCK, $F(3, 572) = 10.16$, $p < .001$, $\eta^2 = .051$; and AI-TPACK, $F(3, 572) = 4.39$, $p = .005$, $\eta^2 = .023$. Post-hoc analyses using Tukey's HSD indicated that freshmen consistently reported lower competency levels compared to upper-year students. For AI-TK, freshmen scored significantly lower than sophomores ($p = .017$, $d = -0.40$), juniors ($p < .001$, $d = -0.51$), and seniors ($p < .001$, $d = -0.53$). For AI-TPK, freshmen scored lower than juniors ($p = .003$, $d = -0.40$) and seniors ($p < .001$, $d = -0.46$). For AI-TCK, freshmen scored lower than sophomores ($p < .001$, $d = -0.66$), juniors ($p < .001$, $d = -0.49$), and seniors ($p < .001$, $d = -0.46$). Finally, for AI-TPACK, freshmen scored lower

than juniors ($p = .008$, $d = -0.37$) and seniors ($p = .009$, $d = -0.35$). These findings indicate a clear developmental trend, with students' AI competencies increasing steadily across study levels.

Table 4.20 Year-level Differences (ANOVA) for AI-TPACK Knowledge and Competence Items

Factor	df (Between, Within)	F	p	η^2	Overall Result	Significant Post Hoc Comparisons (Tukey HSD)
AI-TK	3, 572	9.06	< .001	.045	Significant	Freshman < Sophomore ($p = .017$); Freshman < Junior ($p < .001$); Freshman < Senior ($p < .001$)
AI-TPK	3, 572	6.23	< .001	.032	Significant	Freshman < Junior ($p = .003$); Freshman < Senior ($p < .001$)
AI-TCK	3, 572	10.16	< .001	.051	Significant	Freshman < Sophomore ($p < .001$); Freshman < Junior ($p < .001$); Freshman < Senior ($p < .001$)
AI-TPACK	3, 572	4.39	.005	.023	Significant	Freshman < Junior ($p = .008$); Freshman < Senior ($p = .009$)

Note ANOVA results show the overall effect of grade level (Freshman, Sophomore, Junior, Senior) on AI-TPACK competencies. Effect sizes are reported as η^2 (proportion of variance explained). Post-hoc comparisons are based on Tukey's HSD.

4. Technology Experience-based Differences in AI-TPACK Competence

A one-way ANOVA was performed to analyze variations in AI-related knowledge and TPACK factors among participants with differing levels of technology experience. Table 4.21 demonstrates a significant variance in AI-TCK between groups, indicated by $F(3, 572) = 2.72$, $p = .044$, $\eta^2 = .014$. Participants who had experience of more than five years scored higher than those who had only three to four years experience (marginal, $p = .056$). AI-TK showed a trend-level difference, $F(3, 572) = 2.36$, $p = .070$, $\eta^2 = .012$, with participants who had 5 or more years of experience getting slightly higher scores than those who had 1 to 2 years experience ($p = .052$). No significant differences were observed for AI-TPK, $F(3, 572) = 1.03$, $p = .380$, $\eta^2 = .005$,

or AI-TPACK, $F(3, 572) = 0.87$, $p = .454$, $\eta^2 = .005$, across the experience groups. In general, these results indicate that extended technology experience may correlate with marginally increased AI technological and content knowledge(AI-TCK). In contrast, pedagogical expertise and overall TPACK integration seem to be less affected by the length of technology experience.

Table 4.21 ANOVA and Tukey HSD Results for AI Competencies by Technology Experience

Factor	df (Between, Within)	F	<i>p</i>	η^2	Overall Result	Significant Post Hoc Comparisons (Tukey HSD)
AI-TK	3, 572	2.36	.070	.012	ns (trend- level)	1–2 yrs VS < 5+ yrs (p = .052, marginal)
AI-TPK	3, 572	1.03	.380	.005	ns	None
AI-TCK	3, 572	2.72	.044	.014	Significant	3–4 yrs VS < 5+ yrs (p = .056, marginal)
AI- TPACK	3, 572	0.87	.454	.005	ns	None

Note df = degrees of freedom; η^2 = partial eta squared; ns = not significant.

5. AI Tools Experience-based Differences in AI-TPACK Competence

One-way ANOVAs were conducted to examine whether AI tool experience (less than 3 months, 1 to 2 years, 3 to 4 years, more than 5 years) influenced four AI-related competencies: AI-TK, AI-TPK, AI-TCK, and AI-TPACK. As shown in Table 4.22 significant group differences were found for AI-TK, $F(3, 572) = 5.08$, $p = .002$, $\eta^2 = .026$; AI-TPK, $F(3, 572) = 2.77$, $p = .041$, $\eta^2 = .014$; and AI-TCK, $F(3, 572) = 5.21$, $p = .001$, $\eta^2 = .027$. No significant differences were observed for AI-TPACK, $F(3, 572) = 2.27$, $p = .080$, $\eta^2 = .012$. Post hoc comparisons using Tukey's HSD revealed that participants with less than 3 months of AI tool experience consistently scored lower than more experienced groups on AI-TK and AI-TCK. Specifically, AI-TK scores for less than 3 months were significantly lower than 1 to 2 years ($p = .004$), 3 to 4 years ($p = .009$), and 5+ years ($p = .003$).

AI-TCK scores for less than 3 months were much lower than those for 1 to 2 years ($p = .038$), 3 to 4 years ($p = .013$), and more than 5 years ($p = .001$). The comparison between less than 3 months and more than 5 years was the only one that was significant for AI-TPK ($p = .028$). No pairwise differences were statistically significant for AI-TPACK, while the disparity between less than 3 months and more than 5 years approached significance ($p = .058$).

Table 4.22 ANOVA and Tukey HSD Results for AI Competencies by AI Tool Experience

Factor	df (Between, Within)	F	p	η^2	Overall Result	Significant Post Hoc Comparisons (Tukey HSD)
AI-TK	3, 572	5.08	.002	.026	Significant	< 3 months vs < 1–2 yrs ($p = .004$); < 3 months vs < 3–4 yrs ($p = .009$); < 3 months vs < 5+ yrs ($p = .003$)
AI-TPK	3, 572	2.77	.041	.014	Significant (weak)	< 3 months vs < 5+ yrs ($p = .028$)
AI-TCK	3, 572	5.21	.001	.027	Significant	< 3 months vs < 1–2 yrs ($p = .038$); < 3 months vs < 3–4 yrs ($p = .013$); < 3 months vs < 5+ yrs ($p = .001$)
AI-TPACK	3, 572	2.27	.080	.012	ns (not significant)	< 3 months vs < 5+ yrs ($p = .058$, marginal)

Note df = degrees of freedom; η^2 = partial eta squared; ns = not significant.

4.2.1.2 AI-TPACK Educational Needs of Chinese Pre-service EFL Teachers

1. AI-TPACK Educational Needs

At the factor level, AI-TK emerged as a high-need domain ($M = 3.57$, $SD = 0.64$), indicating that participants demonstrated only moderate technical knowledge of AI-based educational technologies, which represents a clear priority for professional development. Item-level analysis (Table 4.23) further confirms this need, as eight items fell within the high-need range (3.37–3.60). Within AI-TK, the lowest score was for AI-TK5 ($M = 3.37$, $SD = 0.93$), indicating limited familiarity with the

technical capacities of AI-based educational technologies. Similarly, AI-TK4 ($M = 3.48$, $SD = 0.85$) and AI-TK1 ($M = 3.53$, $SD = 0.78$) demonstrate that participants' knowledge and practical interaction with AI tools is insufficient. Items in the AI-TPK and AI-TCK domains (e.g., AI-TPK5, $M = 3.59$; AI-TCK1, $M = 3.51$; AI-TCK4, $M = 3.59$) demonstrate fair competency in interpreting AI feedback and applying field-specific AI tools, addressing the need for targeted training. For AI-TPACK items, AI-TPACK4 ($M = 3.60$, $SD = 0.80$) and AI-TPACK5 ($M = 3.59$, $SD = 0.77$) are at the upper end of the high-need range, indicating that participants are starting to integrate AI with teaching content and strategies, but structured support is still needed to improve comprehensive integration. In conclusion, these findings show that pre-service teachers have early awareness and basic competency in AI-TPACK, but further professional development is required, particularly in technical competency and pedagogical application.

Table 4.23 Item-Level Educational Needs

Factor / Domain / Item	<i>M</i>	<i>SD</i>	Need Level	Interpretation
AI-TK (Factor Level)	3.57	0.64	High need	Participants demonstrated fair technical knowledge; clear training priority.
AI-TK1: I know how to interact with AI-based educational technologies in daily life.	3.53	0.78	High need	Basic ability present; greater familiarity with daily AI tool use is needed.
AI-TK4: I have sufficient knowledge to use AI-based educational technologies.	3.48	0.85	High need	Knowledge remains limited, indicating clear training requirements.
AI-TK5: I am familiar with AI-based educational technologies and their technical capacities.	3.37	0.93	High need	Lowest-rated AI-TK item; strong need for foundational technical training.
AI-TPK5: I can interpret messages from AI-based educational technologies to give real-time feedback.	3.59	0.87	High need	Skills in applying AI for timely feedback require development.

Table 4.23 (continued)

Factor / Domain / Item	<i>M</i>	<i>SD</i>	Need Level	Interpretation
AI-TCK1: I can use AI-based educational technologies to search for educational material in English teaching.	3.51	0.90	High need	Support is needed in applying AI tools to access and select subject-specific resources.
AI-TCK4: I know how to utilize my field-specific AI-based educational technologies (e.g., intelligent tutor for English, Chatbox).	3.59	0.81	High need	Competence is fair; training could strengthen subject-specific AI integration.
AI-TPACK4: I can teach English using AI-based educational technologies with diverse teaching strategies.	3.60	0.80	High need	Fair ability observed; additional training could expand strategy integration.
AI-TPACK5: I can teach lessons that appropriately combine my teaching content, AI-based educational technologies, and teaching strategies.	3.59	0.77	High need	Some integration capacity present; structured support needed to improve.

Note Cut-off values for need levels are High need (≤ 3.60).

2. Year-level AI-TPACK Educational Needs

As can be seen from Table 4.24, A factor-level analysis by grade revealed a consistent pattern of decreased needs for training as years of study increased. Freshmen scored the lowest on all factors, demonstrating a high need for foundational training. Sophomores improved modestly in AI-TK but still needed help, whereas juniors and seniors displayed good competence, implying that some training is advisable. The results suggest that systematic professional development should be provided on AI-TK.

Table 4.24 AI-TPACK Factor -Level Educational Needs Across Year Levels

Year Levels	AI-TK M (SD)	AI-TPK M (SD)	AI-TCK M (SD)	AI-TPACK M (SD)	Interpretation / Need Level
Freshman (n = 140)	3.34 (0.59)	3.46 (0.57)	3.51 (0.63)	3.47 (0.61)	High need across all factors; AI technical knowledge (AI-TK) highest priority.
Sophomore (n = 93)	3.58 (0.64)	—	—	—	High need in AI-TK; other factors moderate need.
Junior (n = 162)	—	—	—	—	moderate need.
Senior (n = 181)	—	—	—	—	moderate need.

Note “—” indicates mean >3.60, corresponding to moderate need or low need.

As presented in Table 4.25, item-level analysis by year levels revealed that freshmen showed the highest training needs across nearly all items, particularly in AI-TK (TK1–TK5), highlighting the need for foundational AI technical training. AI-TPK items indicated a high need in interpreting feedback, selecting tools, monitoring learning, and motivating students. AI-TCK and AI-TPACK items emphasized the importance of subject-specific application and integration skills. Sophomores showed some improvement but still required structured training in AI-TK and selected AI-TPK items. Junior and senior students scored most items with scores more than 3.60, indicating good competence; immediate training needs were modest. As a whole, early-year pre-service teachers should receive priority for professional development, whereas later-year students may benefit from reinforcement and advanced AI pedagogical strategies.

Table 4.25 Item-Level Educational Needs Across Year Levels

Item	Freshman (n = 140)	Sophomore (n = 93)	Junior (n = 162)	Senior (n = 181)	Total (N = 576)	Need Level / Interpretation
AI-TK1: Interact with AI in daily life	3.34	3.52	—	—	—	High need for early-year teachers; technical familiarity requires training

Table 4.25 (continued)

Item	Freshman (n = 140)	Sophomore (n = 93)	Junior (n = 162)	Senior (n = 181)	Total (N = 576)	Need Level / Interpretation
AI-TK2: Use AI to complete tasks	3.49	–	–	–	–	High need for freshmen; foundational skills development needed
AI-TK3: Initiate AI tasks via text/speech	3.49	–	–	–	–	High need for freshmen ; technical skill improvement required
AI-TK4: Some knowledge to use AI	3.21	–	3.53	3.55	3.48	High need for freshmen, juniors, seniors; moderate need for sophomores.
AI-TK5: Understanding AI technical performance	3.15	3.48	3.41	3.44	3.37	High need across all study years.
AI-TPK1: Understand AI contributions in English teaching	3.48	–	–	–	–	High need for freshmen; pedagogical understanding requires training
AI-TPK2: Evaluate AI feedback effectiveness	3.46	–	–	–	–	High need for freshmen; skill in analyzing AI feedback needs training
AI-TPK3: Select appropriate AI tools	3.50	–	–	–	–	High need for freshmen; tool selection competence requires development
AI-TPK4: Monitor students' learning using AI	3.34	3.46	3.49	–	3.51	High need for freshmen, sophomore, junior, senior; moderate need for seniors.
AI-TPK5: Provide immediate feedback using AI	3.51	3.54	–	–	–	High need for freshmen and sophomores; real-time feedback skills require improvement
AI-TPK6: Motivate students via AI	3.46	3.58	–	–	3.59	High need for freshmen, sophomores; motivational strategies need development

Table 4.25 (continued)

Item	Freshman (n = 140)	Sophomore (n = 93)	Junior (n = 162)	Senior (n = 181)	Total (N = 576)	Need Level / Interpretation
AI-TCK2: Know AI for English teaching	3.41	–	3.54	–	3.59	High need for freshmen and juniors; moderate need for sophomores and Seniors.
AI-TCK4: Apply AI in subject field	3.39	–	–	–	–	High need for freshmen; subject-specific application requires training
AI-TPACK1: Use AI for adaptive feedback	3.41	–	–	–	3.59	High need for freshmen; integration skills need development
AI-TPACK2: Use AI for personalized learning	3.44	–	–	–	–	High need for freshmen; personalized instruction skills require improvement
AI-TPACK3: Use AI for real-time feedback	3.47	–	–	–	3.59	High need for freshmen; real-time pedagogical application needs support
AI-TPACK4: Teach using AI with diverse strategies	3.52	–	–	–	–	High need for freshmen; strategy integration needs training
AI-TPACK5: Integrate content, AI, and teaching strategies	3.49	–	–	–	–	High need for freshmen; integrative teaching skills require development
AI-TPACK6: Lead peers in promoting AI integration	3.47	–	–	–	3.60	High need for freshmen; leadership in AI pedagogy requires support
AI-TPACK7: Select AI to monitor students' learning	3.50	–	–	–	–	High need for freshmen; monitoring and tool selection skills need training

Note High need defined as mean ≤ 3.60 ; “–” indicates mean > 3.60 (moderate need or low need).

4.2.2 Results from Interviews on AI-TPACK Educational Needs

The semi-structured interviews were conducted to gain an in-depth understanding of Chinese pre-service and in-service EFL teachers' AI-TPACK-based needs. This section presents the qualitative results that complement the quantitative results, including perceived areas of low confidence in AI-TPACK, prioritized educational or professional needs in AI-TPACK, and suggested AI skills and knowledge in teacher education. For pre-service EFL teachers, each topic is presented at year levels.

4.2.2.1 Chinese Pre-service EFL Teachers' AI-TPACK Educational Needs

1. Perceived Areas of Low Confidence in AI-TPACK.

The results of pre-service EFL teachers' perceived areas of low confidence in AI-TPACK are presented by the year levels.

1) Areas of Low Confidence of Freshmen. As presented in Table 4.26, freshman pre-service English teachers consistently identified AI-TPACK as the most difficult domain. Rather than isolating one area, participants described AI-TPACK as requiring a compounded mastery of all three components, which they perceived as an overwhelming challenge. As one participant put it, "AI-TPACK is the most difficult. It includes technical and pedagogical knowledge, and it demands three times more than the other domains" (PSTF3). Another echoed this by emphasizing that "integrating subject knowledge, pedagogy, and AI technology is quite complex" (PSTF5).

Beyond the intrinsic complexity of integration, freshmen highlighted two additional barriers. First, several pointed to limited institutional and curricular support for AI-related learning. One student noted, "AI updates rapidly and is flexible, but our courses are rarely connected with AI, and resources are lacking" (PSTF1). Another stressed that insufficient resources could "become a huge obstacle that seriously affects our teaching" (PSTF4). Second, freshmen expressed difficulties in designing concrete teaching applications, particularly in AI-assisted speaking and listening tasks, which require balancing linguistic goals with technological affordances. As one explained, "multi-domain knowledge integration is relatively complex, and teachers need to combine AI functions such as speech recognition with language teaching goals" (PSTF5).

In conclusion, the freshmen's low confidence was concentrated in the comprehensive integration of AI-TPACK, underpinned by resource scarcity, rapid technological change, and the high cognitive demands of designing AI-supported pedagogy. This suggests that their perceived challenges are less about isolated technical or pedagogical deficits and more about the compounded complexity of synthesizing them into meaningful classroom practices.

Table 4.26 Perceived Areas of Low Confidence in AI-TPACK Among Freshmen

Major Issue	Minor-issues (Freshmen)	Reference Participants
Areas of Low Confidence	Limited exposure to AI tools, rapid updates, lack of curricular support	PSTF1
	Perceived as most difficult due to multi-domain integration	PSTF2, PSTF3, PSTF5
	Lack of institutional/educational resources to support AI integration	PSTF4
	Difficulty designing AI-mediated English tasks (e.g., listening & speaking with AI speech recognition)	PSTF5

Areas of Low Confidence of Sophomores. As shown in Table 4.27, sophomore participants consistently identified AI-TPACK as the most difficult area, reflecting concerns about the challenges of integrating multiple knowledge domains. One student stressed that “AI-TPACK is the most difficult. . . [it] not only requires mastery of the first three domains to flexibly apply it” (PSTSO1). Another added that “effective integration requires mastery of the other three areas. . . and student cooperation” (PSTSO6), underscoring the compounded nature of the task.

Participants also highlighted the difficulty of applying AI-TPACK in practice, pointing to the gap between theoretical integration and classroom realities. As one explained, “the purpose is to teach and help students to learn effectively, which is demanding” (PSTSO2). Another admitted, “There’s little experience to draw on, so

we rely on ourselves” (PSTSO5), reflecting limited prior models of AI-supported pedagogy.

In addition, several sophomores raised student-centered concerns, noting both the diversity of learners and the risk of over-reliance on AI. One participant cautioned, “The main challenge is students; they may over-rely on AI, and AI teaching lacks real emotional interaction” (PSTSO4).

In summary, sophomore responses suggest that while participants have begun to recognize AI-TPACK’s integrative potential, they remain less confident in their ability to apply it effectively. Their concerns center not only on the cognitive demands of combining technical, pedagogical, and content knowledge but also on the social and emotional aspects of classroom practice.

Table 4.27 Perceived Areas of Low Confidence in AI-TPACK Among Sophomores

Major Issues	Minor issues (Sophomores)	Reference Participants
Areas of Low Confidence	Difficulty integrating multiple domains – Challenges in combining AI knowledge, subject knowledge, and pedagogical knowledge	PSTSO1, PSTSO6
	Application in teaching practice – Difficulty applying AI-TPACK meaningfully in real classroom scenarios	PSTSO2, PSTSO5
	Student-centered challenges – Concerns about students’ diversity, AI dependency, and lack of authentic interaction	PSTSO4

3) Areas of Low Confidence for Juniors. As reported in Table 4.28, junior pre-service English teachers reported varying levels of low confidence across different domains of AI-TPACK, highlighting both technical and integrative challenges. Many participants expressed difficulty with AI-Pedagogical Knowledge (AI-TPK), emphasizing the challenges of combining AI with teaching practices. One student explained,

“The area I find most difficult or feel least confident in is AI-TPK, the integration of AI and teaching knowledge. First, technical support is insufficient in some places, such as difficulties in student supervision and a lack of technical resources. Second, there is a scarcity of subject resources, hardware, and mature technology. Pre-service teachers often lack experience with educational technology; first, the use is insufficient, and second, AI empowerment is even more limited” (PSTJ6).

Another echoed this concern, noting,

“I lack confidence in AI-TPK. AI develops rapidly, and new tools and platforms are constantly updated. Integrating AI into teaching is a challenge. In addition, we lack sufficient practice experience. Unexpected situations may occur during operation, and student responses are unpredictable. We are unsure whether students can accept this style or new technology” (PSTJ4).

Participants also described low confidence in integrating AI with subject and teaching knowledge (AI-TPACK). One noted,

“I think AI-TPACK may be difficult for me. The comprehensive ability required is quite high; we need to perfectly integrate AI technology with subject knowledge. We must first use AI and then apply it to subject teaching. There are few fully implemented successful cases, so we lack reference experience and can only explore on our own, which brings many difficulties. Subject knowledge is the most challenging” (PSTJ3).

Some juniors reported insufficient confidence in subject knowledge integration (AI-TCK), stating,

“I feel unconfident about integrating AI with subject knowledge (AI-TCK) because it requires a lot of time to understand the characteristics of different subjects. Effectively combining AI with subject-specific features is a complex and challenging task” (PSTJ2).

Others expressed low confidence in AI technical knowledge (AI-TK), citing both lack of understanding and difficulties interacting with AI. As one participant explained,

“I lack confidence in AI-TK. On one hand, I rarely understand or am interested in this knowledge. On the other hand, it is like a machine language; sometimes when you communicate with AI, it cannot understand. In such cases, we

may seek human support, which takes time, and even then, the problem may remain unsolved. The main issue is my insufficient understanding, and AI cannot comprehend our instructions accurately” (PSTJ1).

Finally, some juniors emphasized the challenges of combining AI with class activities, noting that adaptation to AI-enhanced practices increases complexity. One participant remarked,

“I lack confidence in integrating AI with teaching knowledge (AI-TPK). Combining AI with traditional teaching methods is a huge challenge. We are used to class activities such as group discussions and role-playing. Introducing AI requires re-examining teaching processes and plans, which increases the complexity of merging teaching knowledge with AI, and many problems are likely to arise” (PSTJ5).

In summary, the juniors’ responses show that their low confidence is mainly in connecting AI with pedagogical knowledge (AI-TPK) and content knowledge (AI-TCK). This problem is made worse by technical limits, fast changes in technology, and a lack of practical experience. It is also affected by the need to adjust traditional class activities to AI-supported learning environments.

Table 4.28 Perceived Areas of Low Confidence in AI-TPACK Among Juniors

Major Issue	Minor Issues	Participants
Areas of Low Confidence	AI-TPK	PSTJ4, PSTJ5, PSTJ6
	AI-TPACK	PSTJ3
	AI-TCK	PSTJ2
	AI-TK	PSTJ1

4) Areas of Low Confidence for Senior. As reflected in Table 4.29, senior pre-service English teachers said they had low confidence mainly in integrating AI with content knowledge (AI-TCK). They said these areas are complex and require high levels of cognition. Several participants highlighted challenges in AI Technological Content knowledge (AI-TCK) integration. One participant explained,

“I lack confidence in integrating AI with content knowledge (AI-TCK). On one hand, I need to understand the complexity of the English subject. I also

need long-term effort and deep study to master its large knowledge system. I must also think about how to use AI to improve and expand these subjects. This is even more difficult. It is also very hard to guide students in English accurately, especially when dealing with metaphors, expressions, symbolism, and literary devices. I think AI cannot adequately explain these complex contents and integrating them is difficult” (PSTSE2).

Another similarly noted,

“I currently lack confidence in AI-subject knowledge, especially AI-TCK. The English knowledge system is vast and complex and accurately matching it with AI technology is challenging. Sometimes I forget corresponding knowledge points, which prevents optimal use of AI in teaching. This is a current weakness” (PSTSE3).

Participants also pointed to difficulties in AI technical knowledge (AI-TK), highlighting the theoretical and practical demands. One student remarked,

“AI technical knowledge is relatively difficult. It includes principles, applications, and potential. Teachers must first understand the theory and then learn to apply it effectively. These aspects pose significant challenges to teachers’ overall competence and learning ability” (PSTSE5).

Concerns were also raised regarding AI Technological Pedagogical Knowledge (AI-TPK). One participant explained,

“The difficulty lies in AI-TPK. Teachers need to understand how AI supports teaching activities. They also need to design new teaching strategies that use these technologies. AI changes very fast. As future teachers, we need to keep updating our knowledge to follow the latest educational technology. This is a major challenge for my future” (PSTSE4).

Seniors described low confidence in AI-TPACK integration, noting its high demands for comprehensive teacher competence. As one participant stated,

“The area I feel least confident about is integrating AI with subject and pedagogical knowledge (AI-TPACK). This requires higher overall competence than other areas and involves multiple factors. Any deficiency in knowledge or skills in earlier domains can affect performance in this final area and whether we achieve the desired outcomes. Therefore, I find this domain particularly difficult” (PSTSE1).

In conclusion, seniors see their low confidence mainly in high-level integration tasks. These include AI-TCK, AI-TPK, AI-TK, and AI-TPACK. This is because combining AI with teaching and subject knowledge is complex, new, and requires high-level thinking.

Table 4.29 Perceived Areas of Low Confidence in AI-TPACK Among Seniors

Major issues	Minor Issues	Participants
Areas of Low Confidence	AI-TCK	PSTSE2, PSTSE3
	AI-TK	PSTSE5
	AI-TPK	PSTSE4
	AI-TPACK	PSTSE1

2. Prioritized Educational Needs in AI-TPACK

1) Results: Prioritized Educational Needs for Freshmen. As depicted in Table 4.30, freshman pre-service teachers expressed diverse perspectives on which domains of AI-TPACK should be prioritized in their training, revealing no single consensus but rather four distinct ranking patterns.

Some participants emphasized AI-TCK as the top priority, arguing that strong subject knowledge is the foundation for meaningful AI integration in English teaching. As one explained, “My highest need is AI-TCK, because in English teaching, subject knowledge such as grammar and vocabulary is very important” (PSTF1).

By contrast, others highlighted AI-TPACK itself as the most urgent, valuing its holistic capacity to connect technology with pedagogy and subject knowledge for practical classroom use. One participant stressed, “AI-TPACK should come first, since it is about applying AI to actual teaching, such as personalized learning or intelligent assessment” (PSTF4). Another added, “AI-TPACK demands high proficiency in both areas, and neither can be absent” (PSTF2).

A third group prioritized AI-TK, viewing technical competence as a prerequisite for any subsequent pedagogical or subject integration. For example, one

participant remarked, “The first task is to understand AI principles. Only by knowing how to operate it can we plan the next steps” (PSTF3).

Finally, a smaller number of foreground AI-TPK, focusing on the practical value of AI in organizing everyday teaching activities. One student explained, “I put AI-TPK first, because applying AI to the teaching process is critical for daily practice” (PSTF5).

Interestingly, across these perspectives, AI-TK was often placed lower in the ranking, with several freshmen deeming it less relevant for English majors compared to domains that directly support teaching and learning.

In conclusion, these results show that freshmen have different training needs. Some see AI integration as focused on the subject (AI-TCK) or teaching methods (AI-TPK). Others see it as focused on technology (AI-TK) or as a mix of all areas (AI-TPACK). This difference shows the need for step-by-step and varied training paths in pre-service teacher education.

Table 4.30 Prioritized Educational Needs in AI-TPACK Among Freshmen

Major issues	Minor issues (Freshmen)	Reference Participants
Prioritized Needs	Priority for AI-TCK – Subject knowledge (grammar, vocabulary, four skills) as foundation for AI integration	PSTF1
	Priority for AI-TPACK – Holistic, integrated knowledge connecting subject, pedagogy, and technology	PSTF2, PSTF4
	Priority for AI-TK – Technical competence as prerequisite for further application	PSTF3
	Priority for AI-TPK – Pedagogical application with AI for everyday classroom practice	PSTF5
	Lower prioritization of AI-TK – Often de-emphasized compared to subject- and pedagogy-linked domains	PSTF1, PSTF2, PSTF4

2) Results: Prioritized Educational Needs for Sophomores. As reported in Table 4.31, sophomore participants consistently prioritized AI-TPACK as their most urgent learning need, mainly due to its difficulty and high relevance to professional teaching. As one explained, “The first thing I need is AI-TPACK... it is very difficult and requires a long time to learn” (PSTSO6). Another echoed this emphasis on its integrative value: “AI-TPACK mainly cultivates comprehensive ability, oriented toward teaching” (PSTSO4).

