Technological Pedagogical Content Knowledge (TPACK) and Suitability of Educational Technology (EdTech) on Teaching and Learning Among Chinese Language Teachers in China

by

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DECLARATION

I hereby declare that the work presented in this thesis was conducted in full compliance with the regulations of Universiti Malaysia Sarawak (UNIMAS). Except where proper acknowledgment is given, this work is solely the effort of the author. This thesis has not been accepted for the award of any other degree and is not being **concurrently** submitted for any other academic qualification.

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ABSTRACT

China's rapid digital transformation in education, supported by initiatives such as the *Smart Education of China (SEC)* platform and AI-driven reforms, has accelerated the integration of Educational Technology (EdTech) into classroom teaching. For Chinese language (CL) education, however, successful adoption depends not only on access to tools but also on teachers' ability to integrate them meaningfully through Technological Pedagogical Content Knowledge (TPACK).

This study investigated the relationship between TPACK, EdTech suitability, and teacher readiness among in-service CL teachers in China. A quantitative, cross-sectional survey was conducted using validated instruments to measure six TPACK components, four EdTech suitability dimensions (Educational Effectiveness, Content Fidelity, Feedback, Professional Development), and three readiness factors (Confidence, Digital Skills, Perceived Barriers). Data were analyzed using ANOVA, correlation, regression, and structural equation modeling (SEM).

Findings revealed consistently high perceptions of EdTech suitability across demographic groups, with no significant differences by age, experience, or education level. Strong correlations were found between TPACK and both Educational Effectiveness and Content Fidelity, while Feedback showed moderate correlations and Professional Development only weak associations. Regression results confirmed that TPACK predicted 45–55% of variance in EdTech suitability. Moreover, EdTech suitability significantly predicted teacher readiness, indicating that when tools are perceived as effective and content-accurate, teachers report higher confidence and stronger digital skills, with fewer barriers.

The study extends the TPACK framework by explicitly linking teacher competence with EdTech suitability and readiness, offering theoretical, practical, and policy insights for advancing meaningful technology integration in CL education.

Keywords: TPACK, EdTech suitability, teacher readiness, Chinese language education, China

Pengetahuan Teknologi Pedagogi Kandungan (TPACK) dan Kesesuaian Teknologi Pendidikan (EdTech) dalam Pengajaran dan Pembelajaran dalam Kalangan Guru Bahasa Cina di China

ABSTRAK

Transformasi digital dalam pendidikan di China semakin pesat dengan sokongan inisiatif seperti Smart Education of China (SEC) dan pembaharuan berasaskan kecerdasan buatan (AI). Perubahan ini mempercepatkan integrasi Teknologi Pendidikan (EdTech) dalam bilik darjah. Namun, bagi pendidikan Bahasa Cina (CL), kejayaan penggunaan EdTech tidak hanya bergantung pada akses kepada alat digital, tetapi juga pada keupayaan guru untuk mengintegrasikannya secara bermakna melalui kerangka ***Technological Pedagogical Content Knowledge (TPACK)****.*

Kajian ini meneliti hubungan antara TPACK, kesesuaian EdTech, dan kesiapsiagaan guru dalam kalangan guru CL yang sedang berkhidmat di China. Reka bentuk kuantitatif rentas-seksyen digunakan dengan instrumen yang disahkan bagi mengukur enam komponen TPACK, empat dimensi kesesuaian EdTech (Keberkesanan Pendidikan, Kesetiaan Kandungan, Maklum Balas, Pembangunan Profesional), serta tiga faktor kesiapsiagaan (Keyakinan, Kemahiran Digital, Halangan yang Dirasai). Analisis data melibatkan ANOVA, korelasi, regresi, dan pemodelan persamaan berstruktur (SEM).

Dapatan menunjukkan bahawa guru mempunyai persepsi yang tinggi terhadap kesesuaian EdTech merentasi kumpulan demografi, tanpa perbezaan signifikan berdasarkan umur, pengalaman, atau kelayakan. Korelasi kuat ditemui antara TPACK dengan Keberkesanan Pendidikan dan Kesetiaan Kandungan, manakala Maklum Balas menunjukkan korelasi sederhana dan Pembangunan Profesional lemah. Regresi mengesahkan bahawa TPACK meramal 45–55% varians dalam kesesuaian EdTech. Selain itu, kesesuaian EdTech secara signifikan meramal kesiapsiagaan guru, terutamanya dari segi keyakinan dan kemahiran digital.

Kajian ini memperluaskan kerangka TPACK dengan menghubungkan kompetensi guru, kesesuaian EdTech, dan kesiapsiagaan, serta menawarkan implikasi teori, praktikal, dan dasar untuk memperkukuh integrasi teknologi dalam pendidikan Bahasa Cina.

Kata Kunci*:* *TPACK, kesesuaian EdTech, kesiapsiagaan guru, pendidikan Bahasa Cina, China*

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LIST OF ABBREVIATIONS

TPACK	Technological Pedagogical Content Knowledge
EdTech	Educational Technology
CL	Chinese Language
SEC	Smart Education of China
AI	Artificial Intelligence
EE	Educational Effectiveness
CF	Content Fidelity
FB	Feedback
PD	Professional Development
C	Confidence (Teacher Readiness & Attitudes)
DS	Digital Skills (Teacher Readiness & Attitudes)
PB	Perceived Barriers (Teacher Readiness & Attitudes)
TK	Technological Knowledge (TPACK component)
PK	Pedagogical Knowledge (TPACK component)
CK	Content Knowledge (TPACK component)
TPK	Technological Pedagogical Knowledge (TPACK component)
TCK	Technological Content Knowledge (TPACK component)
PCK	Pedagogical Content Knowledge (TPACK component)
SEM	Structural Equation Modeling
CFA	Confirmatory Factor Analysis
CGS	Centre for Graduate Studies
UNIMAS	Universiti Malaysia Sarawak
SDGs	Sustainable Development Goals

CHAPTER 1:

INTRODUCTION

1.1 Overview

Chapter 1 discusses the background of the study and problem statement in relation to current issues surrounding digital education and technology integration in Chinese language teaching. The research objectives are outlined together with corresponding research questions and hypotheses, ensuring alignment between the study's aims and its methodological direction. This chapter also presents the scope of the study, its significance from theoretical, practical, and policy perspectives, as well as the conceptual and operational definitions of key terms. The chapter concludes with a brief summary highlighting its role in establishing the foundation for the research.