Following AI-TPACK, sophomores ranked AI-TCK (subject knowledge) and AI-TPK (pedagogical knowledge) as secondary needs. One participant stressed sequencing: “Subject knowledge comes first to build a solid foundation, then pedagogical knowledge follows” (PSTSO6). Another highlighted pedagogy as central to authentic teaching practice: “We cannot always rely on AI for teaching; as teachers, our direct interaction with students makes pedagogical knowledge crucial” (PSTSO4).

By contrast, AI-TK (technical knowledge) was generally placed last. It was perceived as relatively easy to acquire and more preparatory than integration. As one student commented, “AI technical knowledge is relatively simple and can be learned afterwards” (PSTSO2), while another added, “AI-TK is foundational and serves as preparation for the other three areas” (PSTSO1).

In conclusion, sophomores’ prioritization reflects a rationale-based perspective: domains were ranked according to their complexity, classroom relevance, and contribution to future teaching roles. Although AI-TK was acknowledged as necessary, the clear emphasis was on developing AI-TPACK integration, supported by subject and pedagogical knowledge.

Table 4.31 Prioritized Educational Needs in AI-TPACK Among Sophomores

Major issue	Minor Issues (Sophomores)	Participants
Prioritized Needs	High priority: AI-TPACK	PSTSO4, PSTSO6
	Medium priority: AI-TCK & AI-TPK	PSTSO4, PSTSO6
	Low priority: AI-TK	PSTSO1, PSTSO2
	Rationale-based prioritization	PSTSO1, PSTSO6

3) Results: Prioritized Educational Needs for Juniors. As shown in Table 4.32, Junior pre-service English teachers identified AI-Pedagogical Knowledge (AI-TPK) and AI-TPACK integration as the highest priority areas for training, reflecting their focus on practical teaching applications and comprehensive integration. One participant explained, “I think the highest priority is AI-TPK. This is a directly relevant domain, involving how AI is incorporated into teaching practice. The second priority is AI-TPACK, which integrates pedagogy, subject content, and technology” (PSTJ6). Another noted, “AI-TPACK is very important. As teachers, our ultimate goal is to integrate AI into teaching to improve students’ learning outcomes. AI-TPK comes next, leading teaching methods and technology application after determining how AI integrates with specific subjects” (PSTJ4). Similarly, one participant emphasized, “I rank from high to low: AI-TPK, AI-TPACK, AI-TK, and AI-TCK. AI-TPK directly enhances teaching methods and effectiveness, AI-TK is foundational, and AI-TCK, while important, is a lower short-term priority” (PSTJ2).

Several participants placed AI-TPACK at the top of their priority list, highlighting its role in combining knowledge domains for effective teaching. One student explained, “I rank AI-TPACK first because only after integrating all related knowledge can it be better applied in English teaching. Next is AI-TCK, then AI-TPK, which helps organize teaching activities smoothly. AI-TK is less directly relevant to teaching practice” (PSTJ1). Another reinforced this view, stating, “AI-TPACK is critical because it integrates the other three domains. Only by combining these skills can we achieve optimal teaching outcomes” (PSTJ5).

Some participants also emphasized AI-TCK (subject knowledge) as an important secondary priority, noting that a solid disciplinary foundation is necessary for effective AI integration. Technical knowledge (AI-TK) was consistently ranked lower, reflecting its perceived role as a foundational but less urgent requirement, with one student noting, “Since we are not technology majors, AI technical knowledge only needs to be applied in teaching and does not require in-depth study” (PSTJ3).

In summary, juniors’ prioritization reflects a teaching-oriented approach, where training needs are determined by practical applicability, integrative potential, and the importance of disciplinary and pedagogical foundations.

Table 4.32 Prioritized Educational Needs in AI-TPACK Among Juniors

Major Issue	Minor Issues	Participants
Prioritized Needs	High priority: AI-TPK – Direct pedagogical applications	PSTJ2, PSTJ3, PSTJ6
	High/secondary priority: AI-TPACK – Integration of pedagogy, content, and technology	PSTJ1, PSTJ4, PSTJ5
	Secondary priority: AI-TCK – Subject knowledge	PSTJ1, PSTJ2, PSTJ3
	Lower priority: AI-TK – Technical knowledge	PSTJ2, PSTJ3, PSTJ6

4) Results: Prioritized Educational Needs of Seniors. As shown by Table 4.33, senior participants demonstrated a more diversified set of priorities compared to freshmen and sophomores, reflecting their advanced stage of training and awareness of classroom realities. For some, AI-TPACK was prioritized as the most urgent domain. One participant highlighted its integrative role: “I ranked AI-TPACK first... it allows us to comprehensively combine teaching content, methods, and technology to meet diverse classroom needs” (PSTSE4). Similarly, another stressed its centrality despite feeling unprepared: “AI-TPACK is the highest need a comprehensive system that can plan teaching content and integration as a whole” (PSTSE2).

Others placed AI-TPK at the top, underscoring its practical value in guiding classroom practice. As one explained, “My first need is AI-TPK... because by using AI technology we can evaluate students’ performance and provide targeted teaching” (PSTSE1). Another echoed, “First is AI-TPK, we need to understand how to integrate AI into teaching methods” (PSTSE5).

By contrast, some seniors prioritized AI-TCK, pointing to the difficulty of mastering subject knowledge in tandem with AI integration. For example, one student admitted, “AI-TCK is the part I have least confidence in, so I need sufficient learning” (PSTSE3). Finally, AI-TK was consistently ranked lowest, considered

important but relatively accessible: “Although important, AI-TK can be learned by ourselves in daily teaching activities” (PSTSE4).

Table 4.33 Prioritized Educational Needs in AI-TPACK Among Seniors

Major issue	Minor Issues	Participants
Prioritized Needs	High priority: AI-TPK – Direct pedagogical applications	PSTJ2, PSTJ3, PSTJ6
	High/secondary priority: AI-TPACK – Integration of pedagogy, content, and technology	PSTJ1, PSTJ4, PSTJ5
	Secondary priority: AI-TCK – Subject knowledge	PSTJ1, PSTJ2, PSTJ3
	Lower priority: AI-TK – Technical knowledge	PSTJ2, PSTJ3, PSTJ6

3. Suggested AI Skills and Knowledge in Teacher Education

1) Freshmen’s Perspectives on AI Skills and Knowledge. As depicted in Figure 4.11, freshman participants highlighted a broad spectrum of AI-related skills and knowledge they considered essential for English teacher education. A recurring theme was the acquisition of AI tools operation skills, with several students stressing the need to be proficient in widely used educational applications such as automated grading systems, oral practice software, and intelligent platforms.

As one remarked, “We must understand the basic operational skills of AI tools, learn how to use AI, and apply it for personalized teaching” (PSTF1), while another added, “Teachers need to be proficient in various commonly used educational AI tools, such as intelligent teaching software and online learning platforms” (PSTF5).

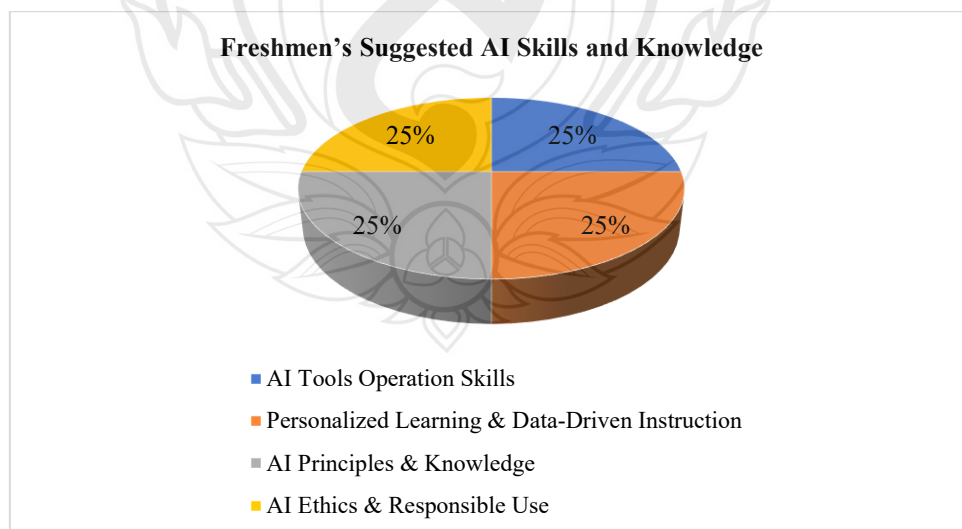
Closely related, many emphasized the potential of personalized learning and data-driven instruction, highlighting AI’s role in analyzing student performance and tailoring teaching. For instance, one participant explained, “AI can design personalized learning plans based on students’ progress and weaknesses”

(PSTF3), and another elaborated, “AI can collect students’ learning data and provide targeted guidance” (PSTF2).

Beyond practical tools, some students insisted on the importance of grasping AI principles and knowledge, noting that technical understanding is critical for effective teaching. As expressed by one, “First, we need to understand AI technology so that we can carry out teaching” (PSTF4), and another echoed, “We need to strengthen our understanding of AI values, principles, and skills” (PSTF3).

Several participants also pointed to the necessity of AI ethics and responsible use, stressing data privacy, balanced application, and student guidance. One observed, “We need to guide students to use AI reasonably and avoid over-reliance” (PSTF4), while another noted, “Teachers need to understand how to protect students’ data privacy and follow AI ethical principles in teaching” (PSTF5). Some freshmen highlighted innovation and interdisciplinary integration, calling for AI to be connected with broader educational and creative goals. One participant suggested, “Students should be encouraged to cultivate innovative thinking and combine AI with other subjects” (PSTF4).

To conclude, freshmen perceived AI skills and knowledge not just as technical know-how, but as a comprehensive package of operational, pedagogical, ethical, and innovative skills that should underpin English teacher education in the AI era.



Note The percentages were calculated based on the number of interviewees who mentioned each issue.

Figure 4.11 Freshmen’s Suggested AI Skills and Knowledge

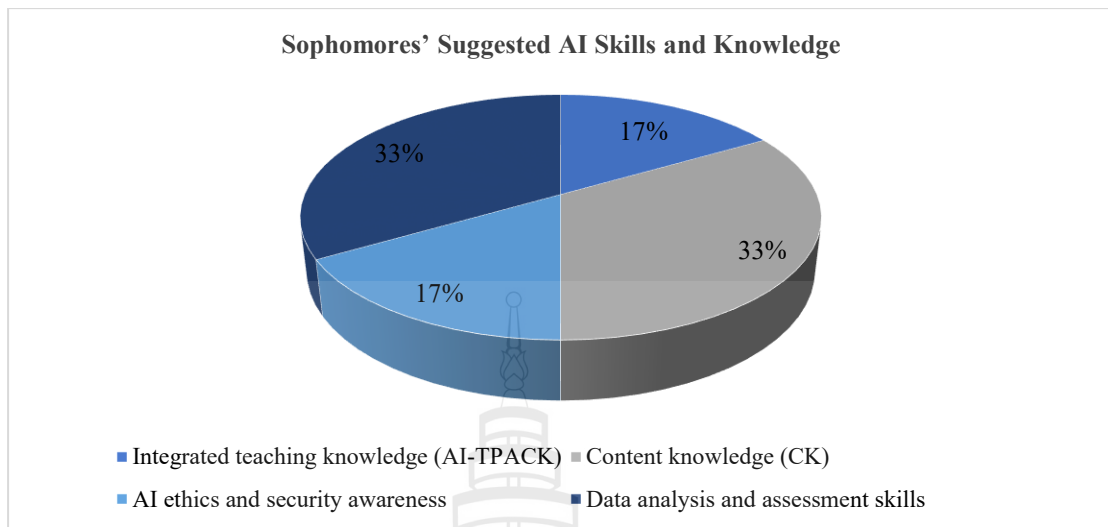
2) Sophomores' Perspectives on AI Skills and Knowledge. As visualized in Figure 4.12, sophomore pre-service English teachers emphasized a range of AI skills and knowledge they considered essential for teacher education. Many highlighted the importance of integrated teaching knowledge (AI-TPACK), stressing the challenge of combining multiple knowledge domains in practical instruction. One participant explained, "I think the requirements for AI-TPACK in subject teaching are high; we need to integrate knowledge from other areas and apply it" (PSTSO2).

Similarly, several sophomores stressed the centrality of subject knowledge (CK) as the foundation for effective AI use in teaching. As one noted, "I think the most important is subject knowledge (CK). If our technical knowledge is not solid, then the application of AI technology cannot be done well... outdated or incorrect knowledge may mislead students" (PSTSO5), while another emphasized, "I think currently the most important is English subject knowledge (CK); pre-service English teachers need to have strong disciplinary literacy subject knowledge (CK)" (PSTSO1).

Participants also highlighted the necessity of AI ethics and security awareness, including data privacy protection, fair use, and bias avoidance. One student remarked, "I think AI ethics and security awareness should include data privacy protection, fairness, and avoiding bias" (PSTSO4).

What's more, sophomores identified data analysis and assessment skills as critical, noting that teachers need to interpret student data and evaluate learning outcomes effectively. One participant observed, "Another important skill is data analysis and evaluation, such as interpreting data and assessing learning outcomes" (PSTSO4), while another emphasized the role of intelligent systems in instructional design, stating, "Teachers should master the use of intelligent assessment systems, monitor student performance, and use these technologies for course content design and optimization, providing personalized design suggestions to create more engaging and practical courses" (PSTSO6).

In conclusion, sophomores perceive AI competencies in teacher education as multi-dimensional, including integrated teaching knowledge, strong disciplinary foundations, ethical awareness, and data-driven instructional skills, all of which are necessary for preparing effective English teachers in the AI era.



Note The percentages were calculated based on the number of interviewees who mentioned each issue.

Figure 4.12 Sophomores' Suggested AI Skills and Knowledge

3) Juniors' Perspectives on AI Skills and Knowledge. As illustrated in Figure 4.13, the junior participants emphasized a broad range of AI-related skills and knowledge that should be embedded in English teacher education and curriculum reform. The recurring theme was the importance of data literacy. As PSTJ2 explained, "Data literacy is very important, which means teachers need to understand how to collect, analyze, and interpret data related to English teaching." Similarly, PSTJ6 linked data literacy with AI thinking, describing it as "knowing how to ask AI questions and how to handle semantics or context," which enables teachers to better identify students' common problems and provide targeted guidance.

Another major area of emphasis was natural language processing and language-related AI skills. For example, PSTJ2 argued that "the concept of natural language processing cannot be ignored... teachers should understand natural language and be able to process it, so that they can make better use of relevant language learning tools." Likewise, PSTJ6 highlighted that "language processing ability means giving AI the right instructions," which is essential for effective integration of AI in teaching.

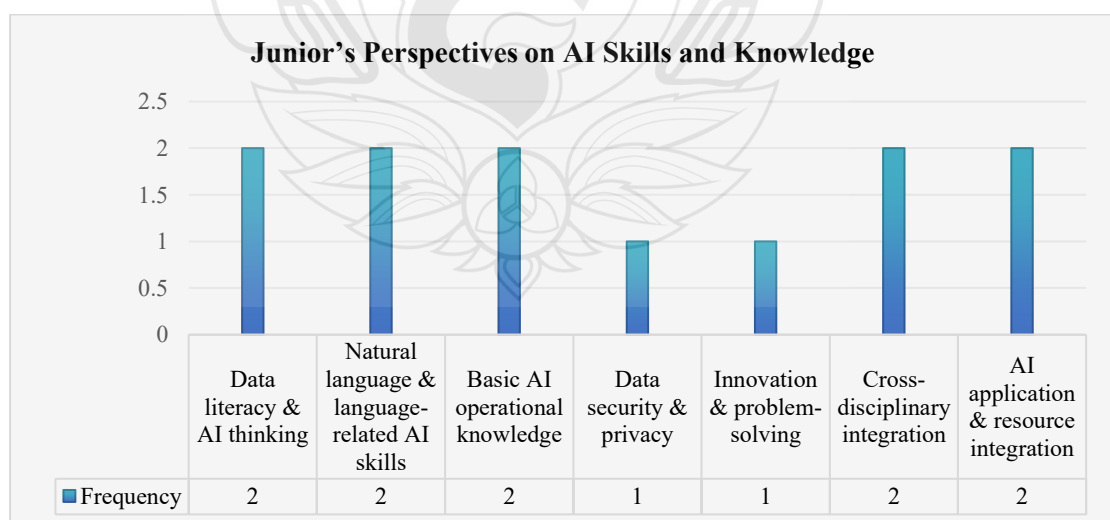
Several participants also stressed the importance of basic AI operational knowledge. As PSTJ1 stated, "The most basic operational knowledge should be emphasized first. If you don't know how to operate, you can start by learning

some basic operational knowledge.” Similarly, PSTJ3 pointed to the need for practical skills such as “speech recognition and natural language processing” as foundational AI competencies.

Beyond technical skills, the juniors also highlighted data security and privacy awareness. As PSTJ3 cautioned, “When using AI for teaching, in the process of collecting and storing student data, we should pay attention to boundaries, ensure data is reasonable and legal, and not violate students’ privacy.” In addition, PSTJ4 emphasized innovation and problem-solving skills, noting that “The use of AI requires creative thinking and problem-solving ability.”

Another significant theme was cross-disciplinary knowledge integration. PSTJ4 explained that “We encourage teachers to combine AI with knowledge from other disciplines through project-based learning to solve students’ real problems.” Similarly, PSTJ6 stressed that English teaching should not be limited to language alone but also involve culture, technology, and society, with AI helping to integrate these elements.

In addition, several participants pointed out the need to strengthen AI applications in teaching practice and resource integration. As PSTJ5 observed, “Only by mastering the various functions of these tools can teachers teach students more effectively,” while PSTJ1 added that teachers must “learn to integrate teaching resources, because AI provides a wide range of resources.”



Note Frequency represents the number of interviewees who mentioned each issue.

Figure 4.13 Juniors’ Perspectives on AI Skills and Knowledge

4) Seniors' Perspectives on AI Skills and Knowledge. As presented in Figure 4.14, senior participants emphasized a wide set of AI-related skills. These skills include technical, pedagogical, and ethical aspects. They often mentioned the ability to choose and evaluate AI-generated resources critically. They said this skill is essential for effective teaching. As one senior explained, "AI resource filtering ability is very important, such as how to select the most high-quality, accurate, and suitable content for students from the massive AI-generated materials" (PSTSE2). Another highlighted the need to distinguish reliable educational tools: "There are many AI products on the market, some good and some bad. Teachers need to judge their quality and applicability" (PSTSE3).

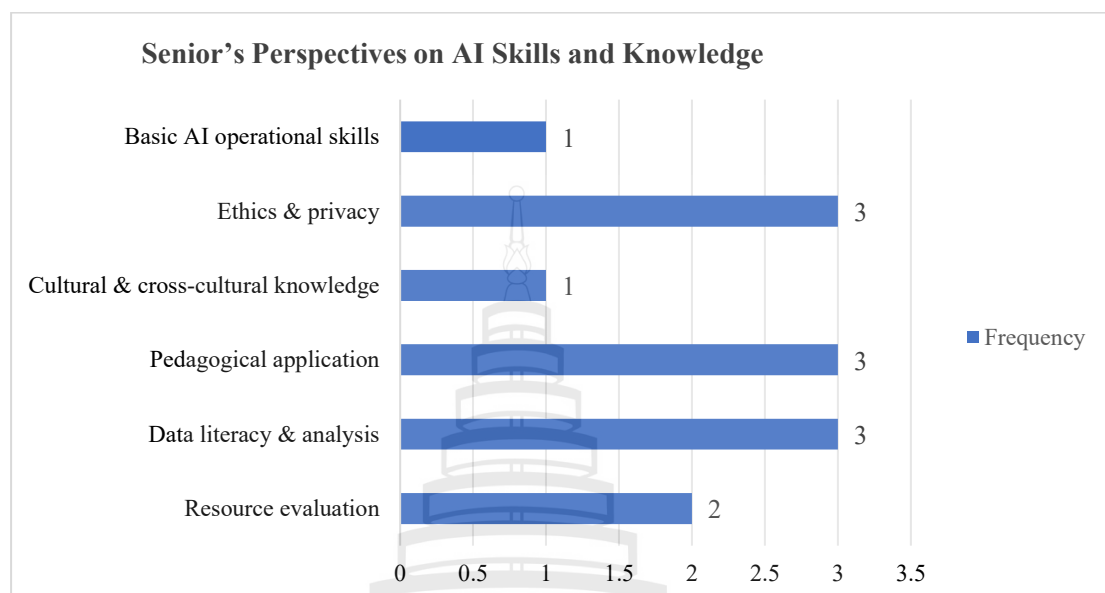
Data literacy and analysis also emerged as a strong priority. Several seniors underlined the value of using AI to analyze student performance and provide targeted support. For example, one noted, "AI data literacy is important... teachers should know how to collect, analyze, and use AI to provide real-time feedback and adjust teaching strategies" (PSTSE3). Another added, "AI technology provides us with a complete schedule and targeted learning plan through data analysis" (PSTSE5).

Alongside technical and analytical skills, seniors stressed the importance of pedagogical discernment and cultural knowledge. One participant explained, "When AI provides possible teaching methods and designs, we should be able to judge students' levels and choose appropriate methods. English education is also an intercultural collision, so we need intercultural knowledge" (PSTSE1).

Ethical considerations were equally prominent. As one emphasized, "AI ethics include property and data security. Privacy infringement may lead to fairness issues, and students should be guided not to over-rely on AI and neglect teacher-student interaction" (PSTSE2). Another similarly insisted, "We also need to understand privacy protection and ensure AI applications comply with social norms and regulations" (PSTSE4).

Moreover, practical AI integration in English teaching was highlighted, especially in language practice. For instance, one student proposed, "We can integrate AI into classroom oral practice, as university students rarely use spoken English" (PSTSE5). Others saw potential in applying AI strategically across skills: "AI-ELT

integration skills are important, such as knowing when to use AI for speaking, when for writing, and how to adjust strategies” (PSTSE4).



Note Frequency represents the number of interviewees who mentioned each issue.

Figure 4.14 Seniors' Perspectives on AI Skills and Knowledge

4.2.2.2 Chinese In-Service EFL Teachers' AI-TPACK Needs

1. Perceived Areas of Low Confidence in AI-TPACK among In-Service EFL Teachers

As illustrated in Table 4.34, most in-service EFL teachers reported low confidence in AI technological knowledge (AI-TK). They found it difficult to keep up with fast-changing tools and technical updates (IST1, IST4, IST5, IST8, IST11, IST12). IST1 commented that “AI technologies and software are updated rapidly, and it is hard for non-technical teachers to keep up.” Similarly, IST5 explained that “AI is developing so fast that we have to keep learning. It’s not just about reading a manual, we must also handle problems like system errors or program failures.” Several other teachers (IST4, IST8, IST11, IST12) echoed this concern, noting that understanding technical operations, programming, or troubleshooting requires skills beyond their English teaching background. As IST8 said, “Developing AI-based games or learning programming is quite challenging for us in humanities.”

Another major area of low confidence involved AI-integrated pedagogical knowledge (AI-TPK). Some teachers struggled to connect AI tools with

teaching methods or to adapt them to specific classroom contexts (IST9, IST10). IST9 admitted, “It’s still pedagogy–AI-integrated teaching knowledge—that I’m least confident about. Every class is different, and AI tools are too general to fit all.” IST10 added, “Combining AI technologies with teaching knowledge is difficult without professional guidance, and time constraints make it even harder.”

A number of teachers expressed uncertainty in integrating AI into subject teaching (AI-TPACK). They recognized that this integration demands combining AI-TK, AI-TPK, and content knowledge, which many found overwhelming (IST3, IST6). IST3 explained, “We lack confidence in AI-TPACK because each domain must be mastered and combined effectively. It’s still very challenging.” Likewise, IST6 described it as “a highly complex process that requires merging disciplinary, pedagogical, and AI technological knowledge together.”

Teachers also mentioned lack of training and practical experience as barriers to AI-TPACK competence (IST2, IST7). IST7 reflected, “Many teachers know little about AI technologies or AI-based teaching knowledge. Without enough training or successful examples, we don’t know how to integrate AI into English instruction.” IST2 further noted difficulties in “selecting appropriate AI teaching resources from the vast online materials and adapting them to students’ needs.”

To conclude, the in-service EFL teachers’ low confidence focused mainly on AI technological knowledge (AI-TK) and AI technological pedagogical content knowledge (AI-TPACK). They viewed AI integration as both promising and complex. They acknowledged that effective use of AI in English education requires continuous learning. Teachers also need technical support. Targeted professional development is essential.

Table 4.34 In-service EFL Teachers’ Perceived Areas of Low Confidence in AI-TPACK

Major issues	Minor Issues	Description	Reference Participants
Perceived Areas of Low Confidence in AI-TPACK	Low confidence in AI technological knowledge (AI-TK)	Teachers found it difficult to keep pace with rapidly changing AI tools and software.	IST1, IST4, IST5, IST8, IST10, IST11, IST12

Table 4.34 (continued)

Major issues	Minor Issues	Description	Reference Participants
		They reported limited technical background, challenges in operating AI tools, and difficulties troubleshooting errors or learning programming skills.	
	Challenges in integrating AI into pedagogy (AI-TPK)	Teachers struggled to combine AI tools with teaching methods or adapt them to diverse classroom contexts. Lack of professional guidance and time were reported as additional constraints.	IST9, IST10
	Difficulty in synthesizing multiple knowledge domains (AI-TPACK)	Integrating AI technology with pedagogical and content knowledge was viewed as complex and demanding, requiring understanding across multiple domains.	IST2, IST3, IST6, IST7
	Insufficient training and practical experience	Teachers expressed limited exposure to AI-related training and few examples of successful classroom implementation, leading to low self-efficacy in AI integration.	IST2, IST7

2. Prioritized Professional Development Needs in AI-TPACK among In-service EFL Teachers

As displayed in Table 4.35, in-service EFL teachers expressed diverse priorities for professional development in AI-TPACK, though most emphasized the integration of AI into pedagogical and subject practices as their foremost need. Several teachers regarded AI-TPACK as the top priority because it directly links to daily

classroom teaching (IST1, IST5, IST11). IST1 explained that “AI-TPACK is the most urgent for frontline teachers because it integrates content, pedagogy, and technology in actual teaching.” Similarly, IST5 stressed that “AI-TPACK should come first since it helps us design lessons, write plans, and evaluate teaching—things we do every day.” IST11 also ranked AI-TPACK highest, noting that understanding how to combine all three knowledge domains is “the most important for real classroom use.”

Others, however, prioritized AI technological knowledge (AI-TK) as a necessary foundation for further learning (IST2, IST3, IST6). IST2 stated that “technical knowledge must come first because teachers need technological support before they can combine AI with subject knowledge.” IST3 and IST6 shared similar opinions, both emphasizing that “without basic AI-TK, we cannot integrate other domains effectively.” For these teachers, AI-TK was viewed as a prerequisite for mastering AI-TPCK or AI-TPACK.

A few teachers placed higher importance on AI-integrated content knowledge (AI-TCK), particularly in relation to English language teaching (IST7, IST10, IST12). IST7 argued that “AI-TCK should be the top priority because integrating AI with the English subject will be most useful in future teaching.” Likewise, IST10 and IST12 positioned AI-TCK at the top, explaining that a strong command of disciplinary knowledge allows teachers to connect AI applications more effectively with curriculum goals.

Some teachers prioritized AI pedagogical knowledge (AI-TPK), focusing on the practical design and delivery of AI-supported lessons (IST9). IST9 commented that “AI-TPK is my most urgent need because it helps me combine AI with teaching methods to achieve better learning outcomes.”

In summary, in-service EFL teachers’ professional development priorities varied widely. Their perspectives were shaped by confidence levels and classroom realities. Several teachers emphasized that AI-TPACK should be the top priority. They viewed it as the ability to integrate technology, pedagogy, and content in authentic classroom practice (IST1, IST5, IST8, IST11). They believed that this comprehensive competence could directly enhance teaching quality and student learning. Others placed AI technological knowledge (AI-TK) at the top of their list. They argued that without a solid understanding of AI tools and systems, effective

integration would be impossible (IST2, IST3, IST6). Some participants prioritized AI-integrated content knowledge (AI-TCK). They stressed that teachers must strengthen their disciplinary understanding first. They also need to learn how AI can support subject learning before moving to complex integration (IST4, IST7, IST10, IST12). Meanwhile, some teachers highlighted AI-integrated pedagogical knowledge (AI-TPK) as their most urgent need. They noted that effective teaching design and student engagement depend on how AI technologies are applied in real classroom settings (IST9). Taken together, these views show that most teachers see AI-TPACK as the ultimate goal. However, their immediate priorities differ. Differences relate to technical competence (IST2, IST3, IST6, IST8), teaching experience (IST1, IST5, IST7), and familiarity with AI-supported pedagogy (IST4, IST9, IST10, IST12).