1.2 Introduction

China's education system is undergoing a major digital transformation, with technology playing a central role in teaching and learning. The launch of the Smart Education of China (SEC) platform in 2022 has significantly expanded digital access, integrating more than 519,000 educational institutions and surpassing 164 million registered users by April 2025 (State Council of the People's Republic of, 2025). In parallel, the Ministry of Education has prioritized AI-driven reforms, embedding artificial intelligence into curricula and teacher development, further accelerating reliance on educational technology (Reuters, 2025).

For Chinese language (CL) education, these reforms present unique opportunities and challenges. Digital tools can enhance vocabulary acquisition, listening and speaking practice, and character recognition. Yet, research consistently shows that the effectiveness of technology use depends not on tool availability alone, but on teachers' ability to design and deliver pedagogically meaningful learning experiences (Y. Zhang & P. Wu, 2023; B. Zou et al., 2025).

The Technological Pedagogical Content Knowledge (TPACK) framework provides a powerful lens to understand this integration, emphasizing the balance among teachers' technological, pedagogical, and content knowledge (Mishra & Koehler, 2006a). Recent adaptations of TPACK, such as AI-TPACK and Culture-DPACK, highlight the need for alignment between technology use and the specific cultural and disciplinary contexts of CL teaching (M. Aydin et al., 2024; Q. Xu et al., 2025). Despite this, evidence shows wide variability in Chinese teachers' digital competence and TPACK profiles, shaped by institutional supports, workload, and professional development opportunities (Lei et al., 2025; Liu et al., 2025).

Beyond knowledge, the suitability of EdTech tools is increasingly recognized as a key determinant of integration success. Suitability refers to whether tools are fit for purpose in terms of:

- Content fidelity, or alignment of digital resources with intended learning goals (Vanacore et al., 2025);
- Feedback quality, enabling timely and actionable responses to learners (Huang et al., 2025);
- Educational effectiveness, demonstrated through improved language learning outcomes (L. Wang et al., 2024); and
- Professional development support, which empowers teachers to select and implement tools effectively (Fütterer et al., 2025; Lindvall, 2025).

However, many CL teachers in China continue to face uneven readiness, citing differences in digital confidence, skills, and perceived barriers. These factors often result in fragmented adoption and inconsistent learning outcomes across schools and sectors (Lei et al., 2025; Li et al., 2025).

Given these realities, there remains a knowledge gap in how Chinese language teachers' TPACK competencies interact with the suitability of EdTech in practice. Specifically, little is known about (i) differences in EdTech adoption across demographics such as age, experience, and education level; (ii) the relationships between TPACK components and EdTech suitability; (iii) which aspects of TPACK best predict effective tool use; and (iv) teachers' readiness and attitudes toward EdTech integration. Addressing these gaps is essential for designing targeted professional development, guiding EdTech curation on platforms like SEC, and ensuring meaningful improvements in CL teaching and learning (Chen et al., 2023; Ministry of Education of the People's Republic of, 2025).

1.3 Background of the Study

The integration of Educational Technology (EdTech) has become a defining hallmark of 21st-century education, fundamentally reshaping how teachers teach and how students learn across the globe. The shift toward digital education is not merely a technological phenomenon but also a profound pedagogical and cultural transformation. Governments and institutions increasingly view EdTech as a catalyst for enhancing teaching quality, expanding access, and promoting equity in learning. In China, this transformation has been particularly pronounced due to large-scale national policies and strategic investments in digitalization.

One of the most significant initiatives is the Smart Education of China (SEC) platform, a nationwide system designed to connect educational institutions, consolidate resources, and promote digital innovation in classrooms. By April 2025, the platform had registered over 164 million users, spanning universities, primary and secondary schools, and vocational institutions (State Council of the People's Republic of, 2025). This digital ecosystem aligns closely with the Ministry of Education's (MOE) agenda for AI-enabled educational reform, which emphasizes the strategic use of artificial intelligence, big data, cloud computing, and interactive tools to improve both teaching quality and educational equity (Reuters, 2025). The SEC thus embodies China's vision of creating a digitally empowered education system capable of meeting the demands of an innovation-driven society.

Within this broader wave of digital transformation, Chinese Language (CL) education occupies a particularly critical position. As a core subject in the national curriculum, Chinese language teaching is not only central to students' academic development but also serves as a cultural vehicle for transmitting linguistic heritage, values, and national identity. Teaching CL requires high levels of pedagogical rigor, cultural authenticity, and linguistic sensitivity, making it a complex subject for technology-mediated instruction. Digital technologies—such as AI-powered writing assistants, intelligent tutoring systems, interactive whiteboards, language learning mobile apps, and speech recognition tools—are increasingly integrated into CL classrooms. These tools support essential learning activities such as vocabulary acquisition, character recognition, reading comprehension, grammar instruction, and oral communication practice (L. Wang et al., 2024).

Despite their promise, evidence shows that technology adoption alone does not guarantee educational improvement. Success depends largely on how effectively teachers integrate these tools into pedagogy (Y. Zhang & P. Wu, 2023; B. Zou et al., 2025). For instance, while AI-based tools can assist with character stroke order or pronunciation drills, their impact is limited unless teachers' design instructional strategies that embed these technologies meaningfully within the curriculum. Thus, teacher competence and evaluative judgment play a decisive role in ensuring that EdTech use is pedagogically sound and contextually appropriate.

To analyze how teachers acquire and apply such competence, scholars often employ the Technological Pedagogical Content Knowledge (TPACK) framework (Mishra & Koehler, 2006). TPACK conceptualizes teacher knowledge as an integration of three domains—technological knowledge (TK), pedagogical knowledge (PK), and content knowledge (CK)—along with their intersections (TPK, TCK, and PCK). More recent refinements, such as AI-TPACK and Cultural-DPACK, extend this framework to emphasize that effective technology use in language education also requires sensitivity to cultural nuances, ethical considerations, and AI-driven instructional design (B. Aydin et al., 2024; Q. Xu et al., 2025). Nevertheless, empirical studies in China highlight persistent gaps in teachers' TPACK competencies, particularly in aligning digital practices with curricular standards, student needs, and cultural expectations (Lei et al., 2025; Qiu et al., 2022).

Equally important, but often overlooked, is the suitability of EdTech tools. Suitability refers to the degree to which digital resources meet pedagogical and contextual demands, including content fidelity, feedback mechanisms, educational effectiveness, and opportunities for sustained professional development (Fütterer et al., 2025; Huang et al., 2025; Vanacore et al., 2025). In CL teaching, suitability becomes particularly critical because of the need to accurately capture tonal pronunciation, idiomatic expressions, and classical text interpretations. Tools that fail to preserve these nuances risk producing distorted representations of the language, resulting in superficial engagement rather than meaningful learning (Fütterer et al., 2025).

Furthermore, while national and institutional investments have expanded digital access, teacher readiness and attitudes toward EdTech remain uneven. Many Chinese language teachers report enthusiasm for innovation but continue to face confidence gaps, limited digital skills, and persistent barriers such as heavy workloads, insufficient technical support, and uncertainty about best practices (Li et al., 2025; Liu et al., 2025). These disparities contribute to inconsistent integration across schools, undermining the equity goals of China's digital education strategy.

Against this backdrop, there is a pressing need to investigate how TPACK competencies and EdTech suitability interact to influence teacher readiness and attitudes. Understanding these dynamics can provide evidence-based guidance for:

1. **Professional development programs**, by tailoring training to strengthen TPACK and evaluative skills for EdTech suitability.
2. **Policy initiatives**, by aligning investments in digital platforms with the real needs of teachers and classrooms.
3. **Classroom practice**, by equipping teachers to integrate technology in ways that are pedagogically rigorous, culturally appropriate, and linguistically accurate.

This study responds to that need by examining the interrelationships between TPACK components, EdTech suitability factors, and teacher readiness/attitudes. Through this analysis, it aims to generate insights that not only advance theoretical understanding but also inform practical strategies for ensuring that the digital transformation of Chinese language education is effective, equitable, and sustainable.

1.4 Statement of the Problem

The rapid expansion of Educational Technology (EdTech) in China has fundamentally reshaped the teaching and learning landscape, particularly in the field of language education. For Chinese language (CL) teachers, the integration of digital tools is no longer a matter of choice but a pedagogical necessity to meet the needs of digitally native students in an increasingly technology-driven society (Godwin-Jones, 2022; Oecd, 2021). However, effective use of EdTech requires more than access to digital platforms or government mandates; it demands that teachers be able to align technological tools with pedagogical strategies and subject matter expertise. The Technological Pedagogical Content Knowledge (TPACK) framework (Koehler & Mishra, 2009; Mishra & Koehler, 2006a) provides a robust lens for analyzing this integration, as it captures the interdependent roles of technological knowledge (TK), pedagogical knowledge (PK), and content knowledge (CK) and their intersections.

Despite significant government investments and reforms, several critical challenges persist: First, there is limited empirical evidence on how different demographic factors (e.g., age, years of teaching experience, and education level) shape Chinese language teachers' perceptions and adoption of EdTech. Prior research suggests that such factors may influence how teachers evaluate core components of EdTech suitability—including educational effectiveness (EE), content fidelity (CF), feedback (FB), and professional development (PD) (Ghavifekr & Rosdy, 2015; Lim et al., 2016). Without empirical clarity, it remains uncertain whether differences in teacher background create disparities in technology integration practices across schools and regions.

Second, existing research indicates that the relationship between teachers' TPACK competencies and EdTech integration is not always consistent. For example, Chai et al. (2022) found that while teachers with high Technological Knowledge (TK) frequently used digital tools, this did not necessarily translate into pedagogically meaningful integration unless Technological Pedagogical Knowledge (TPK) and Technological Content Knowledge (TCK) were also well developed. Similarly, Voogt et al. (2015) reported that some teachers who scored highly on overall TPACK still employed technology in a substitutional manner (e.g., using PowerPoint or digital worksheets) rather than in transformative ways that support higher-order learning. In language education contexts, studies have shown that teachers may possess adequate technical skills but struggle to align tools with linguistic objectives such as pronunciation accuracy, character formation, or discourse practice, leading to superficial or fragmented implementation (Chai et al., 2022; Zhang & Tang, 2021). Misalignments between teachers' technological, pedagogical, and content expertise and the functionalities of EdTech tools frequently result in underutilization, superficial adoption, or ineffective classroom integration. These misalignments may contribute to inconsistent student outcomes and reinforce skepticism about the educational value of technology (Chai et al., 2022; Joke Voogt et al., 2015). A clearer understanding of how specific TPACK dimensions influence teachers' judgments of EdTech suitability is therefore essential.

Third, while the TPACK framework acknowledges the interplay of multiple knowledge domains, little is known about which specific TPACK components are the strongest predictors of successful technology integration in the context of CL education. For example, it is unclear whether technological knowledge (TK) alone, or the more integrative domains such as technological content knowledge (TCK) or technological pedagogical knowledge (TPK), exert greater influence on teachers' ability to meaningfully apply EdTech tools. Without identifying these predictors, professional training programs risk remaining generic and fragmented, failing to equip teachers with targeted competencies that directly improve teaching and learning outcomes (Ertmer & Ottenbreit-Leftwich, 2020; Zhang & Tang, 2021).