Table 4.35 In-service EFL Teachers' Prioritized Professional Development Needs in AI-TPACK

Major Issues	Minor Issues	Description	Reference Participants
Prioritized Professional Development Needs in AI-TPACK	AI-TPACK as the top priority	Teachers emphasized the urgent need to develop integrated AI pedagogical and content knowledge for real classroom applications.	IST1, IST5, IST8, IST11
	AI technological knowledge (AI-TK) as the foundation	Teachers viewed AI-TK as essential for mastering other AI-related domains, highlighting the importance of understanding AI tools and systems first.	IST2, IST3, IST6
	AI-integrated content knowledge (AI-TCK) as the key focus	Teachers stressed the importance of linking AI with English subject knowledge to improve content delivery and curriculum relevance.	IST4, IST7, IST10, IST12

Table 4.35 (continued)

Major Issues	Mnior Issues	Description	Reference Participants
	AI-integrated pedagogical knowledge (AI-TPK) for instructional improvement	Teachers prioritized AI-TPK as crucial for designing and implementing AI-supported teaching practices effectively.	IST9

3. In-service EFL Teachers' Suggested AI Skills and Knowledge in Teacher Education

As demonstrated in Table 4.36, in-service EFL teachers highlighted several AI skills and knowledge areas that should be emphasized in teacher education. They agreed that basic AI operations and practical use are essential. “AI needs basic operation mastery, using AI to support lesson design, understanding data security, and guiding students to use AI correctly” (IST1). “First is AI technical fundamentals. AI applications in education and intelligent teaching platforms, as well as AI courseware creation tools, are necessary” (IST3). “Learning AI basics before entering the classroom enhances teaching effectiveness” (IST4).

Teachers also stressed subject-specific integration. “Training should be tailored to English teaching, covering listening, speaking, reading, and writing tasks” (IST5). “Teachers need to combine AI with teaching content effectively and understand data reliability, privacy, and security” (IST8). “Teachers should practice AI-supported lesson and courseware production aligned with curriculum standards before entering the classroom” (IST12).

Several participants emphasized AI tool familiarity and hands-on practice. “Teachers should know which AI tools apply to English instruction and how to use them” (IST6). “Teacher education should include AI legality, data ethics, and how to evaluate student performance using AI tools” (IST7). “Practical courses should teach how to apply AI systems directly in teaching scenarios” (IST10). “It is most effective to teach which AI software can be used in English teaching and how to use it”

(IST11). “Learning to integrate technology, pedagogy, and content in school settings before real teaching is very helpful” (IST9).

In conclusion, in-service EFL teachers suggested that teacher education should provide early exposure, hands-on training, and subject-specific AI applications. They emphasized building confidence with AI tools, understanding legal and ethical use, and applying AI to real classroom tasks.

Table 4.36 In-Service EFL Teachers’ Suggested AI Skills and Knowledge

Major Issues	Minor Issues	Description	Reference Participants
Suggested AI Skills and Knowledge	Basic AI operation and practical use	Teachers emphasized mastering basic AI operations, applying AI in lesson design, understanding data security, and guiding students in AI use.	IST1, IST3, IST4
	Subject-specific AI integration	Teachers highlighted linking AI tools to English subject content, including listening, speaking, reading, and writing, for curriculum relevance.	IST5, IST8, IST12
	Hands-on AI tool familiarity and practice	Teachers suggested practical training with AI tools, understanding applicable software, and learning how to evaluate students using AI in lessons.	IST6, IST7, IST10, IST11
	Legal, ethical, and data considerations	Teachers stressed understanding AI legality, ethics, data privacy, and reliable use in teaching before classroom application.	IST7, IST8

4.2.3 Multiple Perceptions Toward the Use of AI-based Educational Technologies in EFL Teaching and EFL Teacher Preparation

In this section, the results from the semi-structured interviews of Chinese pre-service EFL teachers, in-service EFL teachers, administrator, and ICT teachers were presented, addressing research sub-research 3.2 as follows:

SQR 3.2. What are the perceptions of administrators, ICT teachers, and in-service EFL teachers toward the use of AI-based educational technologies in EFL teaching and teacher preparation?

4.2.3.1 Demographics of the Interviewees

A total of 1 administrator, 3 ICT teachers, and 12 in-service EFL teachers were interviewed for multiple perspectives on the use of AI-based educational technologies in EFL teaching and EFL teacher preparation. One-on-one semi-structured interviews were conducted. The administrator was coded as AD (AD=administrator), and ICT teachers were coded as ICTT1-ICTT3 (ICT=Information and Communication Technology, T=teacher). The demographics of in-service EFL teachers were presented in Table 4.15, and those of administrator and ICT teachers were presented in Table 4.37.

Table 4.37 The demographics of administrator and ICT teachers

Code	Gender	Years of Teaching/Responsibility
AD	female	8
ICTT1	male	15
ICTT2	male	8
ICTT3	male	6

4.2.3.2 The Results of the Administrator's Interview

This section presents the results from interview with EFL teacher education administrator. Her responses reveal how EFL teacher education programs are managed and how AI integration is perceived at the institutional level. The results from the administrator interview are organized thematically. There are eight themes. Each theme highlights the administrator's perspectives, experiences, reflections on the integration of AI in EFL education, and strategies for preparing pre-service EFL teachers.

1. Background and Institutional Context of the Administrator.

The administrator has been responsible for the EFL teacher education program since 2017. This means she has nearly eight years of experience in program management and curriculum development. The program's design is guided primarily by national professional standards, referred to as the "*guobiao*." As the administrator explained, "We follow the national standards for undergraduate English majors, and we also comply with the standards for teacher education programs." Since the program is part of a normal university, it must reflect the characteristics of teacher education. The administrator emphasized that "we follow national opinions and suggestions on teacher education, including the required courses for pre-service EFL teachers."

The curriculum is built on two main frameworks: one for English majors and another for teacher education competencies. The administrator noted that "we are guided by both the English major standards and the course system for teacher education." This dual focus ensures that the program aligns with national policies while addressing the needs of future EFL teachers.

Technology integration is also a core component of the program. The administrator stated, "We have two courses: Modern Educational Technology and Computer Science, and technology integration is embedded across all teaching-related courses." Courses such as Lesson Plan Design and English Subject Teaching Methodology explicitly cultivate technology integration ability. The administrator added that "AI and modern technology competence are required for all pre-service teachers." Although the college has not yet opened a specific AI-focused course, AI-related training is embedded into existing courses. Teachers are also actively improving their own AI skills. As the administrator explained, "We use AI technologies to enhance teaching, develop lesson plans, design presentations, and support students' learning and writing." Overall, the administrator emphasized that cultivating technology integration ability is "a major trend" and an essential part of teacher preparation.

2. General Perspective on AI in EFL Education and the Importance of Preparing Pre-service EFL Teachers

The administrator expressed a generally positive but cautious attitude toward the use of AI in English language teaching and learning. She believed that AI provides a powerful data processing system capable of collecting and organizing large

amounts of information efficiently. However, she emphasized that it cannot replace teachers in classroom teaching. The administrator explained that effective lesson design and teaching implementation must be based on students' learning conditions and specific instructional goals. According to her, if teachers rely completely on AI, it becomes lifeless, like a person without vitality. She viewed human involvement as essential to give life and creativity to teaching and learning.

The administrator acknowledged that AI could support both teaching and research. She noted that AI can quickly help with reading, organizing, and finding references, which saves a lot of time. Tools such as Doubao and Kimi were mentioned as examples that can assist students with oral practice, writing, and designing teaching materials. The administrator explained that they encourage students to use Doubao in class, especially for improving oral practice or designing AI-based teaching models. She believed that AI technologies are useful and impressive, especially for generating materials and visual aids, but must be guided by clear human instruction and pedagogical goals.

Regarding the preparation of pre-service EFL teachers, the administrator stressed that AI should be viewed as a supplementary tool rather than a substitute. She stated that AI can only make teaching better; it cannot replace human thought. The administrator believed that future English teachers must first construct their own teaching frameworks, understand their students, and set clear teaching objectives before using AI. She emphasized that the brain must build first, and then AI can assist. Without this foundation, students risk becoming overly dependent on technology. The administrator further highlighted that human creativity and reflection are irreplaceable, noting that AI summarizes and imitates, but human thinking can innovate and transform. In her view, cultivating pre-service teachers' critical thinking and pedagogical understanding before integrating AI is the key to meaningful and responsible use of technology in EFL education.

3. The Administrator's Perceived Challenges in Preparing Pre-service Teachers for AI Integration.

The administrator identified two major challenges in preparing pre-service English teachers to integrate AI technologies into their future teaching. The first challenge lies in students' limited ability to use AI effectively. The administrator

explained that many students “still prefer using Baidu and are not yet used to AI tools.” They emphasized that the first step is “to build awareness and improve the ability to use AI.” According to her, effective AI use depends on how clearly users define their commands and tasks. “If the instructions are not specific,” the administrator said, “the output will be completely different.” This highlights the importance of developing students’ understanding of prompt design and task refinement to maximize AI’s value in teaching and learning.

The second challenge is related to pre-service teachers’ academic and pedagogical competence. The administrator pointed out that “AI is intelligent, but it cannot know what you want to teach if you don’t give it clear instructions.” She stressed that teachers must first decide “what to do, what to teach, and how to teach,” because AI cannot make those decisions. If students lack strong subject knowledge and pedagogical understanding, they “will not know how to use AI effectively.” The administrator added that ongoing professional learning is crucial: “If you stop learning, you will not be able to keep up.” She believed that the ability to apply AI in both teaching and research would be an even greater challenge for future teachers than for current ones.

The administrator also mentioned that AI use requires mutual understanding between humans and machines. “AI needs to know you, and you need to know it,” she explained, describing this relationship as a “research partnership.” The more teachers and students interact with AI, the better it can serve their teaching and research goals. The administrator compared this process to “training a small assistant,” noting that “the better you guide it, the more effectively it will support your work.” She concluded that both teachers and students need to improve their human–AI interaction skills to make AI truly beneficial in education.

4. The Administrator’s Strategies for Preparing Pre-service EFL Teachers for AI Integration.

Current Institutional Practices for AI-related Teacher Preparation. She described several practical strategies to help pre-service EFL teachers develop AI competence. She has gradually integrated AI tools into multiple courses, including English Teaching Methodology, Western Civilization, Speech and Debate, and Academic Reading and Writing. She explained, “I use AI technologies in several of my

courses to support teaching.” Previously, students were asked to preview textbook materials, but now “they are encouraged to use AI to search and refine suitable content before class.”

Assignments also involve AI-supported learning. For example, students write short essays that require familiarity, understanding, and application of the lesson content, with AI embedded in the process. She noted, “Whether in-class or after-class, students must use AI tools to complete their assignments.” She also teaches students how to write clear prompts: “I specify how AI should output and execute instructions.” During feedback sessions, the class compares outputs, discusses which are more effective, and analyzes “which prompts lead to stronger human-AI interaction.”

She emphasized that teacher educators’ initiative is key. “If teachers are willing to try,” she said, “they can guide students to improve their AI abilities.” She also noted that the teacher’s own competence is the foundation: “If you know nothing about AI, you cannot expect students to use it.” Currently, students are encouraged to explore various AI platforms such as Doubao, Kimi, and tools developed by the Chinese Academy of Sciences. She explained, “We have already used about forty-five AI tools in different learning contexts, and four of them are now used proficiently.” She concluded that AI has become “a useful assistant” in teaching design, course learning, and literature review, though the process “requires long-term effort and collective exploration.”

In short, the key strategy for preparing pre-service EFL teachers for AI integration is to gradually integrate AI tools into multiple courses. And pre-service EFL teachers are involved in assignments that require AI. The administrator emphasized the importance of clear prompts and teacher initiatives.

5. The Administrator’s Views on Essential Skills for AI-assisted English Teaching

She identified several essential skills for effective AI use in EFL instruction. She stressed that pre-service teachers “must understand what AI can be used for.” Each AI system serves different functions, so students need to “explore its capacity and role.” She explained that Doubao, for example, “can be used for lesson plan writing or activity design,” while Kimi is better for “reading and writing support.

She emphasized the need for strong technical and practical skills: “Students must know how to operate AI and practice using it. They cannot rely only on their own opinions.” Effective use also depends on solid subject knowledge. She said, “If your disciplinary competence is weak, you will not know how to use AI well.” She argued that understanding both the technology itself and how it connects with one’s subject is essential. As she summarized, “Students need to know the technology, and they need to know how to integrate it into their subject. Only then can AI truly serve their teaching.”

The administrator identified technical and practical skills of AI and solid content knowledge as essential for AI-assisted English teaching.

6. The Administrator’s Efforts to Keep the Program Adaptive to AI and Educational Trends

She explained that the program encourages teacher educators to integrate AI technologies into teaching design and implementation. She stated, “As long as all 23 teacher educators in a class use AI and guide students to complete tasks, their abilities will improve quickly.” She acknowledged that the program cannot make major structural adjustments, but it can motivate teacher educators to stay informed about AI trends and understand its potential uses.

She highlighted specific AI tools, noting, “Currently, Doubao is very useful, but six months later, a new tool or feature may be more effective for language learning.” She also mentioned that local teams, such as Tsinghua, can develop AI tools tailored for teaching needs. She emphasized that adaptability requires each teacher educators’ effort: “We need every teacher to engage actively with AI.”

Regarding curriculum design, she explained that AI is not offered as a standalone course. “It would take too many credits if we artificially added a separate AI course,” she said. Instead, she integrates AI into existing courses, aligning it with each course, lesson, and learning task. She added, “Students often do not know how to use AI, so we demonstrate its use in teaching courses, including speaking and oral classes.”

She concluded that integrating AI across courses is more effective than offering it as a single course. “We adjust between teachers and teaching hours, and we lead students in using AI in practice. The effect is much better,” she said. This approach

ensures that the program remains flexible and responsive to changes in AI technologies and language education trends.

In conclusion, the Administrator encourages teacher educators to integrate AI technologies into courses and teaching practice. She stressed the program hasn't made major curriculum adjustments, but it can motivate teacher educators to stay informed about AI trends and understand its potential uses. She pointed out that this approach is more effective and flexible to ensure the EFL teacher program aligns with the development of AI technologies and trends of language education in the AI age.

7. The Administrator's Vision for the Future of AI in EFL Education

1) Administrator's Forecasts on the Evolving Role of AI in EFL Education. She predicted two possible directions for AI in EFL education over the next 5–10 years. In the first, teachers might become overly reliant on AI, doing little beyond inputting content, which risks producing static, lifeless teaching. In the second scenario, a more positive one, AI would assist human thinking, supporting the internalization, construction, and output of knowledge. She explained, "If we do not fully depend on AI, and only use it in certain parts of teaching, it becomes an auxiliary tool that enhances the classroom." She emphasized that this approach could make lessons more diverse, engaging, and participatory. She also noted that student involvement is crucial: "If both teachers and students participate actively, the classroom becomes rich, like an ATM of knowledge." She observed that in her own classes, students' first attempts to use AI were chaotic, but through guided practice, both students and teachers improved together, making the classroom more innovative and interactive.

2) Administrator's Views on Long-term Impacts of AI on EFL Teaching and Teacher Education. She identified potential long-term impacts of AI on teaching practices and teacher education. She noted that over-reliance on AI could reduce teachers' and students' creativity and critical thinking, leading to superficial learning. In contrast, skillful integration of AI can energize classrooms and encourage student participation. She stated, "Students gain knowledge that will continue to benefit their future work and change how they view the world, their subject, and their profession." She also highlighted changes in teaching models: "With AI, the traditional lecture-practice model will change. Teachers will assign tasks, students will practice

independently, and knowledge will be co-constructed through reflection.” She characterized this as a creative, constructive learning approach, where AI serves as a supportive classroom assistant rather than a replacement for human thought.

3) Administrator’s Perspectives on Cross-disciplinary Collaboration with Computer Science Educators. She strongly supported collaboration with computer science educators to enhance AI-assisted teaching. She explained, “AI is originally based on computer science, so cooperation with experts is necessary.” She emphasized that computer science specialists can provide technical support and guidance, helping teachers effectively explore AI functions. She clarified the collaboration model: “We should lead the process as subject educators, and they provide technical assistance. This ensures AI serves the teaching goals of our discipline.” She added that expert input is most useful when teachers understand which functions to use and how to apply them in practice. She concluded, “Cross-disciplinary collaboration should be complementary, with EFL teacher educators guiding the pedagogical use and computer scientists supporting technical implementation.”

8. Administrator’s Suggestions for Enhancing AI-readiness in EFL Teacher Education

She provided recommendations for schools, teachers, and students to improve AI readiness in EFL teacher education. For schools, she suggested investing in high-quality AI tools. She explained, “Many useful AI products require funding. If the school is unwilling to spend, we cannot benefit.” She recommended that schools purchase different AI tools tailored to disciplines, such as humanities, sciences, or engineering. She also emphasized the importance of supporting computer science engineers in each department to provide technical guidance. “If everyone has questions, they can consult these experts,” she said.

For students, she highlighted the need to strengthen disciplinary knowledge while learning to use AI. She stated, “Students need to seriously improve their subject competence. AI is useful for teaching assistance and future research.” She stressed the importance of long-term learning: “A short four-year training period is not enough. Students need a lifelong learning mindset to continuously improve their skills and teaching philosophy.”

For teachers, she encouraged openness and collaboration. “Teachers must embrace change, regardless of age or experience. AI use is irreversible, and everyone is using it,” she said. She recommended collaborative learning within teaching teams, sharing methods, activities, and assessment practices. She emphasized a mindset of experimentation and growth: “Teachers should boldly try, not fear failure. No one is born knowing AI, but everyone can learn it.” She concluded that fostering both teacher and student adaptability is essential for developing AI-ready EFL teachers.

4.2.3.3 The Results of ICT teachers’ Interviews

This section presents the results from interviews with ICT teachers. Their responses reveal how AI integration is understood and practiced within ICT education, as well as their perceptions of preparing pre-service teachers for AI-assisted English teaching. The results are thematically organized, highlighting the ICT teachers’ perspectives, experiences, and suggestions. There are eight themes.

1. ICT Teachers’ Background and Teaching Context

The ICT teachers interviewed have substantial experience teaching both foundational and professional computing courses. ICTT1 has been teaching a core computer course since 2000, offering it almost every semester to dozens of classes. The course now follows a “1+2” structure, with one theory class every two weeks and one practical session per week. It emphasizes practical skills, particularly computer operation, covering office software (Office/WPS), operating systems, multimedia applications, networks, and AI-integrated tools. He highlighted the growing role of AI in teaching, noting, “Students are very interested in generative AI. I also have a strong interest, and students quickly engage with the content.”

ICTT2 focuses on introducing non-computer majors to essential computing knowledge, including office automation, computer networks, multimedia basics, and emerging technologies such as AI, cloud computing, and big data. He emphasized that instruction prioritizes general awareness over technical depth: “We mainly focus on giving them general knowledge, for example, what AI studies.” Popular AI platforms like ChatGPT and Alibaba’s AI tools are introduced, but not central to the curriculum.

ICTT3 teaches Python programming and a basic university computer course. His courses focus on office software, network fundamentals, and basic

computing concepts. The curriculum was self-developed. It addresses limited prior IT experience of students. He highlighted regional and educational disparities. He explained, “Yunnan Province emphasizes exam-oriented education, with IT courses largely overshadowed by major subjects.” ICTT3 also noted upcoming reforms. The basic computer course will be replaced with an “AI fundamentals” course. This reflects rapid technological development.

In short, the ICT teachers demonstrate extensive experience and adaptability. They balance foundational computing skills with emerging technologies, especially AI. They also address students’ diverse backgrounds and uneven prior exposure to technology. Their teaching context reflects both curriculum evolution and regional disparities in students’ information literacy.

2. ICT Teachers’ General Perspectives on AI in Education and the Importance of Preparing Pre-service Teachers

The ICT teachers expressed a generally positive attitude toward the use of AI in education. ICTT1 emphasized that AI greatly facilitates teaching. He noted that “using AI to search for knowledge points and generate text and frameworks helps teachers prepare lessons.” AI broadens teachers’ perspectives and improves the quality of teaching content. It also increases efficiency, especially for tasks that would otherwise take a long time. For example, AI can generate a large number of PPT slides from simple keywords, which teachers can then refine. He also raised a caution, warning about the problem of AI hallucinations. He explained, “If teachers cannot judge which information is correct, AI may bring errors into the classroom. The hallucination problem is very serious.”

ICTT2 highlighted AI’s interdisciplinary nature and its transformative potential for education. He noted that AI reduces teachers’ workload and helps those less familiar with computers access abundant teaching resources. For students, AI offers personalized learning and extends education beyond the classroom. “As long as students have network access, even in remote areas, they can obtain quality resources anytime and anywhere,” he said. ICTT2 also pointed out that AI can help promote educational equity by providing access to high-quality resources in under-resourced regions.

ICTT3 emphasized AI's potential to enhance learning and teaching efficiency. He described AI as a valuable teaching assistant capable of 24/7 support, resource allocation, and personalized guidance. AI can also make lessons more interactive and engaging. He remarked, "For teachers, AI is a great assistant. It can generate lesson plans and PPT slides, which improves work efficiency."

All three teachers strongly agreed on the importance of preparing pre-service teachers for AI-assisted teaching. ICTT1 stressed that AI skills are essential in the modern educational context. "If you cannot use these advanced tools, you will fall behind," he said. He also noted the need to teach future teachers how to overcome AI hallucinations. ICTT2 emphasized understanding AI's educational role beyond merely being a convenience. He stated that pre-service teachers must grasp AI's potential to support lesson design, student engagement, and personalized learning. ICTT3 highlighted the benefits for teaching innovation, practice, and professional growth. He also noted AI's role in reducing educational disparities and helping students acquire skills relevant to a technology-driven future.

To sum up, the ICT teachers view AI as a powerful tool that can enhance teaching efficiency, support personalized learning, and promote educational equity. They strongly advocate equipping pre-service teachers with AI skills, both to improve classroom practice and to prepare them for the evolving educational landscape.

3. ICT Teachers' Strategies for Preparing Pre-service Teachers for AI Integration

The ICT teachers described several strategies for preparing pre-service teachers to use AI. ICTT1 emphasized that AI teaching is still exploratory. He noted that universities are gradually adding AI content to core computing courses. He said, "Currently, we use AI in WPS spreadsheets. Students can ask questions in Chinese to generate formulas automatically. This greatly reduces the difficulty of learning formulas." ICTT1 also highlighted AI for image processing. He explained, "Even for non-computer majors, AI can help process images. For example, changing the background of an ID photo is very simple and produces practical results." He recommended free tools such as Baidu for image tasks.

CTT2 focused on both general and education-focused courses. In general courses, he introduces basic AI applications to help students practice and

become familiar with the tools. In education courses, he integrates AI into pedagogy. He said, “We use AI to design teaching processes and analyze learners.” AI reduces teachers’ workload. Teachers can focus on implementing lessons and ensuring quality. They no longer need to spend excessive time grading assignments. AI acts as a supportive tool that enhances teaching efficiency and effectiveness.

ICTT3 emphasized practical, scenario-based training. He noted that personal ability alone is insufficient. He said, “We need high-quality AI-oriented general courses and scenario-driven intelligent practice platforms.” These platforms include microteaching and simulated classroom environments. AI-enabled tools allow machines to interact autonomously with students. He explained, “The machines can now communicate, chat, and make decisions themselves. This is different from the old way.” He also stressed the importance of long-term, practical AI-oriented training to prepare teachers for real classroom situations.

In conclusion, the ICT teachers emphasized a multi-layered strategy for AI preparation. They advocate exploratory integration into existing courses, hands-on use of AI tools for practical tasks, and the development of scenario-based intelligent practice platforms. They believe these strategies can help pre-service teachers gain both technical skills and practical experience with AI.

4. ICT Teachers’ Views on Essential Skills for AI-assisted Teaching

The ICT teachers highlighted multiple essential skills for pre-service teachers to use AI effectively. ICTT1 emphasized practical AI skills in common applications. He said, “Students should gradually master using AI in spreadsheets, text processing, and PPT creation.” He also mentioned image and animation processing. ICTT1 stressed AI search skills and critical thinking. He warned, “Students need to overcome AI hallucinations. Otherwise, they may bring errors into their work. Students must have critical thinking and the ability to identify correct information.”

ICTT2 focused on interdisciplinary knowledge. He stated that AI teaching raises the skill requirements for pre-service teachers. He explained, “Students must master basic computer applications, psychology, and education-related skills. They also need to know how to use AI tools effectively.” He emphasized that AI does not reduce standards but raises them. He added, “In addition to basic education

knowledge, students need computer and AI skills. They must constantly learn new technologies and emerging tools.”

ICTT3 highlighted foundational, integrative, and innovation-related skills. He noted a large gap between current abilities and required skills. “First, they need to solidify the foundation of AI general knowledge and understand what AI is and its basic principles,” he said. Teachers must also have data analysis skills, AI tool application skills, and new teaching concepts. Innovation, design abilities, and technical integration are essential. ICTT3 emphasized that “students must learn to combine AI with traditional media.” He also stressed continuous self-improvement. He proposed a stepwise approach: first, master AI knowledge; second, understand the subject deeply; third, apply AI and external platforms to enhance teaching in their main discipline. He noted that AI knowledge alone is insufficient; integration with domain expertise is critical.

In summary, the ICT teachers said that pre-service teachers need technical, cognitive, and integrative skills. These skills include hands-on use of AI, critical thinking, multidisciplinary knowledge, and innovation. They also emphasized the importance to integrate AI into traditional teaching methods. These skills will help pre-service teachers use AI well in future classrooms.

5. ICT Teachers’ Perceived Challenges and Concerns

ICT teachers acknowledged that preparing pre-service teachers for AI-assisted teaching involves multiple challenges. They emphasized ethical and moral concerns as a primary issue. Some AI tools are easy to use, but their applications may be inappropriate. ICTT1 explained that replacing a person’s face and generating a video with AI could cause serious problems. He stressed the importance of ethical and legal education, noting, “Students need guidance on correct AI use. Otherwise, they may produce harmful outputs.” He stressed the importance of learning about AI-related laws and guidelines. Teachers also expressed concern about AI hallucinations. These hallucinations could introduce errors into student work if not properly addressed.

Technical and pedagogical gaps exist among students from different majors. These gaps further complicate AI integration. ICTT2 highlighted that non-education majors often lack experience in designing teaching processes or constructing learning scenarios. He explained, “How to design a teaching process and create learning

scenarios is a major challenge for them.” In addition, some students struggle with basic computer skills. Even those familiar with smartphones may not be proficient with computers. ICTT2 emphasized that students must first master their discipline. They must then develop basic educational skills. Finally, they need to apply AI effectively in teaching. The potential of AI to enhance learning cannot be fully realized without the integration of subject knowledge, basic educational skills, and the application of AI.

ICTT3 pointed out that technical challenges are made worse by rapid AI updates. Infrastructure limitations add to the difficulty. Teaching content and methods in AI-assisted classrooms may differ greatly from traditional approaches. Current resources can quickly become outdated. Teacher training is another concern, as few educators currently have sufficient AI expertise. Ethical and privacy issues are also critical. ICTT3 explained that AI can track students’ personal information throughout their education. Ensuring compliance with data privacy laws remains a major challenge.

When discussing English pre-service teachers, ICT teachers emphasized subject-specific difficulties. Using AI for tasks like English speaking practice or translation presents challenges, which can make it hard for students to think independently. ICTT2 warned that students might rely too much on AI. They may use it to finish assignments instead of thinking critically. ICTT3 said over-reliance on AI can reduce interaction with peers and teachers, which may affect social and professional development. Furthermore, it is also becoming harder to distinguish AI-generated work from student work. While some detection tools exist, ICTT3 stated, “They are not fully reliable, and AI’s rapid evolution makes it harder to monitor.”

In summary, ICT teachers recognized that integrating AI into teaching holds great promise. They also noted it brings significant challenges. They emphasized the need for ethical guidance and hands-on AI training. They highlighted the importance of integrating AI with subject knowledge and providing careful supervision. Addressing these issues is essential. It ensures that pre-service teachers can use AI effectively, maintain academic integrity, and foster independent learning.

6. ICT Teachers’ Efforts to Keep ICT Courses Adaptive to AI and Educational Trends

ICT teachers have begun to make continuous efforts to adapt their courses to the rapid development of AI technologies and educational trends. ICTT1

noted that integrating AI into university computer courses “has already become a common practice” and that the trend is “gradually expanding across many subjects.” He explained that his team has started to introduce AI-related content into teaching, especially where it can make learning easier and more engaging. For example, “AI now allows students to describe their ideas in Chinese rather than writing complex formulas,” which helps simplify learning and increase motivation. However, he also emphasized the need to balance new AI content with traditional knowledge, saying that “we cannot abandon basic computer literacy” and must “reasonably arrange class time for both.”

ICTT2 reported that his department is still in the process of updating textbooks and course materials. “Our textbooks have not yet been revised,” he said, “but we have started adding AI knowledge points to relevant sections of teaching design.” In his classes, students are introduced to AI concepts and encouraged to conduct hands-on experiments using AI tools. However, because formal curriculum reform is still under discussion, “we can only integrate AI-related knowledge into existing lessons” at this stage. The department plans to revise the textbooks in the next edition to “focus more on emerging technologies and the application of AI tools.”