Fourth, although national education policies strongly encourage digitalization, many teachers still experience challenges with readiness and attitudes toward EdTech integration. These challenges often manifest in uneven levels of confidence, digital skills, and perceived barriers, including heavy workloads, inadequate institutional support, and uncertainty about effective practices. Such readiness gaps create a persistent misalignment between policy aspirations and classroom realities, resulting in fragmented practices, superficial adoption, and inequities in student learning outcomes (Chen et al., 2023; Willermark, 2021a).

Taken together, these issues reveal a clear research gap. While China has made rapid progress in expanding digital infrastructure and promoting technology-driven education, there remains insufficient understanding of how teacher demographics, TPACK competencies, and readiness factors interact with EdTech suitability to shape effective classroom integration. Addressing this gap is particularly critical in CL education, where cultural authenticity, linguistic fidelity, and pedagogical rigor are paramount.

Therefore, this study seeks to investigate the relationships between TPACK components, EdTech suitability dimensions, and teacher readiness and attitudes in the context of Chinese language education. By addressing these gaps, the research aims to provide a comprehensive, evidence-based understanding of how teachers can align their technological, pedagogical, and content knowledge with context-appropriate EdTech tools. Ultimately, the study seeks to inform professional development programs, EdTech adoption policies, and classroom practices, thereby enhancing both teaching quality and student learning outcomes in Chinese language classrooms.

1.5 Objectives of the Study

1.5.1 General Research Objective

The general objective of this study is to investigate the relationship between Technological Pedagogical Content Knowledge (TPACK) and the suitability of Educational Technology (EdTech) in teaching and learning among Chinese language teachers in China, with particular attention to demographic differences, predictive components of TPACK, and teachers' readiness and attitudes toward technology integration.

1.5.2 Specific Research Objectives:

RO1: To identify the relationship between TPACK components (Technological Knowledge [TK], Pedagogical Knowledge [PK], Content Knowledge [CK], Technological Pedagogical Knowledge [TPK], Technological Content Knowledge [TCK], and Pedagogical Content Knowledge [PCK]) and EdTech Suitability components (EE, CF, FB, PD) among Chinese language teachers?

RO2: To examine which TPACK components (TK, PK, CK, TPK, TCK, PCK) predict EdTech Suitability components (EE, CF, FB, PD) among Chinese language teachers.

RO3: To identify differences in EdTech Suitability components (EE, CF, FB, PD) based on Chinese teachers' age group, teaching experience, and education level.

R04: To identify the relationship between EdTech Suitability components (EE, CF, FB, PD) and Teachers' Readiness & Attitudes components [Confidence (C), Digital Skills (DS) and Perceived Barriers (PB)] among Chinese language teachers.

RO5: To examine which EdTech Suitability components (EE, CF, FB, PD) predict Teachers' Readiness & Attitudes components (C, DS, PB) among Chinese language teachers.

RO6: To examine the level of readiness and attitudes (Confidence, Digital Skills, and Perceived Barriers) of Chinese language teachers toward the use of EdTech tools in their teaching of Chinese language subject.

1.6 Research Questions

RQ1: Are there any significant relationship between TPACK components (Technological Knowledge [TK], Pedagogical Knowledge [PK], Content Knowledge [CK], Technological Pedagogical Knowledge [TPK], Technological Content Knowledge [TCK], and Pedagogical Content Knowledge [PCK]) and EdTech Suitability components (EE, CF, FB, PD) among Chinese language teachers?

RQ2: Which TPACK components (TK, PK, CK, TPK, TCK, PCK) significantly predict EdTech components (EE, CF, FB, PD) among in-service Chinese language teachers?

RQ3: Are there any significant differences in EdTech Suitability components (Educational Effectiveness [EE], Content Fidelity [CF], Feedback [FB], and Professional Development [PD]) among Chinese language teachers based on their age group, teaching experience, and education level?

RQ4: Are there any significant relationship between EdTech Suitability components (EE, CF, FB, PD) and Teachers' Readiness & Attitudes components [Confidence (C), Digital Skills (DS) and Perceived Barriers (PB)] among Chinese language teachers?

RQ5: Which EdTech Suitability components (EE, CF, FB, PD) significantly predict Teachers' Readiness & Attitudes components (C, DS, PB) among Chinese language teachers?

RQ6: What are the levels of teachers' readiness and attitudes, specifically Confidence, Digital skills, and Perceived Barriers of Chinese language teachers toward the use of EdTech tools in teaching the Chinese language subject?

1.7 Research Hypothesis

Based on Research Objective and Research Question No. 1, below are the research hypothesis:

- **H_o1a**: There is no significant relationship between TPACK components (TK, PK, CK, TPK, TCK, PCK) and Educational Effectiveness (EE).
- **H_o1b**: There is no significant relationship between TPACK components and Content Fidelity (CF).
- **H_o1c**: There is no significant relationship between TPACK components and Feedback (FB).
- **H_o1d**: There is no significant relationship between TPACK components and Professional Development (PD).

Based on Research Objective and Research Question No.2, below are the research hypothesis:

- **H_o2a**: TPACK components (TK, PK, CK, TPK, TCK, PCK) do not significantly predict Educational Effectiveness (EE).
- **H_o2b**: TPACK components do not significantly predict Content Fidelity (CF).
- **H_o2c**: TPACK components do not significantly predict Feedback (FB).
- **H_o2d**: TPACK components do not significantly predict Professional Development (PD)

Based on Research Objective and Research Question No. 3, below are the research hypothesis:

- **H_o3a**: There are no significant differences in EdTech Suitability components (EE, CF, FB, PD) among Chinese language teachers across different age groups.
- **H_o3b**: There are no significant differences in EdTech Suitability components (EE,

CF, FB, PD) among Chinese language teachers across different levels of teaching experience.

- **H_o3c**: There are no significant differences in EdTech Suitability components (EE, CF, FB, PD) among Chinese language teachers across different education levels.

Based on Research Objective and Research Question No. 4, below are the research hypothesis:

- **H_o4a**: There is no significant relationship between EdTech Suitability components (EE, CF, FB, PD) and Teacher Confidence (C) among Chinese language teachers.
- **H_o4b**: There is no significant relationship between EdTech Suitability components (EE, CF, FB, PD) and digital skills (DS) among Chinese language teachers.
- **H_o4c**: There is no significant relationship between EdTech Suitability components (EE, CF, FB, PD) and perceived barriers (PB)] among Chinese language teachers.

Based on Research Objective and Research Question No. 5, below are the research hypothesis:

- **H_o5a**: EdTech Suitability components (EE, CF, FB, PD) do not significantly predict Teacher Confidence (C) among Chinese language teachers.
- **H_o5b**: EdTech Suitability components (EE, CF, FB, PD) do not significantly predict digital skills (DS) among Chinese language teachers.

H_o5c: EdTech Suitability components (EE, CF, FB, PD) do not significantly predict perceived barriers (PB)] among Chinese language teachers.

1.8 Scope of the Study

This study examines the integration of Technological Pedagogical Content Knowledge (TPACK) and the suitability of Educational Technology (EdTech) in the teaching and learning of Chinese language in China. It focuses on how Chinese language teachers utilize digital tools in their instructional practices and how their TPACK competencies influence the suitability of these tools in terms of educational effectiveness (EE), content fidelity (CF), feedback (FB), and professional development (PD).

The scope of the study is centered on in-service Chinese language teachers working in primary, secondary, and tertiary education institutions in China. This focus is chosen because language instruction presents unique challenges—such as vocabulary acquisition, character recognition, speaking and listening practice, and the interpretation of classical texts—that require thoughtful technology integration. In line with the research objectives, the study covers:

1. Demographic differences (age, teaching experience, and education level) and their influence on teachers' perceptions and practices of EdTech integration.
2. The relationship between TPACK components (technological knowledge, pedagogical knowledge, content knowledge, technological pedagogical knowledge, technological content knowledge, and pedagogical content knowledge) and EdTech Suitability components (EE, CF, FB, PD).
3. The predictive role of specific TPACK components in determining the suitability of EdTech tools.
4. Teachers' readiness and attitudes, including confidence, digital skills, and perceived barriers, toward integrating EdTech suitability in Chinese language classrooms.

Through this focus, the study aims to generate evidence-based insights that can inform teacher professional development, EdTech adoption strategies, and education policy in China, ensuring that the integration of technology into Chinese language education is both contextually relevant and pedagogically meaningful.

1.9 Significance of the Study

This study is significant for several reasons, spanning theoretical contributions, practical applications, professional development, policy directions, and learner benefits. Collectively, it provides a multi-level impact that advances both academic knowledge and real-world practice in Chinese language (CL) education.

1.9.1 Theoretical Contribution

Theoretically, this research extends the application of the Technological Pedagogical Content Knowledge (TPACK) framework (Mishra & Koehler, 2006a) within the specific context of Chinese language (CL) education in China. While TPACK has been extensively applied in general education and foreign language contexts, its integration with EdTech suitability dimensions—educational effectiveness, content fidelity, feedback, and professional development—remains underexplored.

By investigating the predictive power of different TPACK components on EdTech suitability, this study not only validates the framework but also refines it by situating TPACK in a culturally and linguistically unique educational setting. For example, technological content knowledge (TCK) in CL contexts involves evaluating whether tools can handle the complexity of character-based literacy, tone accuracy, and idiomatic expressions, which differs markedly from alphabet-based languages (D. Zou et al., 2025).

Furthermore, the incorporation of AI-TPACK ((B. Aydin et al., 2024) and Culture-DPACK (Xu, 2025) perspectives reflects an innovative theoretical extension that aligns TPACK with emerging technological and cultural demands in Chinese education. This positions the study at the cutting edge of theory development, bridging classic TPACK with contemporary innovations in AI-driven learning and culturally adaptive pedagogy.

1.9.2 Practical Implications for Teachers

Practically, this study provides actionable insights into how Chinese language teachers can align their TPACK competencies with EdTech suitability to enhance classroom practice. Findings will help clarify which TPACK domains are most influential in shaping suitability judgments:

- For instance, understanding whether technological content knowledge (TCK) or technological pedagogical knowledge (TPK) plays a greater role in ensuring content fidelity or effective feedback allows teachers to target their professional growth (Q. Xu et al., 2025; Xu, 2025).
- Teachers can move beyond superficial adoption—where technology is used for presentation or administrative purposes—toward deep integration that enhances student engagement, comprehension, and mastery (L. Zhang & M. Wu, 2023).

This empowers teachers to act not as passive recipients of tools but as critical evaluators and designers of technology-enhanced pedagogy. By clarifying these relationships, the study addresses the long-standing challenge of EdTech underutilization despite high availability.

1.9.3 Professional Development and Capacity Building

The results also have significant implications for professional development (PD) and teacher capacity building. Current PD programs in China often remain generic and tool-centric, focusing narrowly on digital skills rather than the integrated interplay of TPACK and EdTech suitability (Fang, 2024; Fütterer et al., 2025).

This research identifies specific areas of need—such as enhancing TPK for lesson design, strengthening TCK for Chinese character-based literacy, or addressing readiness barriers related to confidence, workload, and digital self-efficacy. Consequently, education authorities and institutions can design PD programs that are:

- **Discipline-specific:** Tailored to the unique challenges of CL instruction.
- **Context-sensitive:** Addressing urban–rural inequities and generational divides in teacher readiness.
- **Sustainability-focused:** Moving from short-term workshops to long-term, collaborative professional learning ecosystems (Y. Guo & X. Huang, 2024).