ICTT2 also observed differences in students’ backgrounds and readiness. Some students, especially those from less developed areas, struggle with basic computer skills, making it harder to introduce new technologies. He mentioned that while many students “already use AI tools in daily life without realizing it” they often fail to understand AI’s real functions or its role in education. He emphasized the importance of helping students “view AI as a supportive tool rather than something to depend on completely.”

ICTT3 described the institution’s proactive response to educational reforms and national strategies for AI integration. “Our school has responded quickly to national trends,” he explained. The institution is updating its ICT curriculum from three main directions: modernizing infrastructure, promoting the use of intelligent teaching tools, and enhancing practical, project-based learning. He said that the university leadership “plans to open up infrastructure and increase teacher training in digital literacy.” He further emphasized that theoretical learning must be paired with

practice, noting that “without hands-on teaching, project-based learning cannot be effectively applied.”

In short, ICT teachers are actively exploring how to integrate AI into ICT education. Their approaches vary depending on institutional resources, curriculum policies, and student readiness. Despite different stages of reform, all teachers recognized the need to align ICT teaching with emerging AI technologies and evolving educational practices.

7. ICT Teachers' Vision for the Future of AI in Education

ICT Teachers' Forecasts on the Evolving Role of AI in EFL Education. ICT teachers expressed a generally optimistic outlook on AI's future role in English education. They saw AI as a powerful but supplementary teaching tool. It should enhance human teaching, not replace it. ICTT1 emphasized that “AI should be regarded as an important tool. If we fail to master it, we may fall behind.” He acknowledged that AI could enhance teaching efficiency, quality, and student engagement but warned against excessive reliance, noting that “AI hallucinations remain difficult to solve in the short term.”

Similarly, ICTT2 envisioned AI as a “second teacher” functioning as an assistant rather than a substitute. He predicted that AI would become deeply integrated into education within the next five to ten years. Nevertheless, he stressed that “AI cannot replace the real teacher,” particularly in domains requiring emotional connection and interpersonal communication. While AI may facilitate learning through guidance and automation, he maintained that “it cannot replace classroom interaction or the human aspect of teaching.”

ICTT3 highlighted AI's potential as both a learning partner and an instructional assistant. He noted that AI already performs routine teaching tasks effectively, such as grading English writing and generating lesson materials. He remarked that “AI helps teachers monitor students' learning and improve teaching processes.” However, He stressed that the human side of teaching cannot be replaced. He said, “Education involves emotion, care, and encouragement.” He added, “AI cannot replace the warmth and empathy of a teacher.”

Collectively, the ICT teachers regarded AI as a driver for pedagogical innovation and efficiency in EFL education. They emphasized the need for balanced

integration, ensuring that AI serves to augment, rather than diminish, human interaction and the teacher's professional role.

ICT Teachers' Views on Long-term Impacts of AI on EFL Teaching and Teacher Education. All three teachers anticipated that AI would exert substantial long-term influence on both EFL instruction and teacher education. ICTT1 observed that integrating AI could "improve teachers' teaching skills, expand their perspectives, and deepen their understanding of the subject." He argued that conventional teaching models may no longer meet students' growing expectations, stressing that teachers must "recognize the importance of AI in improving quality and efficiency." He further noted that AI could manage repetitive tasks, such as vocabulary practice, thereby enabling teachers to concentrate on higher-order instructional goals.

ICTT2 also emphasized AI's capacity to enhance instructional efficiency and student engagement. He acknowledged that AI provides abundant resources, supporting more flexible lesson design. However, he cautioned against overreliance, stating that "if we rely too much on AI, we may become lazy and stop thinking." He insisted that teachers must continue to act as active designers of learning experiences, rather than passive users of technology. He further observed that excessive dependence on AI might weaken students' motivation to attend traditional classes, as "some students may prefer AI to teachers."

ICTT3 predicted that AI integration would give rise to innovative teaching models and evolving teacher roles. He indicated that AI could "provide personalized learning resources based on students' progress and interests" and simulate authentic language environments that human teachers often find difficult to replicate. He suggested that teachers might gradually transition from knowledge transmitters to "learning planners or facilitators." Moreover, he argued that AI integration would necessitate higher levels of digital and information literacy, requiring teachers to understand "basic AI principles and tools." He also believed that AI could support teachers' professional growth by reducing repetitive work. This would let teachers focus more on pedagogical innovation.

In summary, the ICT teachers saw AI as a transformative force that could change education. It could expand teaching possibilities and improve efficiency. It could also change how teachers are trained. At the same time, they said that human

teachers can't be replaced. Human teachers provide emotional support, moral guidance, and real communication. These are things technology cannot do.

ICT Teachers' Perspectives on Cross-disciplinary Collaboration with English Teacher Educators. ICT teachers generally recognized that cross-disciplinary collaboration between ICT and English teacher educators is essential for the effective integration of AI in EFL education. However, they also noted that such cooperation is still at an early stage in most institutions. ICTT1 observed that "collaboration is necessary, but at present, it remains limited or has not yet been fully established." He mentioned that during professional training, other universities were seen beginning to explore such partnerships. According to him, ICT teachers could provide technical expertise, while English teachers could contribute pedagogical insights. As he explained, "computer teachers understand AI better, and English teachers can share their teaching experience, so both sides can help each other."

ICTT1 provided a practical example of potential collaboration. He described an initiative to develop a "professional knowledge map" using AI, which would visualize the core learning points within a discipline. This system could help students track their learning progress and access related materials. He emphasized that this type of project would require joint effort and financial support, as "it is a large task that one or two computer teachers cannot complete alone." He argued that if AI-assisted learning maps were developed collaboratively, they could benefit not only English majors but also other disciplines.

Similarly, ICTT2 strongly supported the need for interdisciplinary cooperation. He described AI as an "interdisciplinary technology" that can connect multiple domains, including education, healthcare, agriculture, and industry. He argued that English and computer science educators could "work together to build AI-based English teaching platforms." In his view, such collaboration would allow each discipline to contribute its strengths—technical support from ICT and pedagogical design from English education. He emphasized that cooperation would also help reduce the learning burden on both sides, noting that "it takes too much time for computer teachers to learn English teaching, and for English teachers to learn AI." Collaboration, therefore, would allow mutual growth and efficient knowledge exchange.

ICTT3, however, expressed a more cautious view. He argued that meaningful collaboration requires institutional or governmental coordination. From his perspective, large-scale cooperation “should be promoted by national or organizational initiatives.” He believed that personal or small-scale cooperation is possible for research projects, but broader implementation in teaching requires systematic support. As he stated, “if we want to truly apply this in education, we need higher-level support to integrate resources and create a model.” He also noted that while ICT teachers are strong in technology, English teachers possess deep subject expertise, suggesting that collaboration should focus on combining these complementary strengths. Yet, he concluded that “at the school level, it is difficult to achieve. It might be possible at the provincial or national level.”

In conclusion, ICT teachers agreed that collaboration between ICT and English educators is both valuable and necessary for advancing AI-supported EFL education. They saw this cooperation as a way to support innovation, share resources, and grow professionally. At the same time, they said that real and lasting collaboration needs support from institutions. It needs institutional planning, enough funding, and long-term policy support. It should not depend only on individual effort.

8. ICT Teachers’ Suggestions for Enhancing AI-readiness in EFL Teacher Education

ICT teachers gave practical suggestions on how to prepare pre-service EFL teachers for AI-assisted English teaching. They stressed the importance of autonomous learning, technical literacy, and information literacy. They also said it is important to have a clear and balanced understanding of AI’s strengths and limits.

ICTT1 highlighted that the development of self-learning ability is the most essential skill for future teachers. He pointed out that AI technology changes rapidly, and “new tools appear and update very quickly, so students cannot rely only on what teachers cover in class.” He suggested that English teachers should guide students to develop self-directed learning habits, as “teachers can only play an inspiring role in the classroom, while students must learn to explore and master AI tools by themselves.” According to him, cultivating self-learning ability enables students to expand their personal repository of AI tools. He explained, “If a tool helps teaching, we keep it and study it further; if not, we move to another one.”

ICTT1 also stressed that English majors should focus on the practical use of AI tools rather than on complex theoretical knowledge. He noted that “AI theories such as neural networks and programming belong to computer science. English majors only need to understand the basic concepts.” For these students, the priority should be to use AI tools effectively to improve teaching efficiency and outcomes.

Similarly, ICTT2 emphasized two key areas: mastery of basic computer skills and proficiency in AI tools. He stated, “Only by mastering computer knowledge can students operate AI tools effectively.” He encouraged both students and English teachers to “learn AI tools, understand their functions, and grasp the essence of AI.” He believed that AI can automate repetitive tasks, allowing teachers to focus more on instructional design. As he suggested, “We can let AI handle grading and routine work, because it does it faster and more accurately. Teachers should focus on teaching and how to teach well.” His view reflected a strong belief that AI should serve as a supportive assistant, not a replacement for teachers.

ICTT3 offered a broader and more systematic perspective. He argued that EFL teacher education should begin with a solid foundation in AI knowledge and tool application. He explained that teachers must “understand the development, platforms, and tools of AI, such as intelligent voice assistants and AI teaching software.” Beyond technical knowledge, he stressed the importance of information literacy, noting that future educators will need to integrate multiple digital tools like “video, audio, and various intelligent devices” into their teaching practice.

ICTT3 also emphasized personalized learning and value-oriented education. He encouraged teacher educators to explore how AI can support differentiated instruction and individual learning paths. At the same time, he underscored the need to cultivate a balanced attitude toward technology, stating that “students should be guided to see both the advantages and the limitations of AI, so they can use it rationally and positively.”

In summary, ICT teachers advised EFL teacher education programs to develop pre-service teachers’ self-directed learning, technical skills, and information literacy. They believed that these abilities would help future teachers adapt to fast-changing AI technologies and help them use AI in meaningful ways in language teaching. ICT teachers also said that English teacher educators should guide students to

use AI carefully and ethically. This is important to ensure that technological innovation aligns with sound pedagogical and human values.

4.2.3.4 The Results of In-Service EFL Teachers' Interview

This section presents the results from interviews with in-service EFL teachers. The aim was to explore their views on current EFL teacher education programs. It also examined their professional development needs and perspectives on AI in English teaching. These teachers have direct classroom experience. Their insights are practical and forward-looking. Their reflections show how well current programs prepare teachers for AI-assisted education. They also highlight what improvements are needed. The findings are organized into three parts: teachers' evaluation of current programs and professional development needs, their vision for the future of AI in EFL education, and their suggestions for enhancing AI-readiness in EFL teacher education.

1. Evaluation of EFL Teacher Program and Professional Development Needs

1) Evaluation of EFL Teacher Program. Most in-service EFL teachers felt that their teacher education programs had not adequately prepared them for the integration of AI in English teaching. Several teachers noted that traditional training placed more emphasis on pedagogy and subject knowledge rather than on AI-related content. As IST1 explained, "The current teacher education programs focus mainly on traditional methods and subject knowledge, with little guidance on integrating AI into English teaching." Similarly, IST3 mentioned that although they had used some digital tools like interactive whiteboards, they were not aware these technologies were AI-powered, saying, "We used them without understanding whether they involved AI because we did not know the basic principles."

A few teachers acknowledged that some exposure to technology during their studies had been beneficial, but was still limited. IST4 shared, "We had an information technology course related to AI, which helped me in my current teaching, though the influence was not very large." Teachers like IST5 and IST10 emphasized that what they had learned at university often became outdated quickly. As IST5 reflected, "We learned PowerPoint and Word in college, but by the time we started working, the trend had already shifted to flipped classrooms and dual-teacher models." Others noted that AI content was almost absent in their teacher education. IST7 stated,

“We only learned basic computer operations and multimedia production, not how to use AI technologies.” Similarly, IST12 explained that they only began using AI after entering the workforce, saying, “We had no AI-related training during university. It was only after starting work that we received school-based training.”

Some teachers, however, saw value in the foundational training they received, even if it was not directly AI-related. IST6 said, “Our courses covered teaching principles, design, and classroom management. Though AI was not included, these foundations helped me prepare for future AI use.” In a whole, the teachers viewed their preparation as limited or outdated, with AI content either missing or addressed superficially. They highlighted the need for more targeted and practical training that connects AI with real classroom teaching.

2) Professional Development Needs. When asked about professional development, the teachers highlighted a strong need for hands-on AI training. They wanted practical, experience-based sessions. Most agreed that understanding basic AI concepts was essential. They also emphasized that training on using AI tools effectively was needed. IST1 suggested, “Teachers should learn how to select and use AI tools for different English classes, such as listening, reading, and writing.” Similarly, IST3 emphasized the importance of foundational training, recommending, “We need to learn both theoretical knowledge and how to use AI teaching platforms and create AI-assisted lessons.”

Teachers also called for training that connects technology with pedagogy. IST2 noted, “We need two types of training — one on AI skills and one on English teaching methods. Combining both will build confidence in using AI in the classroom.” Many participants preferred interactive and applied learning rather than theory-heavy sessions. As IST8 remarked, “Theory alone is not enough. We need practice to know where our weaknesses are and how to use AI effectively in real teaching.”

Several teachers emphasized the importance of exposure to good examples and model lessons. IST9 said, “It would be helpful to see open classes where teachers use AI effectively so we can learn from their experience.” Others, such as IST10 and IST11, suggested specialized workshops and regional collaborations. IST11

pointed out, “Professional training should show how AI is used in advanced educational areas and how we can apply it in our own contexts.”

Finally, teachers mentioned the need for guidance on data security and ethical use. IST7 stressed, “Training should include data privacy and safe use of AI tools, so we can protect students’ information.”

In summary, the teachers called for continuous, practice-oriented professional development. They wanted training that combined AI technical skills, pedagogical integration, and ethical awareness. They believed this would better prepare them for AI-enhanced English teaching.

2. In-service EFL Teachers’ Vision for the Future of AI in EFL Education

The in-service EFL teachers expressed strong optimism about AI’s role in future English education. Most believed AI would make learning more personalized, efficient, and engaging. They emphasized that AI could adapt to students’ needs. They also saw it as a tool to help teachers improve teaching. As IST1 explained, “AI will make education more personalized. We can select tools based on students’ learning conditions, making teaching styles more individualized and evaluation more precise.” This perspective reflected a shared belief that personalization would become a defining feature of future EFL classrooms.

Several teachers also highlighted AI’s potential to promote educational equity. IST2 noted that AI could help reduce regional disparities by allowing both teachers and students to access quality resources through digital platforms such as MOOCs. She stated, “Teachers can learn advanced methods from excellent educators, and students can study courses taught by top teachers. This promotes educational fairness.” Others agreed that AI could expand opportunities for students in less developed regions to receive the same quality of instruction as those in major cities.

Improving teaching efficiency was another key theme. Many teachers believed AI could handle time-consuming tasks. These included grading and giving feedback. This would allow teachers to focus more on pedagogy. IST3 observed, “If AI is supported in all areas like listening, speaking, reading, and writing, it will greatly improve teaching efficiency.” She added that AI’s data analysis could support

personalized learning. However, she admitted that the lack of time and training limited her current use of AI-based tools.

Teachers also predicted the widespread integration of AI across educational levels by 2030. IST4 predicted, “AI may become universal in all primary and secondary schools. If truly implemented, personalized learning will finally be achievable.” She believed that AI could offer accurate learning feedback, lighten teachers’ workloads, and expand the scope of resource sharing. However, she also cautioned that current resource-sharing platforms remained limited and not yet accessible to all.

Another recurring view was that AI would reshape both teaching methods and classroom environments. IST5 argued that teachers must change traditional teaching styles and that AI could help create immersive language contexts. She described how VR and projection technologies could simulate real-life English-speaking environments. She said, “AI allows students to practice speaking and listening through realistic interactions with virtual characters.” IST6 shared a similar view. She believed AI would bring authentic contexts into English classrooms. She said, “Students will have more opportunities to experience real-life situations. This will enhance their ability to use English in daily life.”

Many participants also linked AI to increased student motivation and classroom engagement. IST7 mentioned that AI could improve efficiency and fun in learning through applications that assess student progress or provide personalized recommendations. She explained, “Apps can evaluate students’ performance automatically and adjust learning content to their needs.” Teachers saw these tools as supportive rather than replacements of the teachers’ role. They emphasized the need to balance AI assistance with teacher-led teaching.

Teachers further stressed the potential of AI to support pronunciation, listening, and speaking training. IST9 believed that AI could “reduce teachers’ burden” and help students practice more autonomously. IST10 highlighted AI’s use in oral practice and grammar correction. She said, “AI can correct pronunciation and grammar errors, making English learning more efficient and individualized.”

Additionally, some teachers perceived AI as an approach to improve the development of students as well as teachers. IST11 was reflective of the potential of AI

to provide remote regions with access to authentic English culture and pronunciation. She asserted that AI could help students in rural areas better understand native English culture. It could also enhance their English cognition. She believed teachers could improve their professional competence and instructional quality by collaborating with AI systems.

In summary, the in-service teachers envisioned a future where AI plays a positive role in English education. They saw AI as a driver of personalization, fairness, and teaching innovation. At the same time, they recognized several challenges. These included training needs, time constraints, and ethical issues. They believed that with proper integration and support, AI could fundamentally reshape how English is taught and learned in China's EFL classrooms.

3. In-service EFL teachers' Suggestions for Enhancing AI-readiness in EFL Teacher Education

The in-service EFL teachers offered practical and insightful suggestions for improving AI readiness in pre-service EFL teacher education. They agreed that future teachers must gain technical knowledge. They also stressed the importance of pedagogical competence. This would help them integrate AI effectively into language teaching. Many teachers emphasized the need to introduce AI-related courses and hands-on training early in teacher education programs. IST1 proposed that "AI-related courses should be added, and practical teaching sessions should be included to integrate AI into real classroom settings." He also suggested inviting experienced teachers to share their expertise and encouraging policymakers to participate in skill competitions or training projects to build broader institutional support.

Teachers repeatedly highlighted the importance of professional knowledge, pedagogical skills, and strong teacher ethics. IST2 stressed that "solid professional knowledge and strong professional literacy are the most basic requirements." She added that English teachers should also possess general knowledge beyond their discipline and cultivate professional ethics to avoid overreliance on AI. She cautioned that "some teachers might become less passionate about teaching if they depend too much on AI," underscoring the need to strengthen moral and professional responsibility in AI-supported contexts.

Several teachers pointed out that AI training should start from fundamental knowledge and gradually move toward practice. IST3 suggested that teachers should “first learn the basics, then join technical training, and finally apply AI in teaching.” He emphasized that AI could enhance efficiency by helping teachers identify and correct students’ mistakes more quickly. Others also called for specific AI-related courses in teacher education programs to provide structured learning opportunities.

Teachers viewed openness to innovation as essential for future EFL educators. IST4 stated that “teachers must not be confined by their existing resources but should learn to use new tools to make their work more efficient.” She gave examples of how AI can support creative and game-based learning, making grammar lessons more engaging. She also recommended that teacher education institutions “reduce unnecessary courses and increase practical ones related to AI and language teaching,” noting that hands-on, skill-based learning is critical for preparing teachers to design effective and interesting lessons.

Another common suggestion was to enhance institutional and leadership involvement in AI development. IST5 observed that “school leaders need to experience the convenience and benefits of AI themselves,” arguing that leadership support can encourage teachers to adopt new tools. He also encouraged pre-service teachers to learn basic programming and problem-solving skills to handle technical challenges during AI use.

Many teachers called for stronger AI training programs that combine theory with practice. IST6 proposed that “teacher education programs should strengthen AI knowledge and provide both theoretical and practical learning opportunities.” Similarly, IST8 emphasized the importance of mastering both the operation and pedagogical integration of AI, stating that “teachers should understand how to combine AI with teaching and gradually apply it in classroom practice.” Both teachers and pre-service students, they argued, need opportunities to become familiar with AI tools through a step-by-step learning process.

Ethical awareness, data security, and privacy protection were also major concerns. IST7 stressed that “training should include basic AI operations, privacy protection, and data security.” She added that teachers’ willingness to use AI is crucial,

because “students follow what their teachers do; if teachers are willing to use AI, students will be too.”

Several teachers advocated for more practice-based learning opportunities. IST9 suggested that “teacher education should create more courses that allow pre-service teachers to apply AI knowledge through practical teaching examples.” He argued that theory alone is not enough and that hands-on experience is essential for effective learning. Likewise, IST10 and IST11 emphasized collaboration with experienced teachers, observation of real classrooms, and exposure to exemplary AI teaching cases. IST10 proposed that “university instructors should integrate AI into listening, reading, and writing courses to serve as models for students.” IST11 added that pre-service teachers should “study successful cases and learn which AI tools can be used in real classrooms.”

In conclusion, the in-service teachers envisioned a teacher education system that combines AI knowledge, pedagogical skills, and ethical awareness. They called for systematic and practice-oriented training. They believed pre-service EFL teachers should learn how to use AI. They also stressed the need to integrate it meaningfully into teaching. As one teacher said, effective AI readiness requires “a balance between theory, operation, and practice.” This would ensure that future English teachers are confident, capable, and responsible users of AI in education.

4.3 Summary of the Chapter

This chapter presents the key results from the quantitative and qualitative phases of the study with respect to three main areas: influencing factors of behavioral intention, AI-TPACK-based educational needs, and multiple perceptions on AI in EFL teacher preparation. The first part reported the influencing factors of Chinese pre-service EFL teachers’ behavioral intention to adopt AI-based educational technologies, and the degree of influence among the factors. The factor structure of the measurement model was refined through EFA and confirmed through CFA. The results showed satisfactory construct validity and reliability. The structural model analysis indicated varying degrees of influence among PE, EE, SI, FC, AI-TK, AI-TPK, AI-TCK, and AI-TPACK

on behavioral intention. The interview findings further illustrated how pre-service and in-service teachers perceived the benefits, ease of use, external support, and potential barriers of AI integration.

The second part of the chapter presents the AI-TPACK-based educational needs of pre-service EFL teachers. The questionnaire results revealed the current level of AI-TPACK competence and identified priority areas for educational and professional development. The interview results complement these findings by highlighting specific needs in AI pedagogical knowledge, AI-enhanced instructional design, and contextual responsive AI application in EFL educational contexts in China. Moreover, this part also reports the results about multiple perceptions of administrators, ICT teachers, and in-service teachers about AI in EFL education and EFL teacher preparation. The results showed shared recognition of AI as an emerging and transforming force in EFL education and EFL teacher preparation. However, each group emphasized different priorities, challenges, and strategic actions.

The results from both quantitative and qualitative data provide a comprehensive understanding of the current status, influencing factors, educational needs, and institutional perspectives related to AI integration in EFL education and adaptation of pre-service EFL teacher education in the AI age. These findings serve as the foundation for the discussion and implications in the next chapter.

CHAPTER 5

CONCLUSION AND DISCUSSION

This chapter provides a conclusion of the results and findings, discussion, the theoretical implications, practical implications, the limitations of the study, and the recommendations for future research.

5.1 Conclusion

The main purpose of this study is to investigate the key factors that influence Chinese pre-service EFL teachers' behavioral intentions to adopt AI-based educational technologies and their AI-TPACK educational needs related to AI-based educational technologies adoption. The objectives of this study were to identify the factors that influence Chinese pre-service EFL teachers' behavioral intention to use AI-based educational technologies in their future EFL teaching practice, to examine the degree of influence and correlations among the identified factors, to identify pre-service EFL teachers' AI-TPACK educational needs and examine stakeholder perceptions to inform effective EFL teacher preparation for AI-assisted EFL teaching and learning.

The UTAUT Model has been supplemented by four AI-TPACK constructs to identify both external and internal factors that influence behavioral intentions. Eight factors, namely performance expectancy (PE), effort expectancy (EE), social influence (SI), facilitating conditions (FC), AI Technological Knowledge (AI-TK), AI Technological Pedagogical Knowledge (AI-TPK), AI Technological Content Knowledge (AI-TCK), and AI-TPACK, were utilized to predict behavioral intentions regarding the use of AI-based educational technologies. Additionally, four constructs of AI-TPACK were employed to assess educational needs related to AI-TPACK.

The study adopts a convergent parallel mixed methods study design. Survey questionnaire and semi-structured interviews were utilized to collect data from pre-service EFL teachers, administrators, ICT teachers, and in-service EFL teachers. Purposive sampling was used to select interviewees. Exploratory factor analysis,

confirmatory factor analysis, and structural equation modeling were used to test the proposed model. Mean, independent samples t-tests, and one-way ANOVA were used to investigate and evaluate the AI-TPACK educational demands of Chinese pre-service EFL teachers based on demographic information. Focus-group interviews with pre-service EFL teachers allowed for a thorough understanding of extra elements and educational needs. In addition, one-on-one interviews were conducted to investigate the perceptions of administrators, ICT instructors, and in-service EFL teachers toward AI in EFL education and teacher preparation. The quantitative and qualitative results and findings were triangulated to answer the research questions and achieve the objectives.

Quantitative findings indicated that behavioral intentions to utilize AI-based educational technologies were directly and positively influenced by performance expectancy ($\beta = .259, p < .001$), social influence ($\beta = .391, p < .001$), and AI Technological Knowledge ($\beta = .481, p < .001$). AI Technological Knowledge (AI-TK) emerged as the most significant factor. Furthermore, AI Technological Knowledge (AI-TK) demonstrated a direct and positive influence on AI Technological Pedagogical Knowledge (AI-TPK) ($\beta = .757, p < .001$) and AI Technological Content Knowledge (AI-TCK) ($\beta = .627, p < .001$). Facilitating conditions (FC) emerged as the most significant factor in the overall model, although its impact on behavioral intentions was not assessed. The analysis revealed a significant direct impact on performance expectancy ($\beta = .441, p < .001$) and a moderate influence on effort expectancy ($\beta = .381, p < .001$). Furthermore, facilitating conditions (FC) exhibited a strong direct and positive influence on AI-TK ($\beta = .683, p < .001$), a weak yet significant impact on AI-TPK ($\beta = .145, p < .039$), a weak to moderate effect on AI-TPACK ($\beta = .141, p < .012$), and a moderate effect on AI-TCK ($\beta = .240, p < .001$). Surprisingly, the results showed a link between AI-TPK, AI-TCK, and EE that had not been identified before. AI-TCK ($\beta = -.379, p < .001$) and AI-TPK ($\beta = -.326, p < .035$) had a significant negative effect on EE of Chinese pre-service EFL teachers to use AI-based educational technologies.

Regarding AI-TPACK educational needs, the findings show that AI-TK ($M = 3.57, SD = 0.64$) was the area with the greatest perceived need. Needs for AI-TPK ($M = 3.65, SD = 0.62$) and AI-TCK ($M = 3.75, SD = 0.64$) were somewhat lower but still noticeable. For AI-TPACK as a whole ($M = 3.64, SD = 0.63$), the needs were more complex. Interestingly, interview data revealed that participants placed the highest

priority on AI-TPACK, while AI-TK was considered less urgent. They explained that although AI-TK is essential, it is relatively basic and easier to learn. The analysis by study year also revealed a clear developmental trend. Freshmen reported the highest level of training needs across all domains, particularly in AI-TK. Sophomores showed slight improvement, especially in technical skills, but this did not fully translate into pedagogical readiness. In contrast, juniors and seniors demonstrated comparatively higher competence, with mean scores above 3.60 in most areas.

The administrator, ICT teachers, and in-service EFL teachers were interviewed to examine their perceptions toward AI in EFL education and EFL teacher preparation. The administrator regarded AI as a tool, not a replacement for teachers. She emphasized solid subject and pedagogical knowledge, and progressive course integration. ICT teachers demonstrated adaptability and a positive attitude. The discussion centered on the potential of AI to enhance efficiency, personalization, and equity. They also identified ethical and technical challenges. In-service EFL teachers highlighted the inadequacy of AI training. They called for more hands-on and case-oriented professional development. Their objective was to integrate AI directly into classroom instruction through training.

5.2 Discussion of Key Findings

The research questions of the present study were (1) What are the factors that influence Chinese pre-service EFL behavioral intentions to use AI-based educational technologies in their future EFL teaching practice? (2) What are the degrees of influence and correlations of these factors? (3) RQ 3. How to prepare pre-service EFL teachers for AI-assisted EFL teaching and learning? SRQ3.1. What are the AI-TPACK educational needs of Chinese pre-service EFL teachers? SQR3.2. What are the perceptions of administrators, ICT teachers, and in-service EFL teachers toward the use of AI-based educational technologies in EFL teaching and teacher preparation? Concerning the questions, the research results and findings were triangulated and discussed in three main parts and presented as follows:

5.2.1 Factors influencing Chinese EFL teachers' Behavioral Intention

A summary of the findings of the influencing factors is provided first. This study advanced the understanding of factors influencing Chinese pre-service EFL teachers' intention to use AI-based educational technologies. In quantitative phrases, a total of 27 hypotheses between eight independent variables and one dependent variable were rigorously tested. It was found that there existed a significant, direct positive influence on intention to use AI-based educational technologies from performance expectancy, social influence, and AI technological knowledge. Unexpectedly, however, effort expectancy, AI-TPK, AI-TCK, and AI-TPACK did not have a significant direct positive influence on intention to use AI-based educational technologies. Three influencing factors explained accounted for 70% of the variance (adjusted R²) in teachers' intention to use AI-based educational technologies. The following parts discuss each factor in a detailed way.