Such targeted PD ensures that teachers develop not only technical fluency but also the pedagogical vision needed to transform EdTech into a driver of meaningful learning outcomes.

1.9.4 Policy and Institutional Implications

At the policy level, this study contributes to China's national agenda for digital transformation in education, particularly through initiatives such as the Smart Education of China (SEC) platform. By providing empirical evidence on the factors that enable or constrain EdTech integration, this research informs policymakers and institutional leaders on how to achieve equitable and sustainable technology adoption.

- Insights into demographic differences—such as the impact of age, teaching experience, and educational background—can guide resource allocation and training priorities (Lei et al., 2025).
- Evidence on barriers such as workload, infrastructure, and institutional culture can inform system-level reforms to reduce inequities across rural and urban schools (X. Yang, 2024).
- Findings also support the development of monitoring and evaluation frameworks that assess not only infrastructure expansion but also pedagogical outcomes (Reuters, 2025; The State Council of the People's Republic of, 2025b).

In doing so, the study strengthens the evidence base for policies that move beyond technology deployment toward teacher-centered and pedagogy-driven integration.

1.9.5 Benefits to Learners

Ultimately, this study contributes to improving student learning outcomes, ensuring that technology adoption in CL classrooms benefits learners in meaningful ways. When teachers align their TPACK competencies with pedagogically suitable tools, students are more likely to experience:

- Interactive and engaging learning environments that enhance motivation (B. Zou et al., 2025).
- Improved language proficiency, particularly in difficult areas such as tone recognition, character writing, and idiomatic expression.
- Stronger cultural understanding, as culturally adapted EdTech preserves authenticity in Chinese traditions, expressions, and values (Huang & Zhao, 2023).
- Enhanced digital literacy, preparing students for lifelong learning and participation in a digitally driven society.

Thus, the significance of this study extends beyond teachers and institutions to direct learner benefits, advancing both linguistic competence and 21st-century digital skills.

1.10 Limitations of the Study

Every study has inherent limitations that shape the interpretation and generalizability of its findings. For this research, several methodological and contextual constraints must be acknowledged:

1.10.1 Self-Reported Data

The study relies heavily on survey responses and self-assessments from teachers regarding their TPACK competencies, readiness, and perceptions of EdTech suitability. While such self-reports are a common and efficient method of data collection in educational research, they are vulnerable to response bias and social desirability effects (Garrison et al., 2003). Teachers may unintentionally overstate their digital competence or readiness to align with perceived professional expectations, or understate challenges due to fear of being seen as resistant to innovation. This potential bias means that reported levels of competence and readiness may not always fully reflect teachers' actual practices.

1.10.2 Cross-Sectional Design

The study employs a cross-sectional research design, collecting data at a single point in time. While this approach enables broad coverage and efficient data gathering, it restricts the ability to establish causal relationships between TPACK competencies, readiness, and EdTech suitability. For instance, while correlations can be observed, it remains unclear whether higher TPACK leads to greater perceptions of suitability, or whether perceptions of suitability motivate teachers to develop TPACK. A longitudinal design would provide stronger insights into how these constructs evolve and interact over time, particularly as teachers gain more experience with new tools and professional development.

1.10.3 Focus on Teacher Perspectives

This research is teacher-centered, examining teachers' knowledge, readiness, and perceptions of EdTech suitability. While teachers are key actors in technology integration, this approach does not capture student learning outcomes directly. Conclusions about educational effectiveness and content fidelity are drawn primarily from teacher perceptions rather than empirical evidence of student performance, engagement, or long-term retention. As such, findings should be interpreted as reflecting the professional judgments and experiences of teachers, rather than direct measures of student achievement.

1.10.4 Variability in Access and Infrastructure

The Chinese education system is marked by significant disparities in infrastructure, internet connectivity, and institutional support between urban and rural regions (Y. Wang et al., 2024). While this study attempts to sample across diverse contexts, it cannot fully control for these variations. Teachers in well-resourced schools may report more positive experiences with EdTech suitability than those in resource-constrained settings. Thus, while findings provide a general overview, they should not be taken as uniformly representative of all regional or institutional contexts in China.

1.11 Delimitations of the Study

The delimitations represent intentional boundaries set by the researcher to define the scope of inquiry, ensuring focus and feasibility. For this study, the delimitations include:

1.11.1 Population Focus

The study is limited to in-service Chinese language teachers in China. Teachers of other disciplines (e.g., mathematics, science, or English) are excluded to maintain a disciplinary focus on Chinese language education. This delimitation enables an in-depth exploration of how EdTech interacts with the unique linguistic and cultural dimensions of CL teaching, though it limits generalizability to other subject areas.

1.11.2 Contextual Scope

The research focuses on formal classroom teaching and learning settings, where EdTech is integrated into day-to-day instructional practices. Other uses of technology—such as administrative management, assessment automation, or extracurricular learning—are deliberately excluded. This boundary ensures the study's findings are directly applicable to instructional design and pedagogy, though it does not capture the broader ecosystem of digital education.

1.11.3 Variables Under Study

The study is confined to three major sets of variables: TPACK components (TK, PK, CK, TPK, TCK, PCK), EdTech suitability dimensions (EE, CF, FB, PD), and teacher readiness/attitudes (confidence, digital skills, perceived barriers). Other potentially relevant factors—such as institutional leadership, parental involvement, or socio-economic background—are excluded to maintain clarity and focus. While these external variables may influence EdTech adoption, their omission ensures the study's framework remains theoretically coherent and empirically manageable.

1.11.4 Geographical Scope

Although China is vast and regionally diverse, the study does not attempt to compare specific provinces or regions in detail. Instead, it aims to draw generalizable insights from a sample of CL teachers working across different educational levels (primary, secondary, and tertiary). This delimitation avoids overcomplicating the analysis with region-specific factors, though it inevitably reduces the granularity of regional interpretations.

Together, the limitations and delimitations clarify both the boundaries and interpretive caution required in engaging with the study's findings. While limitations highlight challenges in validity, causality, and generalizability, the delimitations ensure the research remains focused, feasible, and theoretically consistent. Acknowledging these constraints also underscores opportunities for future research—including longitudinal designs, student-centered outcome studies, cross-subject comparisons, and regionally differentiated analyses—to build on the present study's contributions.

1.12 Definition of Key Terms

1.12.1 Technological Pedagogical Content Knowledge (TPACK)

- **Conceptual Definition**: A theoretical framework describing the knowledge teachers need to integrate technology effectively in teaching, emphasizing the interplay of technological knowledge (TK), pedagogical knowledge (PK), and content knowledge (CK) and their intersections (Mishra & Koehler, 2006a).
- **Operational Definition**: In this study, TPACK is measured through six components: TK, PK, CK, TPK, TCK, and PCK, as assessed using a validated TPACK questionnaire adapted for Chinese language teaching contexts (B. Zou et al., 2025).

1.12.1.1 Technological Knowledge (TK)

- **Conceptual Definition**:

  TK refers to a teacher's understanding of various digital technologies (e.g., software, hardware, apps, online platforms) and the ability to use them productively in different contexts, not limited to teaching (Mishra & Koehler, 2006a).
- **Operational Definition**:

  Measured through items in the TPACK questionnaire assessing teachers' ability to learn, apply, and troubleshoot digital tools (e.g., "I can learn new technologies easily" or "I can troubleshoot common technology problems").

1.12.1.2 Pedagogical Knowledge (PK)

- **Conceptual Definition**:

  PK is the deep understanding of processes, practices, and methods of teaching and learning. It involves knowledge of instructional strategies, classroom management, assessment, and how students learn (Koehler et al., 2014; Shulman, 1987).
- **Operational Definition**:

  Measured through questionnaire items focusing on teachers' knowledge of teaching methods, learner characteristics, and strategies to facilitate effective learning (e.g., "I know how to assess student performance in a classroom").

1.12.1.3 Content Knowledge (CK)

- **Conceptual Definition**:

  CK refers to a teacher's understanding of the subject matter that is to be taught, including concepts, theories, ideas, and established practices within the discipline (Shulman, 1986).

- **Operational Definition**:

  Measured through questionnaire items assessing the extent of teachers' expertise in their subject matter (e.g., "I have sufficient knowledge about my subject to teach it effectively").

1.12.1.4 Technological Pedagogical Knowledge (TPK)

- **Conceptual Definition**:

  TPK is knowledge of how teaching and learning can change when technologies are applied in specific pedagogical strategies. It includes understanding the pedagogical affordances and constraints of various technologies (Mishra & Koehler, 2006a).

- **Operational Definition**:

  Measured by items in the TPACK questionnaire evaluating teachers' ability to integrate technology with teaching methods (e.g., "I can choose technologies that enhance teaching approaches for a lesson").

1.12.1.5 Technological Content Knowledge (TCK)

- **Conceptual Definition**:

  TCK is understanding how technology and content influence and constrain one another. Teachers know how specific technologies can represent subject matter in new ways (Koehler & Mishra, 2009).

- **Operational Definition**:

  Measured by questionnaire items assessing teachers' ability to select or use technologies to present content more effectively (e.g., "I know how to use technology to represent specific content concepts").

1.12.1.6 Pedagogical Content Knowledge (PCK)

- **Conceptual Definition**:

  PCK is a teacher's knowledge of how to effectively teach a specific subject matter, combining pedagogy and content. It involves knowing what teaching methods fit the content and what makes concepts easy or difficult to learn (Shulman, 1987).

- **Operational Definition**:

  Measured through questionnaire items assessing teachers' ability to design subject-specific pedagogy (e.g., "I know how to select teaching approaches that best fit the content of my subject").

1.12.2 Educational Technology (EdTech)

- **Conceptual Definition**: Digital tools and resources—including software, platforms, and devices—used to enhance teaching and learning processes (Y. Zou et al., 2025).
- **Operational Definition:** In this study, EdTech suitability is assessed through four components: educational effectiveness (EE), content fidelity (CF), feedback (FB), and professional development (PD), measured by teacher survey responses.

1.12.2.1 Educational Effectiveness (EE)

- **Conceptual Definition:** The extent to which EdTech tools contribute to achieving intended learning outcomes and improving instructional quality (Wang, 2024).
- **Operational Definition:** Measured using teachers' ratings of perceived impact of EdTech on student engagement, learning performance, and classroom interaction.

1.12.2.2 Content Fidelity (CF)

- **Conceptual Definition**: The degree to which digital tools accurately represent subject content and support the integrity of learning tasks (Vanacore et al., 2025).
- **Operational Definition**: Measured by teachers' perceptions of whether EdTech tools present Chinese language content accurately (e.g., vocabulary, grammar, characters) and align with curricular goals.

1.12.2.3 Feedback (FB)

- **Conceptual Definition**: The quality and timeliness of information provided to students via EdTech tools to guide improvement (Huang & Zhao, 2023).
- **Operational Definition**: Measured by teachers' evaluation of EdTech tools in delivering automated or teacher-mediated feedback that supports student learning.

1.12.2.4 Professional Development (PD)

- **Conceptual Definition**: Structured opportunities that enhance teachers' digital and pedagogical competence for integrating technology meaningfully (Lei et al., 2025).
- **Operational Definition**: Measured by teachers' reports on the availability, accessibility, and relevance of PD programs supporting technology-enhanced CL instruction.