5.2.1.1 AI Technological Knowledge (AI-TK).

AI technological knowledge emerged as the most significant predictor of Chinese pre-service EFL teachers' intention to utilize AI-based educational technologies. This finding is consistent with research on Chinese in-service EFL teachers (An et al., 2022). AI technological knowledge positively and directly influenced effort expectancy; this finding aligns with An et al. (2022), suggesting that a higher level of AI technological knowledge makes it easier for Chinese pre-service EFL teachers to use AI-based educational technologies in their future teaching practice. However, contrary to expectations and a previous study (An et al., 2022), AI technological knowledge did not have a positive direct influence on performance expectancy. The discrepancy suggests that, while AI technological knowledge makes AI-based educational technologies easier to use, it does not always enhance perceptions of their usefulness or importance. Additionally, qualitative findings provide possible explanations for this phenomenon. When it comes to performance expectancy for AI-based educational technologies, Chinese pre-service EFL teachers prioritize teaching efficiency enhancement, student engagement and motivation, workload reduction, and personalized learning over technical aspects of AI.

Moreover, AI-TK had a direct and positive effect on AI-TPK and AI-TCK. These findings are in line with the previous research (Celik, 2023; Ning et al., 2024).

However, AI-TK's effect on AI-TPACK was non-significant. The finding aligns with Ning et al. (2024) but differs from that of An et al. (2022), who found that AIL-TK predicts AI-TPACK. These findings indicate that, while AI-TK serves as a basis for developing AI-TPK and AI-TCK, pre-service EFL teachers may lack the depth, confidence, and practical experience required to completely integrate technology, pedagogy, and content into an integrated AI-TPACK. In other words, their limited mastery of AI technical knowledge limits them from properly adapting it into pedagogically useful teaching designs.

In summary, these findings bring attention to the need for teacher training that focuses not just on technical knowledge but also on the practical benefits of AI in the classroom to inspire intention to use AI-based educational technologies.

5.2.1.2 Social Influence (SI).

The findings of the present study confirmed that social influence was a critical factor shaping pre-service EFL teachers' intention to adopt AI-based educational technologies. This finding aligns with previous studies (An et al., 2022; Mei et al., 2018; Mohammad-Salehi et al., 2021; Teo et al., 2019; Wen et al., 2024). Empirical evidence about the impact of social influence (SI) on artificial intelligence adoption is diverse. Research in higher education settings (e.g., Cabero-Almenara et al., 2024; Pérez, 2024) has identified SI as a crucial determinant in influencing faculty members' use of AI tools. Yao and Halim (2023) found social influence, in conjunction with performance expectancy, to be a significant determinant of AI adoption among educators. In contrast, Andrews et al. (2021) found no significant correlation between SI and librarians' intention to use AI. Wen et al. (2024) found that SI had the strongest effect on Chinese secondary school EFL Students' behavioral intention of using AI tools.

Moreover, as elaborated in the interview, rather than being limited to peer expectations alone, AI integration is situated within a broader ecosystem of stakeholders, including students, parents, colleagues, school leaders, and policymakers. Their attitudes and feedback collectively shape pre-service EFL teachers' perceptions and behavioral intentions. For instance, students' engagement, feedback, and learning performance were found to be the most important elements that directly reinforce teachers' performance expectancy, and to use AI-based educational technologies. At

the same time, colleagues' professional evaluations, classroom experiences, and pedagogical judgments regarding AI-based educational technologies significantly influence teachers' perceived performance expectancy

In the classic UTAUT model, the social influence scale (Venkatesh et al., 2003) tends to use vague terms such as "People who influence my teaching behavior", "People who are important to me", "The senior management of the school" and it is suggested that in research conducted in educational settings, specific stakeholders such as students, school leaders, colleagues, policymakers, and parents be included and integrated into the scale to improve its accuracy and validity.

5.2.1.3 Performance Expectancy (PE).

As the results showed, performance expectancy was one of the influential factors of Chinese pre-service EFL teachers' behavioral intention to use AI-based educational technologies. The statistical modeling revealed that the greater the awareness of the potential and advantages of AI-based educational technologies to enhance the quality and efficiency of teaching among Chinese pre-service EFL teachers, the more likely they are to incorporate these technologies into their future teaching practices. This is in line with the general findings of previous UTAUT studies (e.g., Davis, 1989, 1993; Sang et al., 2011). This is also consistent with recent research findings from the TAM and UTAUT regarding the integration of AI and general technologies into EFL education and other educational sectors (e.g., Abdelhalim, 2016; An et al., 2022; Ballenas & Lasco, 2024; Wen et al., 2024). Ballenas and Lasco (2024) identified a robust positive relationship between performance expectancy and behavioral intention among mathematics educators, emphasizing that the anticipated enhancement in teaching outcomes was a primary motivator for AI acceptance. In a study in Jiangsu Province, preschool teachers indicated that their readiness to embrace generative AI was notably affected by their anticipations of its beneficial effects on education (Zhang & Wareewanich, 2024). Wen et al. (2024) revealed that performance expectancy positively predicted behavioral intention. These findings indicate that, regardless of educational levels and settings, the conviction in AI's pedagogical usefulness serves as a constant and significant driver for integration.

Furthermore, the qualitative findings of the present study suggest that at present, among Chinese pre-service EFL teachers, AI-based educational technologies

or AI tools are perceived to be useful for improving teaching efficiency, reducing workload, supporting personalized learning, enhancing student engagement, learning quality, learning flexibility, and overcoming time and space limitations. Generally, participants had favourable responses with regard to behavioral intention to use AI-based educational technologies, which is an encouraging sign for their future acceptance of these technologies. These findings imply that if the government or educational institutions aim to facilitate the integration of AI into EFL education, they must assist teachers in comprehending the benefits of AI for their instruction.

5.2.1.4 Facilitating Conditions (FC).

Facilitating conditions emerged as the most influential factor in the entire model. It had a strong direct effect on performance expectancy and a moderate effect on effort expectancy. This departs from the classical UTAUT logic (Davis, 1989; Venkatesh & Davis, 2000), where facilitating conditions were believed to influence use behavior only, rather than shaping users' perceptions before adoption. However, more recent studies have started to point in a similar direction. For example, Ballenas and Lasco (2024) reported that access to adequate infrastructural and institutional support directly enhanced mathematics teachers' behavioral intention to adopt AI tools. Likewise, Cabero-Almenara et al. (2024) found that university educators showed significantly stronger AI acceptance when backed by clear institutional policies and technical resources. In the study of Wen et al. (2024), they found that facilitating conditions could positively predict the behavioral intention of Chinese secondary school EFL students' intention to use AI tools.

These findings suggest that in the current stage of AI adoption, especially in the Chinese EFL education and EFL teacher education context, AI is still perceived as emerging and policy-driven. Facilitating conditions are not just external support factors. They actively influence pre-service EFL teachers' perceptions of AI's instructional value (performance expectancy), its practicality, and ease of use (effort expectancy). In essence, before engaging with AI-based educational technologies, the availability of clear guidelines, training resources, reliable infrastructure, and evident institutional support significantly influences EFL teachers' perceptions of AI as either an opportunity or a challenge.

Moreover, facilitating condition had a strong direct and positive effect on AI-TK, a weak but significant effect on AI-TPK, a weak to moderate effect on AI-TPACK, and a moderate effect on AI-TCK. These findings are partly consistent with the study on Chinese EFL teachers (An et al., 2022), in which facilitating conditions were found to be positively related to AIL-TK, AI-TPK, and AI-TPACK. These findings underscore the significance of technical and expert support during the initial phase of technology adoption (An et al., 2022; Geng et al., 2021). As reinforced by qualitative findings, pre-service and in-service EFL teachers both stressed the need for strong facilitating conditions support. Pre-service teachers focused on training, funding, and partnerships. They wanted cooperation with universities and EdTech companies. They also value school-based resource sharing and family understanding. In-service teachers cared more about daily teaching needs. They emphasized easy-to-use software and reliable technical support. They also mentioned the importance of affordable tools and stable infrastructure. They believed school and government investment made AI use easier.

In conclusion, both groups agreed that facilitating conditions are essential. Pre-service teachers focused on learning and preparation. In-service teachers focused on practice and sustainability.

5.2.1.5 Effort Expectancy (EE)

The classic notion in the UTAUT model, that behavioral intention to use technology is directly influenced by effort expectancy, which is challenged in this study. The statistical results indicate that effort expectancy does not have a significant positive direct influence on Chinese pre-service EFL teachers' behavioral intention to use AI-based educational technologies. This suggests that these teachers would not adopt such technologies solely because they are easy to use. These findings align with Mei's (2016) study on Chinese mainland pre-service EFL teachers' behavioral intention to use CALL 2.0. And they are consistent with An et al.'s (2022) findings on modeling Chinese English teachers' behavioral intention to use AI in middle schools. However, the lack of direct influence from effort expectancy differs from previous studies (e.g., Davis, 1989; Venkatesh & Davis, 2000). In a recent study of Chinese secondary school EFL Students' behavioral intention of using AI tools, Wen et al. (2024) found that effort expectancy positively predicted behavioral intention. The UTAUT model has

undergone multiple empirical validations for both validity and reliability. Researchers discovered that variable associations may vary across distinct research contexts (Andrews et al., 2021; Jain et al., 2022). Therefore, this disparity may be explained by the Chinese context, where AI tools such as Doubao and Deepseek are widely accessible and user-friendly, reducing the technical threshold for adoption. Interviews with pre-service EFL teachers confirmed that many found these AI tools easy to use and readily accessible, making effort expectancy less influential on their intention to use AI-based educational technologies. It is reasonable to speculate that effort expectancy would be less influential towards intention to use AI-based educational technologies.

5.2.1.6 AI-TPK.

As the results showed, AI-TPK had no positive and direct effect on Chinese pre-service EFL teachers' behavioral intention to use AI-based educational technologies, and had no positive and direct effect on Chinese pre-service EFL teachers' performance expectancy to use these technologies. These findings align with the study of An et al. (2022). Unexpectedly, the present study found that AI-TPK had a negative influence on effort expectancy. This finding differs from the finding of An et al. (2022). These findings indicate that pre-service EFL teachers' knowledge of pedagogical affordances of AI-based educational technologies, such as providing feedback and monitoring learning, and their understanding of alerts and message interpretation from these technologies alone, do not necessarily translate into a stronger intention or perceived usefulness of AI-based educational technologies. Instead, when their pedagogical awareness of AI becomes more sophisticated, they may begin to recognize the practical complexity and workload involved in adapting AI to real teaching contexts, which could explain the negative influence on effort expectancy. In other words, deeper pedagogical awareness of AI may heighten their sensitivity to its challenges rather than reduce effort expectancy.

Additionally, AI-TPK had a strong direct and positive impact on AI-TPACK. This finding aligns with the findings of Ning et al. (2024), An et al. (2022), and Celik (2023). The finding indicates that a strong comprehension of the pedagogical application of AI (AI-TPK) is a crucial factor in equipping pre-service EFL teachers to integrate technology, pedagogy, and content into a comprehensive AI-TPACK

proficiency. In summary, when pre-service EFL teachers effectively integrate AI-based educational technologies with pedagogical strategies, they are more likely to acquire the comprehensive and practical skills necessary for designing AI-assisted teaching in a practical classroom context.

5.2.1.7 AI-TCK.

The data revealed a previously unrecognized correlation between AI-TCK, BI, PE, and EE. AI-TCK did not influence pre-service EFL teachers' behavioral intention to use AI-based educational technologies. However, AI-TCK had a moderate effect on performance expectancy, while it had a strong negative effect on pre-service EFL teachers' effort expectancy to use AI-based educational technologies.

The findings show that AI-TCK does not directly affect pre-service EFL teachers' intention to use AI-based technologies. AI-TCK mainly reflects their understanding of how AI can enhance English teaching, not their readiness to use it in class. In other words, knowing the potential of AI does not mean they will use it. As indicated by qualitative findings, practical factors like institutional support, classroom feasibility, and implementation pressure from stakeholders like school leadership, students, colleagues, parents, and policies are powerful influencing factors.

However, AI-TCK demonstrated a positive impact on performance expectancy. The results indicate that once pre-service EFL teachers recognized the instructional value of AI in personalized language input, grammar correction, or vocabulary explanation, their perceived usefulness of AI increased.

Unexpectedly, AI-TCK had a negative effect on effort expectancy. A possible explanation is that as pre-service EFL teachers cultivated a deeper understanding of the importance to integrate AI-based educational technologies into teaching content, they concurrently recognized the practical difficulties and cognitive efforts essential for actual use of these technologies. Huang and Liu (2021) discovered that teachers may become overwhelmed by the technical complexities of AI. This indicates that although they could clearly understand the educational potential of AI-based educational technologies, they also realized that the design and implementation of AI-assisted teaching was technically challenging and labor-intensive, resulting in increased perceptions of difficulty rather than ease of use.

Additionally, the present study found that AI-TCK had no direct and positive effect on AI-TPACK, which challenged the previous studies (Celik, 2023; Ning et al., 2024). Cleik (2023) discovered that intelligent-TCK is positively associated with intelligent-TPACK. Similarly, Ning et al. (2024) found that AI-TCK had an impact on AI-TPACK. This finding might suggest that pre-service EFL teachers' increased knowledge of field-specific AI-based educational technologies doesn't guarantee they can use these technologies for pedagogical purposes. This discrepancy may stem from the fact that most pre-service EFL teachers in this study are still at an early technological awareness stage; in other words, they understand what AI tools can do but have not yet developed the pedagogical reasoning to determine why, when, or how to integrate AI meaningfully. Moreover, participants of the present study had little experience with AI-assisted teaching, which constrained the transformation of AI-TCK into teaching practice. Consequently, AI-TCK knowledge lacked the conditions necessary to evolve into full AI-TPACK.

This highlights the need for teacher education programs to move beyond technical literacy and provide sustained pedagogical modeling of AI for teaching and adaptive decision-making. It is essential for teacher education programs to offer not merely theoretical training in AI's subject-specific advantages, but also practical, organized design practice and classroom-based activities that minimize perceived application difficulties and convert AI-TCK into practical teaching confidence. It was found that professional development programs helped teachers integrate field-specific technologies into instruction (Kiray et al., 2018).

5.2.1.8 AI-TPACK.

Concerning AI technical pedagogical content knowledge (AI-TPACK), it had no direct positive effect on BI, PE, and EE. The current study's findings unexpectedly contradict previous research. Cheung et al. (2016) discovered a positive correlation among performance expectancy, effort expectancy, and TPACK. An et al. (2022) identified that the AI-TPACK of Chinese EFL teachers is a significant predictor of their intention to use AI, and it has a positive relationship with performance expectancy and effort expectancy. In the same vein, Lim and Harwati (2021) examined the integration of technology by pre-service teachers for English language instruction in Malaysia and discovered a positive correlation between TPACK and behavioral

intention. In contrast to conventional ICT or CALL tools, AI tools are regarded by many pre-service teachers as unpredictable and challenging, which may influence the transformation of knowledge into intention. Qualitative findings of the present study showed that Chinese pre-service EFL teachers were entirely aware of the significant interplay of pedagogy, technology, and content knowledge as an essential aspect in their intention to use AI-based educational tools. However, this awareness did not automatically translate into immediate intention.

Several reasons may explain this gap. First, most participants lacked hands-on experience with AI tools; their AI-TPCK was mostly theoretical. Second, teacher education programs in China focus more on theory than practice. As a result, students understand the potential of AI without knowing how to use it effectively in class. Third, a psychological gap exists. Understanding AI is one thing; trusting it enough to use it in teaching is another. This cautious attitude is particularly common among both pre-service teachers and those who lack classroom autonomy and fear pedagogical failure.

5.2.2 Degree of Influence and Correlations Among Identified Factors.

The structural model revealed varying degrees of influence among the factors. AI Technological Knowledge (AI-TK) had the greatest effect on behavioral intention (BI), followed by social influence (SI) and performance expectancy (PE). These findings emphasized that AI technological knowledge, perceived usefulness, and important others, such as school leaders, colleagues, students, and parents, are key drivers of AI adoption intentions. Contrary to the finding of An et al. (2022), the most influential factor in teachers' behavioral intentions to use AI is performance expectancy (PE). The discrepancy might be attributed to training experience and teaching experience with AI technologies, since the participants of An et al.'s (2022) study were in-service EFL teachers, and they have already been trained in using AI tools systematically. After gaining AI technological knowledge, they shift their attention to the usefulness of AI tools.

AI-TK also played a central role in influencing multiple constructs. It showed strong positive effects on AI-TPK and AI-TCK, which is consistent with Ning et al. (2024). Moreover, AI-TK had strong and positive effects on effort expectancy (EE). These findings confirmed its foundational position within AI-TPACK-related knowledge.

Facilitating Conditions (FC) further acted as a critical factor. It significantly influenced PE, EE, AI-TK, AI-TPK, and AI-TPACK, indicating that institutional and technical support are important key drivers of AI-TPACK competence development.

The relationship between AI-TPACK components was complex. AI-TPK and AI-TCK had a direct effect on AI-TPACK, while neither had a direct impact on BI. Interestingly, AI-TPK and AI-TCK had a significant negative influence on Effort Expectancy (EE), implying that the higher the AI technological pedagogical knowledge or AI technological content knowledge, the more conscious one may be of the effort required to use AI.

5.2.3 AI-TPACK Educational Needs of Chinese Pre-service EFL Teachers

5.2.3.1 AI-TPACK Competence.

The results show that Chinese pre-service EFL teachers generally perceive themselves as moderately competent in using AI-based educational technologies. Across the four AI knowledge domains, the hierarchy pattern from high to low is as follows: AI-TCK, AI-TPK, AI-TPACK, and AI-TK. The results are different from the findings of Aziz et al. (2022), who used the TPACK model to measure English lecturers' readiness to adopt technological tools in their teaching. They found that the TPK construct had the highest score, followed by TCK and TPACK. TK had the lowest score in their studies. Moreover, Chan and Tang (2025) found that preservice English teachers in Hong Kong had the highest competence in the TK construct, followed by the TPK construct and TCK construct, and the lowest in the TPACK construct. Additionally, Ye et al. (2025) discovered that Chinese pre-service EFL teachers from a university in central China who scored highest in I-TK, followed by I-TPK, I-TCK, and I-TPACK, scored the lowest.

What's more, the mean scores of AI competence among mainland Chinese pre-service EFL teachers range from 3.57 to 3.75. These values are broadly consistent with findings from Ye et al. (2025), who reported mean scores ranging from 3.56 to 3.71. By contrast, Chan and Tang (2025) found higher mean scores in Hong Kong, ranging from 3.86 to 4.06. This suggests that pre-service EFL teachers in mainland China perceive their AI-TPACK competence as slightly lower than Hong Kong counterparts. These findings imply that context, institutional resources, and prevailing pedagogical culture strongly influence the development of AI-TPACK.

The discrepancy may stem from several contextual and developmental factors. The present study was conducted in a region where AI infrastructure and teacher education support remain relatively limited, meaning most pre-service teachers were still at a tool-awareness stage rather than engaging in AI-integrated pedagogical design. In contrast, studies such as Aziz et al. (2022) and Chan and Tang (2025) were situated in more AI-mature educational ecosystems, where structured AI micro-teaching or design-based training was embedded in teacher preparation, allowing TPK or TK competence to emerge more prominently. Similarly, Ye et al. (2025) reported that Chinese pre-service teachers in a comparatively well-resourced institution demonstrated higher self-assessment in AI-TK and AI-TPK, suggesting that program design and institutional readiness significantly influence competence hierarchies. Another explanation concerns the measurement focus; while the study of Aziz et al. (2022) evaluated general technological teaching readiness, the present study targeted AI-enabled instructional design specifically, which is pedagogically more demanding. Moreover, in China's examination-driven context, pre-service teachers tend to emphasize content-aligned TCK functions over transformative AI-TPACK knowledge, especially when pedagogical innovation is not institutionally motivated. Such findings imply that teacher education programs in less AI-advanced regions must prioritize early pedagogical modeling and structured AI-integrated practicum rather than simply increasing tool exposure.

5.2.3.2 Gender Differences in AI-TPACK Competence

An independent samples t-test was performed to investigate gender disparities in AI-TPACK competencies. The key finding indicates that female participants demonstrated significantly higher AI technological pedagogical knowledge (AI-TPK), whereas no other notable gender differences were detected in AI technical knowledge (AI-TK), AI technological content knowledge (AI-TCK), or integrated AI technical pedagogical content knowledge (AI-TPACK). The finding may indicate that female participants are confident in integrating pedagogical and technological aspects of AI-based educational technologies, but total AI-TPACK-related competencies are similar between genders. The findings are in line with some of the previous studies. Jang and Tsai (2012) investigated the impact of interactive whiteboards (IWBs) on the TPACK sub-domains of science and mathematics teachers. The study found no

differences in Content Knowledge (CK), Pedagogical Content Knowledge in Context (PCKCx), Technological Knowledge (TK), and Technological Pedagogical Content Knowledge in Context (TPCKCx) based on gender. Koh and Chai (2011) found no significant differences in the seven sub-domains of TPACK based on gender.

At the same time, the findings are contrary to some of the previous research. According to Tsai (2008), men have higher TK because they are more optimistic, confident, and proficient in technology. The gender impact size is minimal in CK, TK, and KTT. Koh et al. (2010) discovered that men score higher in CK, TK, and KTT. In TPACK, TCK, TPK, PCK, and TK domains, Erdogan and Sahin (2010) found a significant male advantage. Lin et al. (2013) compared PSTs and in-service instructors' gender with all TPACK subdomains. In-service male instructors had a statistically significant advantage in Pedagogical and Technological Knowledge. Koh et al. (2014) found variances in technological aspects such as C-TK, TCK, and C-TPACK in constructivist-oriented TPACK. Male teachers showed more knowledge of these issues than females, although the effect size was minor.

In summary, the findings indicate that gender differences in TPACK or AI-TPACK are neither widespread nor significant. Instead, they appear to differ among settings, teacher groups, and the knowledge domains examined. Beyond gender itself, factors such as teaching experience, disciplinary background, and exposure to digital pedagogy may play a more decisive role in shaping teachers' technological integration competence.

5.2.3.3 Year-level Differences in AI-TPACK Competence

One-way ANOVA was undertaken to investigate year-level disparities in AI-TPACK competences, namely AI-TK, AI-TPK, AI-TCK, and AI-TPACK. Tukey's HSD post-hoc analysis revealed that freshmen consistently reported lower skill levels than upper-year participants. In AI-TK, freshmen got markedly low scores compared to sophomores, juniors, and seniors. In AI-TPK, freshmen scored lower than juniors and seniors. In AI-TCK, freshmen had lower scores than sophomores and seniors. Finally, freshmen had lower scores in AI-TPACK compared to juniors and seniors. These findings demonstrate a distinct developmental pattern, with students' AI competencies progressively enhancing across year levels. These findings align with the findings of Kartal and Afacan (2017) on pre-service science teachers' (PSTs) TPACK

levels. It was found that PSTs' mean scores for KTT, KP, TK, and CK also increased with year levels. These findings may indicate that AI-TPACK competency develops gradually with experience and practice. Rather than being a fixed skill, it appears to be developed by ongoing interaction with digital pedagogy, classroom reflection, and institutional support that promotes adaptive applications of AI in teaching and learning contexts. Since Lee et al. (2006) discovered that novice teachers with low pedagogic competence struggle to integrate technology, pedagogy, and content knowledge. Similarly, Pierson (2001) found that teachers with limited pedagogical knowledge have difficulty understanding technology, facing challenges in integrating pedagogy and technology.

5.2.3.4 Technology Experience-based Differences in AI-TPACK Competence

A one-way ANOVA was used to compare differences in AI-related knowledge and TPACK components among participants with varying levels of technological exposure. The main finding is that extended technology experience may be associated with slightly higher AI technological knowledge (AI-TK) and AI technological content knowledge (AI-TCK). In contrast, pedagogical expertise (AI-TPK) and AI-TPACK integration appear to be less affected by the length of technological experience. The findings are partly in line with those of Kartal and Afacan (2017), who investigated the TPACK of Turkish pre-service science teachers in relation to demographic variables. The study identified relationships between PSTs' levels of computer usage and the survey factors. As the efficacy of PSTs in utilizing computers improves, their levels of KTT, KP, TK, and CK also rise. These findings reveal the complex connection between technology experience and teaching innovation. While exposure to digital technologies tends to develop fundamental technical competence, transforming that competence into AI-enhanced teaching expertise appears to need guided reflection, pedagogical modeling, and practical classroom application. As a result, teacher education programs should not only give access to technology but also provide opportunities for pre-service and in-service teachers to experiment, reflect, and practically interact with artificial intelligence in real classroom settings.

5.2.3.5 AI tools Experience-based Differences in AI-TPACK Competence

Limited previous studies examine the differences in AI-TPACK by AI tools experience. In the present study, One-way ANOVAs were conducted to examine whether AI tool experience (less than 3 months, 1 to 2 years, 3 to 4 years, and more than 5 years) influenced four AI-TPACK competencies: AI-TK, AI-TPK, AI-TCK, and AI-TPACK. The finding is that significant group differences were found for AI-TK, AI-TPK, and AI-TCK, while no significant differences were observed for AI-TPACK.

This pattern offers an interesting insight into how AI experience shapes teachers' AI-TPACK structures. It appears that the longer individuals have used AI tools, the more confident and skilled they become in handling technical and applied aspects of AI technology integration. Teachers with extended AI exposure seem to develop stronger technological and content competence, such as understanding how AI supports subject content and pedagogical applications. However, this experiential advantage does not seem to extend naturally to the higher-level, integrative domain of AI-TPACK.

One possible explanation is that while frequent use of AI tools can build familiarity and procedural know-how, achieving AI-TPACK competence requires more than practical experience. It involves deliberate pedagogical reasoning, reflective practice, and opportunities to design AI-supported learning environments grounded in educational theory. As supported by prior studies (Ansyari, 2015; Drajadi et al., 2018; Turgut, 2017), technical experience lays the groundwork, but pedagogical and instructional scaffolding, often cultivated through targeted teacher education or professional development, are what transform that experience into meaningful, integrative AI teaching expertise.

5.2.3.6 AI-TPACK Educational Needs

The integration of quantitative and qualitative findings provides a comprehensive understanding of the educational needs of Chinese pre-service EFL teachers in developing AI-TPACK competence for AI-based educational technologies integration. While the quantitative analysis identified AI-TK as a high-need domain, and moderate needs in AI-TPK and AI-TPACK, and no immediate needs in AI-TCK. The qualitative thematic analysis complements these insights by uncovering specific areas requiring intervention. Together, these results reveal interconnected challenges

and opportunities for targeted teacher training. Compared with previous needs analysis studies of pre-service teachers,

The quantitative results indicate that AI-TK is the most critical area of need. The finding differs from the finding of Ye et al. (2025), in which Chinese pre-service EFL teachers demonstrate a solid overall level of AI readiness with high mean scores in AI-TK. In the present study, participants scored low in technical understanding, suggesting that many of them can operate AI-based educational tools but do not yet grasp how these systems work. Item-level results reinforce this gap, with most of the AI-TK items falling in the high-need range, especially AI-TK5, which points to limited familiarity with AI's internal mechanisms and intelligent processing logic. AI-TK1 and AI-TK4 also indicate insufficient hands-on interaction with AI tools in realistic instructional tasks. The findings partly align with Chan and Tang (2025), who found a low score in TK4 (I have sufficient knowledge to use AI-based tools). The limited knowledge of advanced AI tools and technical characteristics corresponds with Celik (2023) and Velandar et al. (2024), who stressed the necessity for systematic training to acquire essential technical skills for AI integration. The findings might suggest that teachers' understanding of AI remains largely surface-level, emphasizing tool use rather than conceptual comprehension. Limited engagement with AI's underlying mechanisms and practical classroom applications may constrain their confidence in integrating AI meaningfully. This reveals a gap between knowing what AI tools can do and truly understanding how they function or why they are pedagogically meaningful, a gap that could be addressed through focused, practice-based professional training.

Needs within AI-TPK and AI-TCK were comparatively less urgent but still apparent. Teachers were somewhat capable of interpreting AI feedback and recognizing AI's potential in English language instruction. Chan and Tang (2024) and Ye et al. (2025) similarly highlighted gaps in TCK or I-TCK. However, Gregorio et al. (2024) and Karataş and Ataç (2024) found high readiness and low needs in I-TPK. In the present study, AI-TPK need is found in AI-TPK5 (I can interpret messages from AI-based educational technologies to give real-time feedback), which indicates that Skills in leveraging AI for timely feedback require development. The findings suggest that they understand what AI can do, but not necessarily how to strategically use it in response to learner diversity, curriculum standards, or assessment requirements.

For AI-TPACK, needs were more complicated. Ye et al. (2025) and Chan and Tang (2024) pointed out significant gaps in TPACK and recommended that participants receive more training on topics like choosing and implementing AI tools for teaching English and progress tracking, as well as the pedagogical requirements to use AI tools in the English classroom. And in the present study, items like AI-TPACK4 (I can teach English using AI-based educational technologies with diverse teaching strategies.) and AI-TPACK5 (I can teach lessons that appropriately combine my teaching content, AI-based educational technologies, and teaching strategies.) suggest that participants have already begun to think beyond tool operation and to recognize AI's relevance to lesson design and pedagogical strategy. But their present understanding is still basic and conceptual rather than executable. They know AI matters but are not yet confident in how to translate that awareness into a structured teaching practice.

Qualitative findings on areas of low confidence in AI-TPACK suggest that across academic stages, pre-service EFL teachers showed limited confidence mainly in integrative aspects of AI-TPACK rather than in isolated domains. Freshmen often felt overwhelmed, describing AI-TPACK as a “three-fold challenge” that demands mastery of technology, pedagogy, and content at once. Their concerns centered on limited AI exposure and scarce institutional support. Sophomores began to see AI-TPACK as meaningful but struggled with practical application. They worried about how to manage student engagement and avoid over-reliance on AI tools, reflecting early awareness of human-AI balance in language teaching. Juniors, while more experienced, still found AI-TPK and AI-TCK difficult. Many linked their low confidence to fast technological change, lack of teaching experience, and difficulty matching AI tools to linguistic goals. Seniors, despite broader conceptual understanding, reported hesitation in advanced integration tasks, particularly in applying AI to complex language areas such as metaphor, discourse, and cultural nuance. Their reflections reveal a more discipline-conscious awareness of AI's limitations in handling deep linguistic content. In general, the transition from external barriers to cognitive and epistemic challenges implies that teacher education should prioritize progressive, context-rich training that develops both confidence and pedagogical judgement in AI-supported classroom teaching.

In short, pre-service teachers were not resistant to AI or entirely unprepared. They were at a transitional stage where they are aware of AI's pedagogical value but still lack the technical depth and design-level competence needed to integrate AI-based educational technologies meaningfully rather than superficially. This suggests a shift is needed in teacher education from teaching AI as a digital tool to teaching it as a design partner and pedagogical decision-making resource. Aligned with previous studies by Çelik (2023) and Velandar et al. (2024), this research calls for cohesive professional development frameworks and clear curricular guidance.

5.2.3.7 Year Level Differences in AI-TPACK Educational Needs.

The quantitative and qualitative results reveal a clear developmental pattern in how AI-TPACK needs evolve across year levels. Qualitative findings also suggest that pre-service EFL teachers showed a gradual evolution in their understanding of AI-TPACK across academic stages. Freshmen mostly viewed it as fragmented and tool-centered, often describing AI-TPACK as complicated and constrained by limited resources. Sophomores began to organize their thinking, treating it as a process that links AI knowledge with teaching goals and classroom needs. By junior year, a deeper awareness emerged. Many regarded AI-TPACK not just as a theory but as a working framework that unites technology, pedagogy, and content. Their use of metaphors and concrete examples reflected growing professional insight. Seniors reached the most advanced level, portraying AI-TPACK as a flexible, multi-dimensional system for adaptive teaching and reflective practice. They emphasized judgment, contextual use, and professional competence. Taken together, the findings suggest a developmental path starting from basic tool familiarity to a more integrated, adaptive, and reflective understanding. This pattern highlights the need for teacher education programs to guide learners step by step, helping them move beyond technical know-how toward informed, context-sensitive pedagogy in AI-assisted language teaching.

Teachers with more years of experience showed higher-level perceptions across different TPACK sub-domains, according to Chuang and Ho (2011). Cetin-Berber and Erdem (2015) examined the Technological, Pedagogical, and Content Knowledge (TPACK) of Turkish pre-service teachers and discovered significant disparities in their perceptions across all sub-domains of TPACK (TK, CK, PK, PCK,

TCK, TPK, TPACK) based on their year of study. The results revealed significant differences in PCK and TCK.

In the present study, freshmen express the highest level of training demand in all domains, especially AI-TK, indicating that many are still trying to grasp how AI systems actually operate. At this early stage, they lack not only technical fluency but also the cognitive awareness required to judge AI outputs. Their equally high scores in AI-TPK suggest that they struggle to interpret AI-generated feedback or determine appropriate pedagogical use. It is a predictable outcome given their limited exposure to practical teaching scenarios.

Sophomores show marginal progress, particularly in technical familiarity, yet this confidence does not fully translate into pedagogical readiness. They appear to be in a liminal stage, which is beyond basic AI literacy, but not yet capable of actively implementing AI-supported instructional processes. Hence, training for this group should shift from tool familiarization to structured, guided classroom simulations that foreground AI-supported feedback, learner monitoring, and differentiated instruction.

In contrast, juniors and seniors show quite good competence (mean > 3.60 on most indicators). This shows that AI knowledge has begun to be integrated into their broader professional teaching frameworks, which are most likely influenced by methods coursework, micro-teaching, and practicum experiences. They no longer require introductory training. Rather, its developmental barrier is design-level competence, which is about how AI may be strategically used for adaptive learning, automated evaluation, or teacher-AI collaboration in course planning.

Interview results show that pre-service EFL teachers' priorities in AI-TPACK change across academic stages. Freshmen had varied views. Some focused on AI-integrated content knowledge (AI-TCK) to strengthen grammar, vocabulary, and language skills. Others emphasized overall AI-TPACK, AI technological knowledge (AI-TK), or AI pedagogical knowledge (AI-TPK). This reflects exploratory thinking and a need for flexible guidance. Sophomores were more consistent. They ranked AI-TPACK highest for its integration and classroom relevance. AI-TCK and AI-TPK came next. AI-TK was seen as preparatory and less urgent. Juniors focused on teaching-oriented skills. They valued AI-TPK and AI-TPACK for learner-centered teaching. AI-TCK and AI-TK remained important as foundational knowledge. Seniors showed

varied priorities. Some emphasized AI-TPACK, others AI-TPK, and a few AI-TCK. AI-TK remained a common foundation across all groups. Together, the pattern suggests progression. Students move from content and technical basics toward pedagogical application and integrated AI-TPACK.

In-service EFL teachers' priorities were shaped by their teaching experience and familiarity with AI tools. Many saw AI-TPACK as the most important because it helps them connect content, pedagogy, and technology in real lessons. Some focused on AI-TK, regarded it as the base for any effective use of AI. Others gave more weight to AI-TCK, especially in English teaching, to make sure AI fits curriculum goals. A few teachers emphasized AI-TPK for designing AI-supported lessons.

In conclusion, these findings indicate that effective AI-focused professional development for EFL teachers should be staged and context sensitive: beginning with content and technical foundations, progressing to pedagogical application, and culminating in integrative AI-TPACK, fostering adaptive, reflective, and classroom-ready AI-enhanced language teaching.

5.2.3.8 Essential AI Skills and Knowledge for Teacher Education

Previous research revealed that the COVID-19 course improved pre-service teachers' digital abilities and increased technological usage (Moorhouse, 2023; Sartika et al., 2021); however, teachers of languages may require AI-specific digital skills to properly use AI tools (Konhke et al., 2023). In interviews, pre-service EFL teachers' perspectives reveal a clear progression in how they perceive essential AI skills and knowledge for teacher education. Freshmen prioritized basic AI use. They focused on how to operate tools, use AI ethically, and explore personalized learning. Many also mentioned creativity and connections between different subjects. Sophomores went a step further. They tried to connect technology with teaching and language content. They valued solid subject knowledge, ethical thinking, and the use of data to guide teaching activities. Juniors showed stronger technical skills. They discussed data literacy, natural language processing, and diagnostic thinking. They also emphasized hands-on practice, innovation, and problem-solving. Seniors showed the most mature understanding. They viewed AI critically, questioning AI resources and making thoughtful teaching choices, stressing intercultural awareness. They valued ethics, responsibility, and strategic integration of AI across language skills.

5.2.3.9 The Evolving Role of AI in EFL Education

1. AI as a Supplementary Tool

The administrator emphasized that AI should be viewed as a supplementary tool rather than a replacement of human teachers. She expressed a generally positive but cautious attitude toward AI in English language teaching and learning. She believed AI provides a powerful data processing system capable of efficiently collecting and organizing large amounts of information to support both teaching and research. However, she stressed that AI cannot replace teachers in classroom teaching. This aligns with previous research suggesting that AI will not replace teachers in the future (Hrastinski et al., 2019), as teacher-student interaction remains indispensable for effective learning and individual student development (Cheng & Tsai, 2019).

The administrator envisioned two possible directions for AI in EFL education over the next 5-10 years. In the first, teachers might become overly reliant on AI, risking static, lifeless teaching. She noted that over-reliance could reduce creativity and critical thinking in teachers and students, leading to superficial learning. As Southworth et al. (2023) observed, a lack of comprehension of the basics may result in a misassessment of AI advantages, leading to superficial AI integration. In contrast, skillful integration can energize classrooms and encourage participation. In the second, more positive scenario, she believed that AI would assist human thinking, supporting knowledge internalization, construction, and output.

The administrator underscored the need to prioritize human agencies, suggesting that successful AI integration depends on teachers' motivation, critical thinking, and pedagogical competence.

2. AI as a Supplementary and Transformative Tool

ICT teachers regarded AI as both a supplementary and transformative tool in EFL education. They were positive about AI in education. They regarded AI as a powerful tool to improve teaching efficiency, support personalized learning, and promote educational equity. ICT teachers held an optimistic view of AI in education, regarding it as a powerful, supplementary tool. They suggested that pre-service teachers be trained in artificial intelligence to improve classroom practice and prepare them for the changing educational landscape. Their suggestions are backed up by previous

studies indicating that AI training programs can foster positive dispositions among both K-12 and tertiary educators (Yang et al., 2024), thereby supporting teachers in making a smoother transition from traditional to AI-based instructional practices. They described AI as a second teacher assisting rather than replacing human teachers. They also highlighted AI's potential as a learning partner and instructional assistant, emphasizing balanced integration to facilitate human interaction. All teachers anticipated substantial long-term influence, noting that AI could improve teaching skills, broaden perspectives, enhance teaching efficiency, and allow teachers to focus on higher-order teaching goals. They predicted innovative teaching models and evolving teacher roles, transitioning from knowledge transmitters to learning planners or facilitators. ICT Teachers acknowledged the significance of interdisciplinary collaboration between ICT and English teacher educators for the effective integration of AI in EFL education, emphasizing that substantial collaboration necessitates institutional or governmental support, including planning, funding, and sustained policy support.

3. AI as a Classroom Support Tool

In-service EFL teachers viewed AI primarily as a classroom support tool, pointing out that their training programs had not prepared them well enough for using AI in English classes. It was said that the training was traditional, with more focus on teaching methods and subject knowledge than on skills related to AI. Previous research indicates that pre-service teachers hold positive attitudes toward the pedagogical application of digital technologies; however, they perceive the knowledge acquired in classrooms as primarily basic and general (Graça et al., 2021; Janes et al., 2023). Some said they had used educational technology while they were in school, but most said it was limited or out of date, and AI information was rarely presented in a useful or important way. They stressed the need for more focused, hands-on training that links AI directly to real classroom teaching.

The teachers expressed strong optimism about the future of AI in EFL education. They believed AI could make learning more personalized, efficient, and engaging by adapting to students' needs, improving motivation, and offering support with pronunciation, listening, and speaking. Many also highlighted AI's potential to handle routine tasks such as grading and feedback, allowing teachers to focus on higher-

order instruction. AI was also perceived as a tool to promote educational equity and support both student and teacher development. However, they also acknowledged challenges related to training readiness, time constraints, and ethical concerns. The perspective of EFL teachers reflects the classroom-level integration of AI, emphasizing practical application and students' needs

5.2.3.10 Preparation of pre-service EFL teachers for AI-assisted EFL teaching and learning.

1. Strengthening Pedagogical Foundations

Regarding pre-service EFL teacher preparation in the AI Age, the administrator believed that pedagogical foundations should be built before AI-based educational technologies integration. She believed future English teachers must first construct their own teaching frameworks, understand their students, and set clear teaching objectives before using AI. She further highlighted that human creativity and reflection are irreplaceable, noting that AI summarizes and imitates, while human thinking can innovate and transform. In her view, cultivating pre-service EFL teachers' critical thinking and pedagogical understanding before integrating AI is key to meaningful and responsible AI technology use in EFL education.

The administrator identified two major challenges in preparing pre-service teachers to integrate AI. The first is students' limited ability to use AI effectively. The second is related to pre-service teachers' content and pedagogical competence. She emphasized that both teachers and students need to improve their human-AI interaction skills to make AI truly beneficial.

The key strategy for preparing pre-service EFL teachers is the gradual integration of AI tools into multiple courses. This involves assignments that require the use of AI, with an emphasis on clear prompts and teacher initiatives.

Regarding efforts to keep the program adaptive, she encourages teacher educators to integrate AI into courses and teaching practice. She emphasized that this approach was more effective and flexible for ensuring the program aligns with the development of AI technologies and trends in language education. Moreover, she pointed out that the teacher program had not made major curriculum adjustments. A similar situation is observed globally, as Lucas et al. (2025) emphasized that embedding digital competence within initial teacher education (ITE) is a complex process that

entails the creation of policies promoting the pedagogical use of digital technologies and the systematic alignment of curricula with established digital competence frameworks. Therefore, without timely curriculum reforms and policy support, teacher education programs may struggle to equip pre-service teachers with the AI-related competencies needed for future classrooms, potentially widening the gap between technological advancement and pedagogical practice. The administrator identified technical and practical AI skills, alongside solid content knowledge, as essential for AI-assisted English teaching.

Regarding cross-disciplinary collaboration with computer science educators, she strongly supported such efforts to enhance AI-assisted teaching. She suggested collaboration should be complementary, with EFL teacher educators guiding pedagogical use and computer scientists supporting the technical implementation.

In short, the administrator advocates for a balanced approach to AI. She sees AI as a supplementary tool that supports teaching and processes data. But it cannot replace teachers, as Human creativity and critical thinking are irreplaceable. She emphasized that pre-service teachers must first build a strong pedagogical foundation to use AI effectively in EFL teaching. The program's strategy is to gradually integrate AI into multiple courses. The Challenges identified include students' ineffective AI use and weak pedagogical skills. And she also stressed that better human-AI interaction is needed. Looking forward, she forecasts both positive and negative futures for AI in EFL, strongly supporting complementary cross-disciplinary collaboration with computer science educators.

2. Developing Technical, Ethical and Interdisciplinary Competence

For preparing pre-service EFL teachers for AI-assisted teaching and learning, the ICT teachers emphasized to encourage technical adaptation, enhance ethical awareness, and develop interdisciplinary competence among pre-service EFL teachers.

In response to the rapid development of AI technologies and their usage in education, ICT teachers are making continuous efforts to adapt courses. They noted that AI integration in university computing courses has become common and is expanding across subjects. Ongoing updates to textbooks and course materials and proactive institutional responses to reforms and national AI strategies were discussed.

ICT Teachers put forward strategies like pairing theoretical learning with hands-on, project-based practice. In general, they actively explore AI integration depending on institutional resources, curriculum policies, and student readiness. Finally, ICT teachers advocated for the promotion of autonomous learning, technical competency, and information literacy among pre-service teachers. Pre-service EFL teacher educators should promote the critical and ethical application of AI by students, ensuring conformity with pedagogical and human values, while equipping pre-service teachers to adapt to rapidly evolving AI technologies and use them meaningfully and effectively in language teaching.

Despite the potential benefits, ICT teachers acknowledged multiple challenges in preparing pre-service teachers for AI-assisted teaching. Ethical and moral concerns were a primary issue, alongside technical and pedagogical gaps among students from different majors. ICT teachers discussed technological challenges such as quick AI updates, infrastructure constraints, and privacy concerns. They also emphasized over-reliance on AI, which might negatively affect critical thinking and social interactions. These findings align with the previous studies; AI integration in education demands an extensive understanding of its ethical aspects, which can only be obtained through focused training and teaching (Akgun & Greenhow, 2021). As a result, the teachers must be equipped with the fundamental knowledge required to deal with the ethical challenges of using AI-based tools in the classroom (D'Souza et al., 2024).

ICT teachers also stressed several essential skills for effective AI use, including practical AI skills in common applications and interdisciplinary knowledge. They believe that pre-service teachers must master computer applications, psychology, and education-related skills alongside AI tools. Foundational, integrative, and innovation-related skills, self-improvement and the integration of AI knowledge with subject expertise were also highlighted.

In summary, the ICT teachers showed significant experience and adaptability in delivering computing courses, effectively adapting to a variety of student backgrounds. The participants indicated positive outlooks on AI in education, highlighting its capacity to improve teaching efficiency, facilitate personalized learning, and promote educational equity. ICT teachers outlined methods for integrating

AI, emphasized the importance of interdisciplinary and practical skills, and identified challenges, including ethical issues, technical deficiencies, and infrastructure constraints. Their approach involves the active adaptation of ICT courses in response to advancements in AI, viewing AI as both a transformative and supplementary tool in EFL education. They advocate for balanced integration, cross-disciplinary collaboration, and ongoing professional development. Their recommendations emphasize the development of pre-service teachers' self-directed learning, technical and information literacy, and ethical AI adoption to equip them for an AI-enhanced educational environment.

3. Practice-Oriented and Progressive AI Integration

As for preparing EFL Teachers, in-service EFL teachers proposed starting AI-related training early and building it up from basic knowledge to hands-on application to improve EFL teachers' preparedness.

Technical literacy, teaching competency, teacher ethics, and professional responsibilities were stressed. They recommended structured AI courses, step-by-step practice, classroom observation, collaboration with experienced teachers, and leadership and institutional support. They stressed the importance of openness to innovation, problem-solving ability, and basic programming skills when equipping the pre-service EFL teachers. The in-service teachers called for a teacher education program that balances AI knowledge, pedagogical integration, and ethical awareness through systematic, practice-oriented training. They emphasized that AI readiness requires integration of theory, operation, and practice to ensure that future English teachers are confident, capable, and responsible AI users in the classroom.

Regarding professional development needs, in-service EFL teachers showed a strong need for ongoing, hands-on AI training. The importance of hands-on experience in professional development was highlighted by previous studies. Delgado et al. (2020) argue that experiential learning is crucial for the professional identity formation of EFL pre-service teachers, as it facilitates the acquisition of essential pedagogical skills and knowledge required for effective teaching (Mali, 2024; Tutyandari et al., 2022), which is increasingly important in the age of AI. They wanted practical sessions built on real teaching cases. Their focus was not only on learning AI tools but also on using them effectively in teaching. Many asked for model lessons and

examples of good AI classroom practice. They also want clear guidance on data security and ethical use. In short, they stressed the importance of professional development that includes technical skills, classroom application, and ethical responsibility.

The perceptions of administrators, ICT teachers, and in-service EFL teachers collectively provide critical implications for the design of AI-informed teacher education programs. Their shared concerns emphasize the urgency of embedding hands-on AI training, ethical awareness, and pedagogical innovation into EFL teacher education to bridge the gap between technological development and classroom practice. The implications are presented in the next section.

5.3 Theoretical Implications

The results of this research also imply that existing technology acceptance and competence models need adjustment in the AI age. Venkatesh (2022) discussed the adoption and use of AI tools grounded in the UTAUT model and suggested extending operations management, individual characteristics, technology characteristics, environmental characteristics, and interventions as possible determinants of UTAUT constructs, moderators of UTAUT relationships, and possible additional direct predictors of employee adoption and use. Enlightened by the suggestions of Venkatesh (2022) and based on the results of the present study, future research in the EFL education context is recommended to identify potential determinants of the UTAUT and AI-TPACK constructs, as well as moderators that may influence EFL teachers' or learners' adoption and use of AI tools.

The UTAUT predicts technology adoption primarily through performance expectancy, effort expectancy, social influence, and facilitating conditions, but it doesn't explicitly account for pedagogical competence, ethical considerations, or AI-specific cognitive skills. As the findings of the present study indicate, factors like teacher confidence in AI decision-making, teachers' and students' AI literacy, or ethical concerns may also shape adoption. The proposed adjustments are listed as follows: First, add AI-specific constructs, such as AI pedagogical confidence, AI ethics, and AI Cognitive load. Second, add moderators to the UTAUT model, including g teaching

experience, subject-specific exposure to AI, and AI training experience as moderators, rather than only age, gender, or voluntariness. And consider institutional AI culture as a contextual moderator, reflecting support and encouragement in practical teaching settings. Third, introduce student engagement or learning outcome feedback as an endogenous variable influencing behavioral intention, reflecting that teachers' adoption decisions are informed by classroom results.

For the adjustment of AI-TPACK, AI-TPACK extends TPACK by adding AI-specific knowledge (AI-TK, AI-TPK, AI-TCK, AI-TPACK), but it treats knowledge domains largely as static. Interviews in the present study indicate that teachers' ethical understanding, pedagogical judgment, and contextual adaptation are dynamic and influence intention to use AI. The proposed adjustments are listed as follows: Firstly, integrate ethical and socio-cultural dimensions. Add AI Ethics Knowledge (AEK), which explicitly accounts for understanding transparency, fairness, bias, and privacy issues in AI tools. Add contextual adaptation knowledge, which refers to the ability to adjust AI tools according to student needs, classroom constraints, and regional digital infrastructure. Secondly, emphasize pedagogical decision-making. Introduce AI pedagogical competence, which reflects teachers' ability to select and apply AI tools pedagogically, not just technically. Thirdly, introduce a reflective practice layer since teachers' AI use is not just knowledge-driven but also experience-driven. Include a dynamic feedback mechanism that classroom outcomes and reflection inform the refinement of AI-TPACK domains.

In conclusion, the unified model for the AI Age was proposed by suggesting the consideration of the following core components: First, Teacher AI Knowledge, including AI-TK, AI-TCK, AI-TPK, AI-TPACK, ethical knowledge, and contextual adaptation knowledge, was encouraged to be added to the model. Second, behavioral intention determinants like performance expectancy (including pedagogical effectiveness), effort expectancy (ease of integration), social influence (students, school leaders, colleagues, policymakers, and parents), and facilitating conditions (infrastructure, technical support, educational or professional trainings, policy, and guidelines). Third, moderators, such as teaching experience, subject exposure, AI training, and institutional culture, were suggested. Finally, feedback loops, such as classroom outcomes, student engagement, and reflective practice, were recommended.

The adjustments not only help to capture both technical and pedagogical dimensions of AI adoption but also integrate ethical and contextual factors that are critical in education. Linking knowledge frameworks (AI-TPACK) with behavioral models (UTAUT) will promote a comprehensive teacher adoption model in AIED.

5.4 Practical Implications

Some practical implications related to EFL teacher education, professional development of in-service EFL teachers, school leaders, policy makers, and ethical use of AI in education in China can also be tentatively drawn from the present study.

5.4.1 EFL Teacher Education

The findings indicate that AI-TPACK training in pre-service teacher education ought to use a progressive and specialized pedagogical framework. Students in their first and second years need basic support that focuses on AI-TK and practices that build their confidence, rather than being involved in high-level integration promptly. At this stage, training should focus on getting students used to using AI tools through hands-on activities, practicing in low-pressure settings, and guided investigations of how AI may be used in language teaching and learning.

By the time students are in their junior and senior years, instructional design should focus on application-oriented learning. This could include activities like microteaching, AI-enhanced lesson planning, peer review, and classroom modeling. The curriculum should help students apply AI knowledge to make decisions about how to teach, not only how to use technologies.

Teacher education programs should consider AI-TPACK not merely as a singular course but as an integrated and interdisciplinary competency, included throughout educational technology, pedagogy, assessment, and hands-on experience. This involves early scaffolding, gradually increased complexity, and practical pedagogical integration, ensuring that AI-TPACK is regarded not as an isolated skill but as an evolving teaching and learning competency.

Additionally, based on the findings of the present study, pedagogical foundations should be established before the integration of AI-based educational

technologies. Pre-service teachers should be supported in developing technical adaptability, enhancing ethical awareness, and developing interdisciplinary competence to ensure effective and responsible educational AI applications. Furthermore, AI-related training should be started early, and building it up from basic knowledge to hands-on application to improve EFL teachers' preparedness.

5.4.2 Professional Development of EFL Teachers

The results show that in-service EFL teachers need AI professional development that is flexible, based on their own needs, and can be immediately applied, rather than uniform training that works for everyone. Their needs differ based on their teaching experience, technical confidence, and the reality of the classroom. This means that training courses need to be adaptable and personalized.

Professional development should focus on AI applications that are useful in the classroom, such as how AI can help with teaching goals, keeping students engaged, formative assessment, and personalized teaching. Training should go beyond just teaching teachers how to use tools and instead focus on things like linking the curriculum, teaching methods, ethics, and real classroom application.

Additionally, long term adoption of AI-based educational technologies needs ongoing support systems, including peer learning groups, coaching, resource centers, and technical support from the institution. Many teachers stated that they were ready, but the conditions weren't supportive for them. Hence, professional development needs to be practical, sequential, and backed up by school-level policies and infrastructure. Professional development should be an ongoing process rather than a one-time strategy.

5.4.3 School leaders

Concerning the implications for school leaders, it is imperative for leaders to guarantee facilitating conditions to ensure schools possess dependable infrastructure for AI-based educational technologies, encompassing stable and cost-effective Internet connectivity, sufficient and secure AI-based educational tools, and prompt technical support. Moreover, school leaders must recognize that the availability of AI and Internet connectivity does not inherently translate into the adoption of AI in classroom practices. Professional training, such as hands-on training, AI-related workshops on technical principles, tool operations, and integration with teaching, and exemplary lessons integrating AI into EFL teaching, are expected to be provided by school

leadership. Additionally, it may be advantageous for school administrators to invest in multiple easy-to-use AI technologies to ensure that teachers and students enjoy consistency, proficiency, and assurance within the AI ecosystem. Leaders are accountable for establishing a conducive, technology-friendly environment that facilitates in-service EFL teachers' collaborative investigation of the effective application of AI-based educational technologies. In this setting, EFL teachers within a school could collaborate, sharing content and successful classroom experiences to underscore the use and significance of AI-based educational technologies.

5.4.4 Policymakers

The findings indicate that China's AI-in-education strategy has entered a critical stage. Most pre-service EFL teachers now have access to AI tools, yet their competence remains largely limited to technical use rather than pedagogical integration. This gap appears clearly as AI-TPACK scores were moderate, and teachers' behavioral intention to adopt AI-based educational technologies varied with experience and training. Simply providing access is inadequate. Therefore, first, policy must help teachers transform technical knowledge into meaningful classroom practice. The emphasis should be on using AI as a collaborative facilitator in assessment, feedback, and personalized teaching and learning.

Second, district policies must be clear, transparent, and adaptive to context. Teachers expect guidance on the legal, ethical, and safety implications of AI, as well as secure platforms that provide appropriate safeguards for both students and staff. Holmes et al. (2023) stressed the need for perspectives from stakeholders on AI ethics in education, as well as the necessity for frameworks that address ethical issues around data and algorithms. The findings of the current study also imply that policy development should be collaborative with involvement from teachers, students, and families to ensure that guidelines reflect varied perspectives and local context.

Third, rapid technological change means that policies cannot stay fixed; regular assessment and adaptation are required to keep up with emerging technologies, expanding pedagogy, and emerging risks. Policymakers can create a teacher-centered AI ecosystem by connecting infrastructure, pedagogy, and professional support, helping teachers to go from technical familiarity to confident, ethically conscious, and pedagogically meaningful AI use in practical classrooms.

5.4.5 Ethical Implications for Teacher Preparation

The findings of this study point to an increasingly urgent need to integrate AI ethics education within pre-service EFL teacher preparation programs. First, ethics should be integrated early and systematically into the teacher education curriculum. Ethics training should therefore begin as early as the freshman year or sophomore year.

Second, training in ethics should include both theoretical lectures and hands-on activities. As pre-service teachers learn how to use AI to plan courses or assess AI-generated feedback or content, they ought to be guided to consider ethical challenges, including bias, false information, and privacy violations. Learning through case studies and classroom simulations can be particularly effective.

Third, ethical training timing should align with students' pedagogical maturity. Early digital ethics courses may cover ethical tool use, privacy, and AI-generated content evaluation. When students start teaching practicum or microteaching in their junior and senior years, training should focus on applied ethics, including how to make ethical decisions when using AI to assess students, give feedback, or plan classroom activities. This developmental sequencing would ensure that ethics training grows in parallel with technical and pedagogical competence.

Finally, teacher education programs should evaluate pre-service teachers' ethical readiness to use AI in professional contexts. Assessment frameworks could include reflective notes, ethical case analyses, or scenario-based evaluations that improve teachers' capacity to recognize and respond to ethical challenges in an AI-rich teaching context. Furthermore, universities and teacher training institutions should establish clear ethical guidelines specifically adapted to AI use in education, providing both teachers and students with clear reference points.

5.5 Limitations of the Study

Despite the contributions, there are a few limitations with this study that should be noted. To begin with, there are methodological limitations. First, the participants in the present study were selected from one university. Although the sample size fully met the requirements of SEM, the sample scope may limit the generalizability of the

findings and restrict comparisons across regions, institutional contexts, or demographic groups.

Second, the study is a cross-sectional survey design, which limits the examination of the effects of specific training or professional development on pre-service EFL teachers' AI-TPACK and behavioral intention. The findings of the present study suggest the potential value of workshops, hands-on training, and peer-led learning models for AI integration of AI in EFL teaching and learning, but the study did not empirically examine or compare the effectiveness of these inventions.

Third, there are theoretical and model-related limitations. The study applied the UTAUT model expanded by four AI-TPACK constructs, which does not allow causal inferences. Some hypotheses were not supported, suggesting possible indirect or mediating relationships that were not fully tested. The model did not include moderating variables such as AI literacy, policy pressure, institutional support, or AI ethics awareness, which were found by this study to influence behavioral intention in meaningful ways.

5.6 Recommendations for Future Research

Based on the findings of the study and limitations, some recommendations for future research are made. First, future research should involve pre-service teachers from different regions and institutions in China. This will improve generalizability and make it possible to compare groups based on demographics and contextual factors.

Second, intervention-based designs are recommended to investigate the effectiveness of different training and professional development approaches for AI integration. This includes workshops, hands-on training, and peer-led learning models suggested by the present study. Future studies should compare or assess which methods most effectively build teachers' AI-TPACK and influence their behavioral intention.

Third, research on the indirect or mediating effects in AI adoption under the existing model is recommended. Future research is encouraged also to examine additional moderating factors, including AI literacy, policy pressure, institutional

support, and AI ethical awareness, to better understand the pathways and factors that influence behavioral intention.



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APPENDIX A

DOCUMENT CERTIFYING HUMAN ETHICS APPROVAL



The Mae Fah Luang University Ethics Committee on Human Research
333 Moo 1, Thasud, Muang, Chiang Rai 57100
Tel: (053) 917-170 to 71 Fax: (053) 917-170 E-mail: rec.human@mfu.ac.th

CERTIFICATE OF APPROVAL

COA: 171/2024

Protocol No: EC 24120-10

Title: Behavioral Intentions to Use AI-based Educational Technology and Professional development Needs: A Mixed-method Study on Pre-service EFL Teachers in China

Principal investigator: Mrs. Zongbi Qin

School: Liberal Arts

Funding support: Dissertation support Grant

Approval:

1) Research protocol	Version 2 Date August 8, 2024
2) Information sheet and informed consent documents	Version 2 Date August 8, 2024
3) Questionnaire	Version 1 Date July 5, 2024
4) Interview question	Version 1 Date July 5, 2024
5) Research participant recruitment information	Version 1 Date August 8, 2024
6) Principal investigator and Co-investigators	
- Mrs. Zongbi Qin	- Lecturer Maneerat Chuaychoowong, Ed.D.

The aforementioned documents have been reviewed and approved by the Mae Fah Luang University Ethics Committee on Human Research in compliance with international guidelines such as Declaration of Helsinki, the Belmont Report, CIOMS Guidelines and the International Conference on Harmonization of Technical Requirements for Registration of Pharmaceuticals for Human Use - Good Clinical Practice (ICH - GCP)

Date of Approval: August 26, 2024

Date of Expiration: August 25, 2025

Frequency of Continuing Review: 1 year

(Lecturer Jullapong Achalapong, M.D.)

Chairperson of the Mae Fah Luang Ethics Committee on Human Research



The Mae Fah Luang University Ethics Committee on Human Research
 333 Moo 1, Thasud, Muang, Chiang Rai 57100
 Tel: (053) 917-170 to 71 Fax: (053) 917-170 E-mail: rec.human@mfu.ac.th

For research protocol approved by the Mae Fah Luang University Ethics Committee on Human Research (MFU EC), the investigators must comply with the followings:

1. Strictly conduct the research as required by the protocol.
2. Use only the information sheet, consent form, questionnaire, case record form and advertisement bearing the MFU EC stamp of approval.
3. Submit a progress report (AP 05/2024) for continuing review and for renewing the approval within 30 days before expiration date.
4. When there are changes of the protocol, the investigator must submit an amendment report (AP 06/2024) with amended protocol for MFU EC approval before implementing any changes in the research (unless those changes are required urgently for the safety of the research subjects).
5. When there is any unanticipated problem or serious adverse event, the investigator must submit a safety report (AP 07/2024) as set forth in the ICH-GCP.
6. When there is any deviation or non-compliance with the approved protocol, the investigator must submit a protocol deviation/non-compliance report (AP 08/2024).
7. When the research is complete or terminated, the investigator must submit a closing report (AP 09/2024).

Please go to <https://ethic.mfu.ac.th> to download MFU EC forms for reporting.

I, as an investigator, agree to comply with the above obligation.

Zongbi Qin

(Mrs. Zongbi Qin)

Date ...27Aug, 2024.....

APPENDIX B

LIST OF EXPERTS

1. Professor Dr.Xiaobin Liu, School of Foreign Studies, South China Normal University
2. Assistant Professor Chayaporn Kaoropthai, Mae Fah Luang University
3. Dr. Phoranee Kaewbovorn, Mae Fah Luang University



APPENDIX C

THE RESULTS OF THE ITEM-OBJECTIVE CONGRUENCE (IOC) EVALUATION ITEMS-OBJECTIVES CONGRUENCE (IOC) OF FOCUS GROUP INTERVIEW QUESTIONS FOR PRE-SERVICE EFL TEACHERS

2. Items-objectives Congruence (IOC) of Focus group interview questions for pre-service EFL teachers

Objective	Focus	Interviews questions	Experts' Scores			IOC Scores	Comments
			1	2	3		
To identify the factors that influence Chinese pre-service EFL teachers' behavioral intention to use AI-based educational technologies in their future EFL teaching Practice and to explore AI-TPACK based education needs of Chinese pre-service EFL teachers.	Basic information (Personal Experience and Attitudes towards AI in Learning):	1.Can you share your own experiences with using AI-based technology in your English learning journey, and how has it impacted your learning experience and enjoyment of the process?	+1	+1	+1	1	
	Factors influencing intentions	2.What factors positively and negatively influence your intentions to adopt AI-based educational technologies in English teaching?	+1	+1	+1	1	
	Performance Expectancy	3.Could you share your perspective on the importance of using AI-based educational technology in EFL teaching and learning, and provide examples of how you believe AI can enhance your English learning or teaching practices?	+1	+1	+1	1	
	Effort Expectancy	4.In your opinion, is it easy or difficult to integrate AI technologies into English teaching? Can you elaborate on the specific challenges or facilitators you anticipate?	+1	+1	+1	1	
	Social Influence	5.Who do you think influences your decisions to use AI-based educational technologies in your classrooms, and how might their opinions or attitudes impact your decision to use AI-based educational technologies?	+1	+1	+1	1	

	Facilitating Conditions	6. What kinds of support or resources do you believe would facilitate you in effectively incorporating AI technology into your teaching practices? Can you discuss potential barriers to accessing these resources and strategies to overcome them?	+1	+1	+1	1	
	Behavioral Intentions	7. Could you tell us about your future plans for using AI-based educational technologies in your English teaching? And how likely are you to use AI-based educational technologies?	+1	+1	+1	1	
	Barriers and Concerns	8. What are the primary concerns or barriers that you anticipate encountering when considering the adoption of AI-based educational technology, and how might these concerns be addressed?	+1	+1	+1	1	
	Education Needs	9. Do you feel adequately prepared by your teacher education program to effectively utilize AI technology in teaching English? If not, what specific types of training or curriculum do you believe would enhance your confidence and preparation for integrating AI into your future English teaching?	+1	+1	+1	1	
	AI-TK (Technological Knowledge)	10. Could you share how you stay updated with AI-based educational technologies and which specific AI-powered platforms, tools, or apps you believe would benefit your future EFL teaching practices?	+1	+1	+1	1	
	AI-TCK (AI Technological	11. Which English skills do you think AI technologies can	+1	+1	+1	1	

	Content Knowledge)	improve the most?					
	AI-TPK (AI Technological Pedagogical Knowledge)	12. Can you give an example of using AI tools in your English class to help students learn or solve a problem?	+1	+1	+1	1	
	AI-TPACK (AI Technological Pedagogical Content Knowledge)	13. what is your understanding of AI Technological Pedagogical Content Knowledge (AI-TPACK)?	+1	+1	+1	1	
	AI-TPACK Education Needs	14. What areas of AI Technological Pedagogical Content Knowledge (AI Technological Knowledge, AI Technological Content Knowledge, AI Technological Pedagogical Knowledge, AI Technological Pedagogical Content Knowledge) do you feel least confident in, and why?	+1	+1	+1	1	
		15. Considering your education needs, what's your ranking of AI Technological Knowledge (AI-TK), AI Technological Content Knowledge (AI-TCK), AI Technological Pedagogical Knowledge (AI-TPK), AI Technological Pedagogical Content Knowledge (AI-TPACK)?	+1	0	+1	0.66	... ranking (from the most to the least of...)
	Preparation for AI Integration	16. Are there specific AI-related skills or knowledge areas you believe should be emphasized in pre-service teacher education programs for EFL teachers?	+1	+1	+1	1	
	Ending Question	17. Is there anything else you would like to add or discuss?	+1	+1	+1	1	

APPENDIX D

THE RESULTS OF THE ITEM-OBJECTIVE CONGRUENCE (IOC) EVALUATION ITEMS-OBJECTIVES CONGRUENCE (IOC) OF THE SURVEY QUESTIONNAIRE

1. Items-objectives Congruence (IOC) of the Survey Questionnaire: Behavioral Intention and AI -TPACK Education Needs Pre-service EFL Teacher Survey

Survey Questionnaire: Behavioral Intention and AI -TPACK Education Needs Pre-service
EFL Teacher Survey

Part A: Demographic Information

Objectives	Variables	Questionnaire item	Evaluation				
			Experts' Scores			IOC Scores	Comments
			1	2	3		
To collect vital background information		Name _____ —	+1	+1	0	0.66	In some cases, asking for the respondent's name may be inappropriate.
		Gender Male ☐ Female ☐	+1	0	+1	0.66	Should add “other ☐ ”
		Grade Freshman ☐ Sophomore ☐ Junior ☐	0	+1	+1	0.66	Where is senior?
		Experience in technology usage (Internet, computer, laptop, smartphone, tablet, WeChat, QQ, blog): _____ year(s)	+1	0	+1	0.66	Ambiguous - Do you mean experience in all technologies listed?

technology in their future EFL teaching Practice.		PE3: Using AI-based educational technologies will increase my productivity in teaching.	+1	+1	+1	1	
		PE4: If I use AI-based educational technologies for teaching English, I will increase my employment opportunities.	+1	+1	-1	1	The answer may simply be predictable, and it will be ineffective for outcome analysis.
	EE: Effort Expectancy (Adapted from Venkatesh et al., 2003)	EE1: My interaction with AI-based educational technologies for teaching English will be clear and understandable.	+1	+1	0	0.66	The content's meaning is not clear and needs further explanation.
		EE2: It will be easy for me to become skillful at using AI-based educational technologies.	+1	+1	+1	1	
		EE3: I will find AI-based educational technologies easy to use.	+1	+1	0	0.66	The question's meaning is similar to EE2.
		EE4: Learning to operate AI-based educational technologies is	+1	+1	0	0.66	The question's meaning is similar to EE2.

		Experience in AI tools usage (Squirrel AI, Youdao Translation, Baidu Translation, Liulishuo, BaiCiZhan, Shanbay English, Chaoxing Xuexitong Platform, Seewo Whiteboard): _____ month(s)	+1	0	+1	0.66	- Ambiguous
Part B: Behavioral Intentions							
Objectives	Variables	Questionnaire item	Experts' Scores			IOC Scores	Comments
			1	2	3		
To identify the factors that influence Chinese pre-service EFL teachers' behavioral intention to integrate AI-based educational	Performance Expectancy (Adapted from Venkatesh et al., 2003)	PE1: AI-based educational technologies will be useful for my teaching.	+1	+1	+1	1	
		PE2: Using AI-based educational technologies will enhance my teaching effectiveness.	+1	+1	+1	1	

		easy for me.					
	SI: Social Influence (Adapted from Venkatesh et al., 2003)	SI1: People who influence my teaching behavior think that I should use AI-based educational technologies.	+1	+1	0	0.66	The question is not clear.
		SI2: People who are important to me think that I should use AI-based educational technologies.	+1	+1	0	0.66	According to the rationale in Table 7, the target's meaning of the question should focus on those who have an impact from the AI usage of the teacher rather than those who are important to the teacher. SI3: The senior management of the school will be helpful in the use of AI-based educational technologies.
		SI3: The senior management of the school will be helpful in the use of AI-based educational technologies.	+1	+1	0	0.66	The question is not clear.

		SI4: In general, the school will support the use of AI-based educational technologies.	+1	+1	+1	1	This question should fit with the item of FC not SI.
	FC: Facilitating Conditions (Adapted from Venkatesh et al., 2003)	FC1: I will have the resources necessary to use AI-based educational technologies.	+1	+1	+1	1	
		FC2: I will have the knowledge necessary to use AI-based educational technologies.	+1	+1	+1	1	
		FC3: I think that using AI-based educational technologies fits well with the way I like to teach.	+1	+1	+1	1	This question should be in the item of EE.
		FC4: When I have difficulties in using AI-based educational technologies in teaching, specific people (IT technician or Teaching equipment administrator) will help me.	+1	+1	+1	1	

	BI: Behavioral Intention (Adapted from Venkatesh et al., 2003)	BI1: I will use AI-based educational technologies in my future teaching.	+1	+1	+1	1	
		BI2: I plan to use AI-based educational technologies often in my future teaching.	+1	+1	0	0.66	The question is similar to BI1.
		BI3: I intend to use AI-based educational technologies as much as possible in my future teaching.	+1	+1	0	0.66	The question is similar to BI3.
Part C AI-TPACK							
Objectives	Variables	Questionnaire item	Experts' scores			IOC Scores	Comments
			1	2	3		
To identify the factors that influence Chinese pre-service EFL teachers' behavioral intention to use AI-based educational technology in	AI- TK: AI-Technological Knowledge (Adapted from Celik, 2023)	AI- TK 1: I know how to interact with AI-based educational technologies in daily life.	+1	+1	+1	1	
		AI- TK 2: I know how to execute some tasks with AI-based educational technologies.	+1	+1	+1	1	

their future EFL teaching Practice and To explore AI-TPACK based education needs of Chinese pre-service EFL teachers.		AI- TK 3: I know how to initialize a task for AI-based educational technologies by text or speech.	+1	+1	+1	1	
		AI- TK 4: I have sufficient knowledge to use AI-based educational technologies.	+1	+1	+1	1	
		AI- TK 5: I am familiar with AI-based educational technologies and its technical capacities.	+1	+1	0	0.66	The question is similar to AI-TK4.
	AI- TPK: AI-Technological Pedagogical Knowledge (Adapted from Celik, 2023)	AI- TPK1: I can understand the pedagogical contribution of AI-based educational technologies in English teaching.	+1	+1	+1	1	
		AI- TPK2: I can evaluate the usefulness of feedback from AI-based educational technologies for English teaching and learning.	+1	+1	+1	1	

		AI- TPK3: I can select AI-based educational technologies for students to apply their English knowledge.	+1	+1	+1	1	
		AI- TPK4: I know how to use AI-based educational technologies to monitor students' English learning.	+1	+1	+1	1	
		AI- TPK5: I can interpret messages from AI-based educational technologies to give real-time feedback.	+1	+1	+1	1	
		AI- TPK6: I have the knowledge to select AI-based educational technologies to sustain students' English learning motivation.	+1	+1	+1	1	
	AI- TCK: AI-Technological Content Knowledge (Adapted from Celik, 2023)	AI- TCK 1: I can use AI-based educational technologies to search for educational material in English teaching.	+1	+1	+1	1	

	AI- TCK: AI-Technological Content Knowledge (Adapted from Celik, 2023)	AI- TCK 2: I am aware of various AI-based educational technologies which are used by professionals in English teaching.	+1	+1	+1	1	
		AI- TCK 3: I can use AI-based educational technologies to better understand English contents.	+1	+1	+1	1	
		AI- TCK 4: I know how to utilize my field-specific AI-based educational technologies (e.g., intelligent tutor for English).	+1	+1	+1	1	
		AI- TPACK : AI-Technological pedagogical content knowledge (Adapted from Celik, 2023)					
		AI- TPACK 1: In English teaching, I know how to use different AI-based educational technologies for adaptive feedback.	+1	+1	+1	1	
		AI- TPACK 2: In English teaching, I know how to use different AI-based educational technologies for personalized learning.	+1	+1	+1	1	

		AI- TPACK 3: In English teaching, I know how to use different AI-based educational technologies for real-time feedback.	+1	+1	+1	1	
		AI- TPACK 4: I can teach English using AI-based educational technologies with diverse teaching strategies.	+1	+1	+1	1	
		AI- TPACK 5: I can teach lessons that appropriately combine my teaching content, AI-based educational technologies, and teaching strategies.	+1	+1	+1	1	
		AI- TPACK 6: I can take a leadership role among my classmates in the integration of AI-based educational technologies into English teaching.	+1	+1	+1	1	
		AI- TPACK 7: I can select various AI-based educational technologies to monitor students' learning in my teaching process.	+1	+1	+1	1	

APPENDIX E

THE RESULTS OF THE ITEM-OBJECTIVE CONGRUENCE (IOC) EVALUATION ITEMS-OBJECTIVES CONGRUENCE (IOC) OF INTERVIEW QUESTIONS FOR IN-SERVICE EFL TEACHERS

3. Items-objectives Congruence (IOC) of Interview questions for in-service EFL teachers

Objective	Focus	Interviews questions	Experts' Scores			IOC Scores	Comments
			1	2	3		
To examine in-service EFL teachers' views on integrating AI-based educational technology in EFL teaching and EFL teacher preparation.	Basic information	1. What is the name of your School? Your name? Your age? Your English teaching experiences? Have you ever used AI technology in your teaching? If yes: Tell us about your experience of using AI-based technology in teaching. How has it been? Did you enjoy it? Why or why not?	+1	+1	+1	1	In some cases, asking for the respondent's name may be inappropriate
	Factors influencing intentions	2. What are the driving factors and hinders influencing your intention to use AI-based educational technologies?	+1	+1	+1	1	
	Performance Expectancy	3. Do you think using AI-based educational technology in EFL teaching and learning is important? Why or why not?	+1	+1	+1	1	
	Effort Expectancy	4. Do you think it is easy to use AI-based technologies in teaching English? Why or why not?	+1	+1	+1	1	
.	Social Influence	5. Who is influencing your decision to use AI-based educational technology in your English teaching practices?	+1	+1	+1	1	The scope of the question should not only focus on people but also on social environment

							s affected by the use of AI.
Facilitating Conditions	6.What support or resources do you think would make it easier for you to use AI-based educational technologies in teaching English?	+1	+1	+1	1		
Behavioral Intentions	6. What are your plans for using AI-based educational technologies in your English teaching?	+1	+1	+1	1		
Barriers and Concerns	7. What concerns or barriers do you see in using AI-based educational technologies in the EFL classroom? How can these concerns be addressed?	+1	+1	+1	1		
Professional Development Needs	8. Do you feel your teacher education program has prepared you well enough to effectively use AI-based technologies in teaching English? Why or why not?	+1	+1	+1	1		
	9. What kinds of training do you think would help you feel more prepared and confident about using AI in your future English teaching?	+1	+1	+1	1		

Future Perspectives	10. How do you think AI will change EFL education in the future, and how might this affect your decision to use AI-based educational technologies?	+1	+1	+1	1	
AI-TK (Technological Knowledge)	11. Can you keep up with AI-based educational technologies? If so, how?	+1	+1	+1	1	
	12. Which AI-powered platforms, tools or apps do you think would benefit your EFL teaching?	+1	+1	+1	1	
AI-TCK (Technological Content Knowledge)	13. Which English skills do you think AI technologies can improve the most?	+1	+1	+1	1	
AI-TPK (Technological Pedagogical Knowledge)	14. Can you give an example of using AI tools in your English class to help students learn or solve a problem?	+1	+1	+1	1	
AI-TPACK (Technological Pedagogical Content Knowledge)	15. What is your understanding of AI Technological Pedagogical Content Knowledge (AI-TPACK)?	+1	+1	+1	1	

	)	16.In your opinion, what specific AI Technological Pedagogical Content Knowledge components (AI-TK, AI-TCK, AI-TPK, AI-TPACK) are most crucial for effective EFL teaching?	+1	+1	+1	1	
	AI-TPACK based Professional Development Needs	17.What areas of AI Technological Pedagogical Content Knowledge (AI Technological Knowledge, AI Technological Content Knowledge, AI Technological Pedagogical Knowledge , AI Technological Pedagogical Content Knowledge) do you feel least confident in, and why?	+1	+1	+1	1	
		18.Considering your professional development needs, what's your ranking of AI Technological Knowledge (AI-TK) , AI Technological Content Knowledge (AI-TCK) , AI Technological Pedagogical Knowledge (AI-TPK, AI Technological Pedagogical Content Knowledge (AI-TPACK)?	+1	0	+1	0.66	... ranking (from the most to the least of...)
	Preparation for AI	19.Are there specific AI-related skills or	+1	+1	+1	1	

	Integration	knowledge areas you believe should be emphasized in EFL teacher program?					
	Suggestions for EFL teacher education	20. What suggestions do you have for preparing pre-service EFL teachers for AI-assisted English teaching?	+1	+1	+1	1	
	Ending Question	21. Regarding today's topic, anything else would you like to share with me?	+1	+1	+1	1	



APPENDIX F

THE RESULTS OF THE ITEM-OBJECTIVE CONGRUENCE (IOC) EVALUATION ITEMS-OBJECTIVES CONGRUENCE (IOC) OF INTERVIEW QUESTIONS FOR ADMINISTRATOR

4. Items-objectives Congruence (IOC) of Interview questions for administrator

Objective	Focus	Interviews questions	Experts' Scores			IOC Scores	Comments
			1	2	3		
To examine administrators' views on integrating AI-based educational technology in EFL teaching and EFL teacher preparation	Basic information	1. How many years have you been responsible for the EFL teacher program?	+1	+1	+1	1	
		2. What guidelines or policies inform the design of the EFL teacher program's plan and curriculum?	+1	+1	+1	1	
		3. Is technology integration ability cultivation a focus of the plan and curriculum for EFL teacher program?	+1	+1	+1	1	
	General Perspective on AI in EFL Education	4. What do you think about using AI technologies in English language education?	+1	+1	+1	1	

		5.What do you think about the importance of preparing pre-service EFL teachers for AI-assisted English language teaching?	+1	+1	+1	1	
	Challenges and Concerns	6.What challenges do you see in preparing pre-service EFL teachers to integrate AI technologies in their future teaching practice?	+1	+1	+1	1	

	Teacher Preparation for AI Integration	7.How do you prepare pre-service EFL teachers for using AI technologies in their future classrooms?	+1	+1	+1	1	
		8.What skills do they need for effective use of AI technologies in EFL instruction?	+1	+1	+1	1	
	Adaptability and Flexibility	9.How do you keep the EFL teacher program adaptable to changes in AI technologies and language education trends?	+1	+1	+1	1	
	Future Vision	10.How do you see the role of AI technologies evolving in EFL education in the next 5-10 years?	+1	+1	+1	1	
		11.For the integration of AI technologies in EFL education, what are the potential long-term impacts on teaching practices and EFL teacher education?	+1	+1	+1	1	

		12.For preparing pre-service EFL teachers for AI-assisted English teaching, do you think it is necessary to cooperate with computer science educators? If yes, how? and in what way? If not, why?	+1	+1	+1	1	
	Suggestions for EFL teacher education	13.For preparing pre-service EFL teachers for AI-assisted English teaching, what are your suggestions?	+1	+1	+1	1	
	Ending Question	14.Regarding today's topic, anything else would you like to share with me?	+1	+1	+1	1	



APPENDIX G

ITEMS-OBJECTIVES CONGRUENCE (IOC) OF INTERVIEW QUESTIONS FOR ICT TEACHERS

5. Items-objectives Congruence (IOC) of Interview questions for Interview questions for ICT teachers

Objective	Focus	Interviews questions	Experts' Scores			IOC Scores	Comments
			1	2	3		
To examine ICT teachers' views on integrating AI-based educational technology in EFL teaching and EFL teacher preparation	Basic information	1. What courses are you teaching this semester?	+1	+1	+1	1	
		2. Please tell me about your experiences in teaching ICT courses.	+1	+1	+1	1	
	General Perspective on AI in EFL Education	4. What do you think about using AI technologies in education?	+1	+1	+1	1	
		5. What do you think about the importance of preparing pre-service teachers for AI- assisted teaching?	+1	+1	+1	1	
	Teacher Preparation for AI Integration	6.How do you prepare pre-service teachers for using AI technologies in their future classrooms?	+1	+1	+1	1	
		7.What skills do they need for effective use of AI technologies in future teaching?	+1	+1	+1	1	
	Challenges and Concerns	8.For preparing pre-service teachers from different majors for AI-assisted teaching, what challenges do you face?	+1	+1	+1	1	
		9.For preparing pre-service EFL teachers for AI-assisted teaching, what are the challenges, concerns, and suggestions?	+1	+1	+1	1	

	Adaptability and Flexibility	10.How do you keep the ICT course adaptable to changes in AI technologies and education trends?	+1	+1	+1	1	
	Future Vision	11.How do you see the role of AI technologies evolving in education in the next 5-10 years?	+1	+1	+1	1	
		12. For the integration of AI technologies in EFL education, what are the potential long-term impacts on teaching practices and EFL teacher education?	+1	+1	+1	1	
		13. For preparing pre-service EFL teachers for AI-assisted English teaching, do you think it is necessary to cooperate with English teacher educators? If yes, how? and in what way? If not, why?	+1	+1	+1	1	
	Suggestions for EFL teacher education	14. For preparing pre-service EFL teachers for AI-assisted English teaching, what are your suggestions?	+1	+1	+1	1	
	Ending Question	15. Regarding today's topic, anything else would you like to share with me?	+1	+1	+1	1	

APPENDIX H

SEMANTIC AND CONCEPTUAL EQUIVALENCE ASSESSMENT RESULTS

Semantic and Conceptual Equivalence Assessment

Behavioral Intention and AI -TPACK Education Needs Pre-service EFL Teacher Survey

This survey is designed to uncover the factors influencing Chinese pre-service EFL teachers' intentions of using AI-based educational technologies in future teaching practice and their AI TPACK-based education needs. You are invited to assess both semantic and conceptual equivalence between the original English Version 1 and the back-translated English version 2 of the questionnaire. Please use the criteria as shown below:

- 5 means "Full equivalence"
- 4 means "High equivalence"
- 3 means "Moderate equivalence"
- 2 means "Low equivalence"
- 1 means "No equivalence"

The Original English Version 1	The Back-translated English Version 2	Semantic and Conceptual Equivalence					Comments
Experience in using any of the following technologies (Internet, computer, laptop, smartphone, tablet etc.) or applications (WeChat, QQ, blog, Tiktok ect.): _____ year(s).	Experience using any of the following technologies (including the internet, computers, laptops, smartphones, tablets, etc.) or applications (such as WeChat, QQ, blogs, Douyin, etc.): _____ years.	5 ☐	4 ☒	3 ☐	2 ☐	1 ☐	
Experience in using any of the following AI tools (ChatGPT, Kimi, Wenxin Yiyan, Tongyi Qianwen, iFlytek Mars, Doubao, iFlytek, Squirrel AI, Youdao Translation, Baidu Translation, Liulishuo, BaiCiZhan, Shanbay English, Chaoxing Xuexitong Platform, Seewo Whiteboard etc.): _____ month(s).	Experience using any of the following AI tools (including ChatGPT, Kimi, Wenxin Yiyan, Tongyi Qianwen, iFLYTEK Mars, Doubao, iFLYTEK, Squirrel AI, Youdao Translation, Baidu Translation, Liulishuo, Baicizhan, Shanbay English, Chaoxing Learning Platform, Seewo Whiteboard, etc.): _____ months.	5 ☐	4 ☒	3 ☐	2 ☐	1 ☐	
PE1: AI-based educational technologies will be useful for my teaching.	PE1: AI-based educational technologies will be useful for my teaching.	5 ☒	4 ☐	3 ☐	2 ☐	1 ☐	
PE2: Using AI-based educational technologies will enhance my teaching effectiveness.	PE2: Using AI-based educational technologies will enhance my teaching effectiveness.	5 ☒	4 ☐	3 ☐	2 ☐	1 ☐	
PE3: Using AI-based educational technologies will increase my productivity in teaching.	PE3: Using AI-based educational technologies will improve my teaching productivity.	5 ☒	4 ☐	3 ☐	2 ☐	1 ☐	Conveys the same concept of growth and enhancement.

PE4: If I use AI-based educational technologies for teaching English, I will increase my employment opportunities.	PE4: If I use AI-based educational technologies in English teaching, it will increase my employment opportunities.	5 ☐	4 ☒	3 ☐	2 ☐	1 ☐	
EE1: My interaction with AI-based educational technologies for teaching English will be clear and understandable.	EE1: My interaction with AI-based educational technologies for English teaching will be clear and easy to understand.	5 ☐	4 ☒	3 ☐	2 ☐	1 ☐	
EE2: I will find AI-based educational technologies easy to use.	EE2: I will find using AI-based educational technologies easy.	5 ☒	4 ☐	3 ☐	2 ☐	1 ☐	
EE3: It will be easy for me to become skillful at using AI-based educational technologies.	EE3: I will easily master the skills to use AI-based educational technologies.	5 ☐	4 ☒	3 ☐	2 ☐	1 ☐	Version 2 has a higher level of competence, so slight change in meanings.
EE4: Learning to operate AI-based educational technologies is easy for me.	EE4: For me, learning to operate AI-based educational technologies is easy.	5 ☒	4 ☐	3 ☐	2 ☐	1 ☐	
SI1: People who influence my teaching behavior think that I should use AI-based educational technologies.	SI1: People who influence my teaching behavior think I should use AI-based educational technologies.	5 ☒	4 ☐	3 ☐	2 ☐	1 ☐	"Think that I should" and "Think I should" does not change the concept.
SI2: People who are important (parents of the students, family members, friends ect.) to me think that I should use AI-based educational technologies.	SI2: People who are important to me (students' parents, family members, friends, etc.) think I should use AI-based educational technologies.	5 ☒	4 ☐	3 ☐	2 ☐	1 ☐	
SI3: The senior management (the principal or headmaster, department heads or directors, other senior administrators) of the school will be helpful in the use of AI-based educational technologies.	SI3: The senior management of the school (principals, deans, department heads, or other senior administrators) will provide assistance in using AI-based educational technologies.	5 ☐	4 ☒	3 ☐	2 ☐	1 ☐	Version 2 is more effective in its expression.
SI4: In general, the school (people, infrastructure, climate) will support the use of AI-based educational technologies.	SI4: Overall, the school (personnel, infrastructure, atmosphere) will support the use of AI-based educational technologies.	5 ☐	4 ☒	3 ☐	2 ☐	1 ☐	
FC1: I will have the resources necessary to use AI-based educational technologies.	FC1: I will have the necessary resources to use AI-based educational technologies.	5 ☒	4 ☐	3 ☐	2 ☐	1 ☐	
FC2: I will have the knowledge necessary to use AI-based educational technologies.	FC2: I will have the necessary knowledge to use AI-based educational technologies.	5 ☒	4 ☐	3 ☐	2 ☐	1 ☐	
FC3: I think that using AI-based educational technologies fits well with the way I like to teach.	FC3: I think that using AI-based educational technologies aligns well with my preferred teaching methods.	5 ☒	4 ☐	3 ☐	2 ☐	1 ☐	More clarity in version 2.

AI- TPK4: I know how to use AI-based educational technologies to monitor students' English learning.	AI-TPK4: I know how to use AI-based educational technologies to monitor students' English learning.	5	4	3	2	1	
		●	□	□	□	□	
AI- TPK5: I can interpret messages from AI-based educational technologies to give real-time feedback.	AI-TPK5: I can interpret the information conveyed by AI-based educational technologies to provide real-time feedback.	5	4	3	2	1	
		□	●	□	□	□	
AI-TPK6: I have the knowledge to select AI-based educational technologies to sustain students' English learning motivation.	AI-TPK6: I have the knowledge to select AI-based educational technologies that continuously motivate students to learn English.	5	4	3	2	1	
		□	●	□	□	□	
AI- TCK 1: I can use AI-based educational technologies to search for educational material in English teaching	AI-TCK1: I can use AI-based educational technologies to search for English teaching materials.	5	4	3	2	1	
		□	●	□	□	□	
AI- TCK 2: I am aware of various AI-based educational technologies which are used by professionals in English teaching.	AI-TCK2: I am aware of various AI-based educational technologies used by professionals in English teaching.	5	4	3	2	1	
		□	●	□	□	□	
AI- TCK 3: I can use AI-based educational technologies to better understand English contents.	AI-TCK3: I can use AI-based educational technologies to gain a deeper understanding of English content.	5	4	3	2	1	
		□	●	□	□	□	
AI- TCK 4: I know how to utilize my field-specific AI-based educational technologies (e.g., intelligent tutor for English, Chatbox).	AI-TCK4: I know how to apply AI-based educational technologies within my professional field (e.g., intelligent English tutoring, conversational robots, etc.).	5	4	3	2	1	Here the terms "utilize" implies effectiveness and is specific, where as "Apply" suggests practical implement and is more general.
		□	□	●	□	□	
AI- TPACK 1: In English teaching, I know how to use different AI-based educational technologies for adaptive feedback.	AI-TPACK1: In English teaching, I know how to use different AI-based educational technologies to provide adaptive feedback.	5	4	3	2	1	
		□	●	□	□	□	
AI- TPACK 2: In English teaching, I know how to use different AI-based educational technologies for personalized learning.	AI-TPACK2: In English teaching, I know how to use different AI-based educational technologies to achieve personalized learning.	5	4	3	2	1	Both ideas are the same, version 2 adds clarity.
		□	●	□	□	□	
AI- TPACK 3: In English teaching, I know how to use different AI-based educational technologies for real-time feedback.	AI-TPACK3: In English teaching, I know how to use different AI-based educational technologies for real-time feedback.	5	4	3	2	1	
		●	□	□	□	□	
AI- TPACK 4: I can teach English using AI-based educational technologies with diverse teaching strategies.	AI-TPACK4: I can use AI-based educational technologies and combine multiple teaching strategies to teach English.	5	4	3	2	1	Version 2 adds clarity and meaning remains same.
		□	●	□	□	□	

FC4: When I have difficulties in using AI-based educational technologies in teaching, specific people (IT technician or Teaching equipment administrator) will help me.	FC4: When I encounter difficulties in using AI-based educational technologies for teaching, there will be specific personnel (such as IT technicians or teaching equipment administrators) to assist me.	5 ●	4 □	3 □	2 □	1 □	
BI1: I will use AI-based educational technologies in my future teaching.	BI1: I will adopt AI-based educational technologies in my future teaching.	5 ●	4 □	3 □	2 □	1 □	
BI2: I plan to use AI-based educational technologies often in my future teaching.	BI2: I plan to frequently use AI-based educational technologies in my future teaching activities.	5 □	4 ●	3 □	2 □	1 □	"Often" is used in more casual setting -s, however both convey the same meaning.
BI3: I intend to use AI-based educational technologies as much as possible in my future teaching.	BI3: I intend to use AI-based educational technologies as much as possible in my future teaching.	5 ●	4 □	3 □	2 □	1 □	
AI- TK 1: I know how to interact with AI-based educational technologies in daily life.	AI-TK1: I know how to interact with AI-based educational technologies in daily life.	5 ●	4 □	3 □	2 □	1 □	
AI- TK 2: I know how to execute some tasks with AI-based educational technologies.	AI-TK2: I know how to use AI-based educational technologies to complete certain tasks.	5 □	4 ●	3 □	2 □	1 □	
AI- TK 3: I know how to initialize a task for AI-based educational technologies by text or speech.	AI-TK3: I know how to initiate tasks with AI-based educational technologies through text or voice.	5 □	4 ●	3 □	2 □	1 □	
AI- TK 4: I have sufficient knowledge to use AI-based educational technologies.	AI-TK4: I have sufficient knowledge to use AI-based educational technologies.	5 ●	4 □	3 □	2 □	1 □	
AI- TK 5: I am familiar with AI-based educational technologies and its technical capacities.	AI-TK5: I am familiar with AI-based educational technologies and their technical capacities.	5 □	4 ●	3 □	2 □	1 □	
AI- TPK1: I can understand the pedagogical contribution of AI-based educational technologies in English teaching.	AI-TPK1: I can understand the educational contributions of AI-based educational technologies in English teaching.	5 □	4 □	3 ●	2 □	1 □	Difference in terminology and phrasing. Version 1 focuses on teaching practices, while version 2 focuses on concepts and potential ambiguity.
AI-TPK2: I can evaluate the usefulness of feedback from AI-based educational technologies for English teaching and learning.	AI-TPK2: I can evaluate the effectiveness of feedback provided by AI-based educational technologies in English teaching and learning.	5 □	4 ●	3 □	2 □	1 □	
AI- TPK3: I can select AI-based educational technologies for students to apply their English knowledge.	AI-TPK3: I can select AI-based educational technologies for students to apply their English knowledge.	5 ●	4 □	3 □	2 □	1 □	

AI-TPACK 5: I can teach lessons that appropriately combine my teaching content, AI-based educational technologies, and teaching strategies.	AI-TPACK5: I can teach courses that effectively integrate teaching content, AI-based educational technologies, and teaching strategies.	5 ☐	4 ☐	3 ☒	2 ☐	1 ☐	The change from "Lessons" to "Courses" and "Appropriately" to "Effectively" shifts the scope slightly but the general idea is retained.
AI-TPACK 6: I can take a leadership role among my classmates in the integration of AI-based educational technologies into English teaching.	AI-TPACK6: I can take a leading role among classmates in promoting the integrated use of AI-based educational technologies in English teaching.	5 ☐	4 ☒	3 ☐	2 ☐	1 ☐	
AI-TPACK 7: I can select various AI-based educational technologies to monitor students' learning in my teaching process.	AI-TPACK7: I can select various AI-based educational technologies to monitor students' learning progress during teaching.	5 ☐	4 ☒	3 ☐	2 ☐	1 ☐	
Comments and Suggestions	Overall, semantic and conceptual equivalence is largely achieved in this translation. There are only minor differences in phrasing, with the majority of comparisons scoring 4 or 5, indicating full or high equivalence. The ranks have gone down to 3 only when the concept is changed or the specificity is shifted, however most of these also did not disrupt the overall conceptual integrity. Therefore, semantic and conceptual equivalence is very well achieved across the questionnaire items.						

Evaluator (signature): Laraib Ayub

Date: 2024年10月15日

APPENDIX I

FOCUS GROUP INTERVIEW QUESTIONS LIST 1 (FOR PRE-SERVICE EFL TEACHER)

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Focus Group Interview Questions List 1 (For pre-service EFL teacher) 焦点小组访谈问题清单 1 (职前英语教师)

Basic information (Personal Experience and Attitudes towards AI in Learning):

基本信息 (个人经历和对 AI 应用于学习的态度) :

1. Can you share your own experiences with using AI-based technology in your English learning journey, and how has it impacted your learning experience and enjoyment of the process?
1. 您能分享一下您在英语学习过程中使用 AI 技术的经历吗? 它对您的学习体验和学习乐趣有什么影响?

Factors influencing intentions:

影响意愿的因素:

2. What factors positively and negatively influence your intentions to adopt AI-based educational technologies in English teaching?
2. 在英语教学中, 哪些因素会影响您使用 AI 技术的意向? 有哪些积极因素? 有哪些消极因素?

Part A: Behavioral Intentions Based on the UTAUT Model

A 部分: 基于 UTAUT 模型的行为意愿

Performance Expectancy:

绩效预期:

3. Could you share your perspective on the importance of using AI-based educational technology in EFL teaching and learning, and provide examples of how you believe AI can enhance your English learning or teaching practices?
3. 您能否分享一下您对在英语教学中使用 AI 教育技术的重要性的看法吗? 能举例说明您认为 AI 能如何提升您的英语学习或教学效果?

Effort Expectancy:

努力预期:

4. In your opinion, is it easy or difficult to integrate AI technologies into English teaching? Can you elaborate on the specific challenges or facilitators you anticipate?
4. 在您看来, 将 AI 技术融入英语教学是容易的还是困难的? 您能详细说明您预期的具体挑战或有利因素吗?

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Social Influence:

社会影响:

5. Who do you think influences your decisions to use AI-based educational technologies in your classrooms, and how might their opinions or attitudes impact your decision to use AI-based educational technologies?

5. 您认为谁会影响您在课堂上使用 AI 教育技术的决定，他们的意见或态度会如何影响您使用 AI 教育技术的决定？

Facilitating Conditions:

便利条件:

6. What kinds of support or resources do you believe would facilitate you in effectively incorporating AI technology into your teaching practices? Can you discuss potential barriers to accessing these resources and strategies to overcome them?

6. 你认为哪些类型的支持或资源能够帮助你有效地将 AI 技术融入教学？你能讨论一下获取这些资源可能遇到的障碍以及克服它们的策略吗？

Behavioral Intentions:

行为意向:

7. Could you tell us about your future plans for using AI-based educational technologies in your English teaching? And how likely do you think you are to actually use AI-based educational technologies?

7. 能谈谈您未来在英语教学中使用 AI 教育技术的计划吗？您认为自己实际使用 AI 的教育技术的可能性有多大？

Barriers and Concerns:

障碍和担忧:

7. What are the primary concerns or barriers that you anticipate encountering when considering the adoption of AI-based educational technology, and how might these concerns be addressed?

8. 在考虑采用 AI 教育技术时，您预计会遇到哪些主要问题或者障碍？如何解决这些问题？

Education Needs:

教育需求:

9. Do you feel adequately prepared by your teacher education program to effectively utilize AI technology in teaching English? If not, what specific types of training or curriculum do you

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believe would enhance your confidence and preparation for integrating AI into your future English teaching?

9.您认为您的目前的教育和课程为您在英语教学中有效利用 AI 技术做好准备了吗？如果没有，您认为哪些具体的培训或课程可以增强您将 AI 技术融入英语教学的信心和能力？

Part B: Perceptions on AI-TPACK

B 部分：对整合 AI 技术的学科教学知识的看法

AI-TK (Technological Knowledge):

AI-TK (AI 技术知识) :

10. Could you share how you stay updated with AI-based educational technologies and which specific AI-powered platforms, tools, or apps you believe would benefit your future EFL teaching practices?

10. 您能否分享一下您如何及时了解 AI 教育技术最新动态的， 您认为哪些 AI 平台、AI 工具或 AI 应用程序将有利于您未来的英语教学？

AI-TCK (Technological Content Knowledge):

AI-TCK (技术内容知识) :

11. Which English skills do you think AI technologies can improve the most?

12. 您认为 AI 技术对提高哪些英语技能最有效？

AI-TPK (Technological Pedagogical Knowledge):

13. Can you give an example of using AI tools in your English class to help students learn or solve a problem?

12. 您能举一个在英语课上使用 AI 工具帮助学生或解决问题的例子吗？

AI-TPACK (Technological Pedagogical Content Knowledge):

整合 AI 技术的学科教学知识

13. what is your understanding of AI Technological Pedagogical Content Knowledge (AI-TPACK)?

13. 您是如何理解整合 AI 技术的学科教学知识(AI- TPACK)的？

AI-TPACK Education Needs:

AI-TPACK 教育需求:

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14.What areas of AI Technological Pedagogical Content Knowledge (AI Technological Knowledge, AI Technological Content Knowledge, AI Technological Pedagogical Knowledge , AI Technological Pedagogical Content Knowledge) do you feel least confident in, and why?

14.您对整合 AI 技术的学科教学知识的哪些领域（AI 技术知识(AI-TK)、整合 AI 技术的学科知识（AI-TCK）、整合 AI 技术的教学知识（AI-TPK）、整合 AI 技术的学科教学知识（AI-TPACK））最没有信心，为什么？

15.Considering your education needs, what's your ranking (from the most to the least of need) of AI Technological Knowledge (AI-TK) , AI Technological Content Knowledge (AI-TCK) , AI Technological Pedagogical Knowledge (AI-TPK, AI Technological Pedagogical Content Knowledge (AI-TPACK) ?

15.根据您的教育需求，您对 AI 技术知识(AI-TK)、整合 AI 技术的学科知识（AI-TCK）、整合 AI 技术的教学知识（AI-TPK）、整合 AI 技术的学科教学知识（AI-TPACK）的排序（从高需求到低需求）是怎么样的？

Preparation for AI Integration:

AI 应用准备:

16.Are there specific AI-related skills or knowledge areas you believe should be emphasized in pre-service teacher education programs for EFL teachers?

16. 您认为职前英语教师的教育项目中应该强调哪些 AI 相关技能或知识领域？

Ending Question:

结束问题:

17.Is there anything else you would like to add or discuss?

17.关于今天的话题，您还有什么要补充或讨论的吗？

APPENDIX J

INTERVIEW QUESTIONS LIST 2 (FOR IN-SERVICE EFL TEACHER)

Version.....I..... Date.....July 5, 2024.....

Interview Questions List 2 (For in-service EFL teacher)

访谈问题清单 2 (在职英语教师)

Basic information:

1. What is the name of your School? Your age? Your English teaching experiences? Have you ever used AI technology in your teaching? If yes, Tell us about your experience of using AI-based technology in teaching. How has it been? Did you enjoy it? Why or why not?

请问您来自哪个学校? 您几岁? 请分享一下您的英语教学经历。您在英语教学中使用过 AI 吗? 如果有的话, 请您分享一下您在英语教学中使用 AI 的经历。使用的体验如何, 您喜欢吗? 为什么喜欢或不喜欢?

Factors influencing intentions:

2. What are the driving factors and hinders influencing your intention to use AI-based educational technologies?

影响您使用 AI 技术意愿的驱动因素和阻碍因素有哪些?

Part A: Behavioral Intentions Based on the UTAUT Model

Performance Expectancy:

3. Do you think using AI-based educational technology in EFL teaching and learning is important? Why or why not?

您认为在英语教学中使用 AI 技术重要吗? 为什么重要或不重要?

Effort Expectancy:

4. Do you think it is easy to use AI-based technologies in teaching English? Why or why not?

您认为在英语教学中使用 AI 技术容易吗? 为什么容易或什么难?

Social Influence:

5. Who is influencing your decision to use AI-based educational technology in your English teaching practices? (probe: Is it policymakers, administrators, fellow teachers, students, or parents?) Who do you feel has the most influence on your decision? And how do their opinions affect your decision?

谁会影响您在教学中使用人工智能的决定? (是政策制定者、管理者、同事教师、学生还是家长? 你觉得谁对你的决定影响最大? 他们的意见如何影响你的决策?

Facilitating Conditions:

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6. What support or resources do you think would make it easier for you to use AI -based educational technologies in teaching English?

您认为哪些支持或者资源会让您在英语教学中使用 AI 教育技术变得更容易?

Behavioral Intentions:

7. What are your plans for using AI-based educational technology in your English teaching?

对于在英语教学中使用 AI 教育技术, 您有什么计划?

Barriers and Concerns:

8. What concerns or barriers do you see in using AI-based educational technology in the EFL classroom? How can these concerns be addressed?

对于在英语课堂中使用 AI 教育技术, 您有什么担忧或您认为有什么阻碍? 如何解决这些问题?

Professional Development Needs:

9. Do you feel your teacher education program has prepared you well enough to effectively use AI technology in teaching English? why or why not?

对于在英语教学中有效使用 AI 教育技术, 您认为您的师范教育帮助您做好充分的准备了吗? 为什么或为什么没有?

10. What kinds of training do you think would help you feel more prepared and confident about using AI in your future English teaching?

您认为什么样的培训可以帮助您更好的做好准备和增强您在未来教学中使用 AI 教育技术的信心?

Future Perspectives:

11. How do you think AI will change EFL education in the future, and how might this affect your decision to use AI-based educational technologies?

您认为 AI 将如何改变未来的英语教育? 这会如何影响到您使用 AI 教育技术的决定?

Part B: Perceptions on AI-TPACK

AI-TK (Technological Knowledge):

12. Can you keep up with AI-based educational technologies? If so, how?

您能跟上 AI 教育技术的发展吗? 如果可以, 您是如何做到的? (如果不可以, 为什么?)

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13. Which AI-powered platforms, tools or apps do you think would benefit your EFL teaching?

您认为哪些 AI 赋能的平台、工具或者应用会对您的英语教学有所帮助？

AI-TCK (Technological Content Knowledge):

14. Which English skills do you think AI technology can improve the most?

您认为 AI 技术可以最有效地提高哪些英语技能？

AI-TPK (Technological Pedagogical Knowledge):

15. Can you give an example of using AI tools in your English class to help students learn or solve a problem?

您能举一个在课堂上使用 AI 工具帮学生学习或解决问题的例子吗？

AI-TPACK (Technological Pedagogical Content Knowledge):

16. What's your understanding of AI Technological Pedagogical Content Knowledge (AI-TPACK)?

您是如何理解整合 AI 技术的学科教学知识(AI- TPACK)的？

17. In your opinion, what specific AI Technological Pedagogical Content Knowledge components (AI-TK, AI-TCK, AI-TPK, AI-TPACK) are most crucial for effective EFL teaching?

在您看来，整合 AI 技术的学科教学知识的哪些领域（AI 技术知识（AI-TK）、整合 AI 技术的学科知识（AI-TCK）、整合 AI 技术的教学知识（AI-TPK）、整合 AI 技术的学科教学知识（AI-TPACK））对于有效英语教学最为关键？

AI-TPACK based Professional Development Needs:

18. What areas of AI Technological Pedagogical Content Knowledge (AI Technological Knowledge, AI Technological Content Knowledge, AI Technological Pedagogical Knowledge , AI Technological Pedagogical Content Knowledge) do you feel least confident in, and why?

您对整合 AI 技术的学科教学知识的哪些领域（AI 技术知识、整合 AI 技术的学科知识、整合 AI 技术的教学知识、整合 AI 技术的学科教学知识）最没有信心，为什么？

19. Considering your professional development needs, what's your ranking (from the most to the least of need) of AI Technological Knowledge (AI-TK), AI Technological Content Knowledge

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(AI-TCK), AI Technological Pedagogical Knowledge (AI-TPK), AI Technological Pedagogical Content Knowledge (AI-TPACK)?

根据您的职业发展需求，您对以下的内容的排序（从最需要到最不需要）是怎怎样的：AI 技术知识（AI-TK）、AI 技术内容知识（AI-TCK）、AI 技术教学法知识（AI-TPK）、AI 技术教学内容知识（AI-TPACK）。

根据您的职业发展需求，您对 AI 技术知识（AI-TK）、整合 AI 技术的学科知识（AI-TCK）、整合 AI 技术的的教学知识（AI-TPK）、整合 AI 技术的学科教学知识（AI-TPACK）的排序（从高需求到低需求）是怎怎样的？

Preparation for AI Integration:

20. Are there specific AI-related skills or knowledge areas you believe should be emphasized in EFL teacher program?

您认为在针对职前英语教师的教育项目中应该强调哪些 AI 相关技能或知识领域？

Suggestions for EFL teacher education:

21. What suggestions do you have for preparing pre-service EFL teachers for AI-assisted English teaching?

为了让职前英语教师为 AI 辅助的英语教学做好准备，您有什么建议？

Ending Question:

22.Regarding today's topic, anything else would you like to share with me ?

对于今天的话题，您还有什么想要和我分享吗？

APPENDIX K

INTERVIEW QUESTIONS LIST 3 (FOR ADMINISTRATOR)

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Interview Questions List 3 (For administrator)

访谈问题清单 3（专业负责人）

General information:

1. How many years have you been responsible for the EFL teacher program?
您负责英语专业多少年了？
2. What guidelines or policies inform the design of the EFL teacher program's plan and curriculum?
英语专业的培养方案和课程设计是依据哪些指导方针或政策制定的？
3. Is technology integration ability cultivation a focus of the plan and curriculum for EFL teacher program?
在英语专业的培养方案和课程设计中，是否注重技术整合能力的培养？

General Perspective on AI in EFL Education:

4. What do you think about using AI technologies in English language teaching and leaning?
您如何看待在英语教学和英语学习中使用人工智能技术？
5. What do you think about the importance of preparing pre-service EFL teachers for AI-assisted English language teaching?
您如何看待培养职前英语教师使用人工智能进行辅助教学的重要性？

Challenges and Concerns:

6. What challenges do you see in preparing pre-service EFL teachers to integrate AI technologies in their future teaching practice?
对于培养职前英语教师在未来教学中融入 AI 技术，您认为有哪些挑战？

Teacher Preparation for AI Integration:

7. How do you prepare pre-service EFL teachers for using AI technologies in their future classrooms?
您如何培养职前英语教师以使得他们有能力在未来教学中使用人工智？
8. What skills do they need for effective use of AI technologies in EFL instruction?

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为了在未来的英语教学中有效的使用 AI 技术，您认为职前教师需要具备哪些技能？

Adaptability and Flexibility:

9. How do you keep the EFL teacher program adaptable to changes in AI technologies and language education trends?

您是如何调整英语教师教育项目以适应人工智能技术及教育趋势变化的？

Future Vision:

10. How do you see the role of AI technologies evolving in EFL education in the next 5-10 years?

您如何看待 AI 未来 5-10 年在英语教育发展中所充当的角色？

11. For the integration of AI technologies in EFL education, what are the potential long-term impacts on teaching practices and EFL teacher education?

在英语教育中融入人工智能技术，可能对英语教学和英语教师教育产生哪些长期影响？

12. For preparing pre-service EFL teachers for AI-assisted English teaching, do you think it is necessary to cooperate with computer science educators? If yes, how? and in what way? If not, why?

为了让职前英语教师为 AI 辅助的英语教学做好准备，您认为有必要和计算机科学的教育者合作吗？如果需要合作，如何合作？以何种方式？如果不需要合作为什么？

Suggestions:

13. For preparing pre-service EFL teachers for AI-assisted English teaching, what are your suggestions?

为了培养职前英语教师为 AI 辅助的英语教学做好准备，您有什么建议？

Ending Question:

14. Regarding today's topic, anything else would you like to share with me?

对于今天的话题，您还有什么想要和我分享吗？

APPENDIX L

INTERVIEW QUESTIONS LIST 4 (FOR ICT TEACHERS)

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Interview Questions List 4 (For ICT teachers)

访谈问题清单 4（信息技术教师）

General information:

1. What courses are you teaching this semester?
您本学期教授哪些课程?
2. Please tell me about your experiences in teaching ICT courses.
请您分享一下教授大学计算机课程的经历。

General Perspective on AI in Education:

3. What do you think about using AI technologies in education?
您如何看待在教学中使用人工智能?
4. What do you think about the importance of preparing pre-service teachers for AI-assisted teaching?
您如何看待培养职前教师使用 AI 能进行辅助教学的重要性?

Teacher Preparation for AI Integration:

5. How do you prepare pre-service teachers for using AI technologies in their future classrooms?
您是如何培养职前教师以使得他们有能力在未来教学中 AI 技术?
6. What skills do they need for effective use of AI technologies in future teaching?
为了在未来的教学中有效的使用 AI 技术, 您认为职前教师需要具备哪些技能?

Challenges and Concerns:

7. For preparing pre-service teachers from different majors for AI-assisted teaching, what challenges do you face?
培养不同专业的职前教师进行 AI 能辅助教学, 您所面临的挑战是什么?
8. For preparing pre-service EFL teachers for AI-assisted teaching, what are the challenges, concerns, and suggestions?

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对于培养职前英语教师在未来进行 AI 辅助教学，您认为有哪些挑战，您有哪些担忧和建议？

Adaptability and Flexibility:

9.How do you keep the ICT course adaptable to changes in AI technologies and education trends?

您是如何调整大学计算机课程以适应 AI 技术及教育趋势变化的？

Future Vision and cooperation

10.How do you see the role of AI technologies evolving in education in the next 5-10 years?

您如何看待 AI 技术未来 5-10 年在教育发展中所充当的角色？

11.For the integration of AI technologies in EFL education, what are the potential long-term impacts on teaching practices and EFL teacher education?

在英语教育中融入 AI 技术，可能对英语教学和英语教师教育产生哪些长期影响？

12.For preparing pre-service EFL teachers for AI-assisted English teaching, do you think it is necessary to cooperate with English teacher educators? If yes, how? and in what way? If no, why?

为了让职前英语教师为 AI 辅助的英语教学做好准备，您认为有必要和英语育者合作吗？如果需要合作，如何合作？以何种方式？如果不需要合作，为什么？

Suggestions:

13.For preparing pre-service EFL teachers for AI-assisted English teaching, what are your suggestions?

为了培养职前英语教师为 AI 辅助的英语教学做好准备，您有什么建议？

Ending Question:

14.For the topic today, anything else you would like to share with me?

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对于今天的话题，您还有什么想要和我分享吗？



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