1.12.3 Teacher Readiness and Attitudes

- **Conceptual Definition**: The preparedness of teachers to adopt and integrate digital tools, including their technical competence, confidence, and supportive environment (J. Liu et al., 2024).
- **Operational Definition**: Measured through survey items assessing teachers' confidence (C) in using EdTech, their digital skills (DS), and their perceived barriers (PB) (e.g., wokload, infrastructure, lack of support).

1.12.3.1 Confidence (C)

- **Conceptual Definition**:

  Confidence refers to a teacher's belief in their ability to effectively use educational technologies in teaching and learning. It aligns with Bandura's (1997) concept of self-efficacy, emphasizing the individual's judgment of their capability to apply EdTech tools to achieve instructional goals (Tondeur et al., 2017).
- **Operational Definition**:

  Measured through questionnaire items that assess teachers' self-perceived confidence in selecting, applying, and managing digital tools in their classrooms (e.g., "I feel confident in integrating digital technologies into my teaching").

1.12.3.2 Digital Skills (DS)

- **Conceptual Definition**:

  Digital skills represent the technical and functional abilities required to effectively use digital technologies, including information management, communication, collaboration, content creation, safety, and problem-solving (Unesco, 2018; van Laar et al., 2017). In the teaching context, digital skills extend to the ability to use EdTech for instructional and assessment purposes (Ilomäki et al., 2016).

- **Operational Definition**:

  Measured through items in the questionnaire assessing teachers' technical proficiency in using hardware, software, and online platforms (e.g., "I have the necessary digital skills to operate EdTech tools for teaching").

1.12.3.3 Perceived Barriers (PB)

- **Conceptual Definition**:

  Perceived barriers are the challenges or obstacles that teachers believe hinder their effective integration of EdTech in teaching. These barriers may include lack of infrastructure, limited training, insufficient technical support, or negative attitudes toward technology (Ertmer, 1999; Hew & Brush, 2007).

- **Operational Definition**:

  Measured through questionnaire items that capture teachers' perceptions of obstacles related to technology adoption (e.g., "Lack of time prevents me from effectively using EdTech in my teaching").

1.13 Chapter Summary and Restatement of Study Focus

This chapter has established the contextual, conceptual, and methodological foundations of the study by outlining the background of Educational Technology (EdTech) integration in Chinese language education, the central role of Technological Pedagogical Content Knowledge (TPACK), and the emerging importance of EdTech suitability and teacher readiness. The problem statement clarified that, despite extensive national investment in digital infrastructure, there remains limited empirical evidence on how

Chinese language teachers' TPACK competencies relate to the pedagogical suitability of EdTech tools and to their readiness and attitudes toward technology integration.

The research objectives and questions were formulated to address these gaps by examining: (i) demographic differences in perceptions of EdTech suitability; (ii) the relationships between TPACK components and EdTech suitability; (iii) the predictive power of specific TPACK dimensions; and (iv) the links between EdTech suitability and teacher readiness and attitudes. The scope, significance, and key constructs of the study were subsequently defined to ensure conceptual clarity and analytical focus.

To guide the reader into the subsequent chapter, it is important to restate that the core focus of this study is the integrated examination of three interrelated domains: teachers' TPACK competencies, the pedagogical and cultural suitability of EdTech (educational effectiveness, content fidelity, feedback, and professional development), and teachers' readiness and attitudes (confidence, digital skills, and perceived barriers) in the context of Chinese language education in China. Chapter 2 therefore builds directly on this foundation by critically reviewing the theoretical and empirical literature on these three domains, synthesizing existing evidence, and identifying the specific research gaps that inform the development of the conceptual framework and hypotheses of the present study.

This explicit signposting clarifies the conceptual progression from problem identification (Chapter 1) to theory building and gap analysis (Chapter 2), thereby strengthening coherence and easing the transition for the reader.

CHAPTER 2:

LITERATURE REVIEWS

2.1 Overview

Chapter 2 reviews the relevant literature that informs this study, beginning with educational technology in the Chinese context and the challenges of large-scale digital transformation. The discussion then focuses on the Technological Pedagogical Content Knowledge (TPACK) framework and its extensions, highlighting its role in guiding technology integration in Chinese language education. The chapter also elaborates on the suitability of EdTech, framed through educational effectiveness, content fidelity, feedback, and professional development. Teacher readiness and attitudes toward EdTech are further examined, emphasizing confidence, digital skills, and perceived barriers. The chapter concludes by identifying key research gaps and formulating the basis for the research framework.

2.2 Educational Technology in the Chinese Context

China's digital education agenda has accelerated markedly over the past decade, underpinned by national platforms and AI-forward policy. The flagship Smart Education of China (SEC) platform now functions as the country's backbone for public digital-learning services. As of April 2025, SEC reported 164 million registered users and over 519,000 connected institutions, consolidating a nationwide infrastructure to democratize access and improve quality (China, 2025; State Council of the People's Republic of, 2025).

Policy has moved in lockstep. In April 2025, the Ministry of Education issued new guidelines to embed artificial intelligence (AI) across curricula, teaching methods, and instructional materials, aiming to cultivate higher-order skills and modernize pedagogy (Reuters, 2025). In Beijing, AI education has even been made compulsory, requiring at least eight hours per year for primary and secondary school students (Beijing Municipal Education, 2025). These measures align with China's "strong-education nation" plan by 2035 and highlight how educational informatization is viewed as both a driver of quality and an instrument of equity (Moe, 2024; Reuters, 2025; World, 2025b).

2.2.1 Integration of EdTech in Language Education

Within language education—particularly Chinese Language (CL)—adoption has diversified across mobile-assisted language learning (MALL), AI-powered writing assistants, speech recognition tools, and cloud collaboration platforms. These applications have improved outcomes in vocabulary acquisition, character recognition, and pronunciation accuracy (Fang, 2024). Nevertheless, research cautions that the effectiveness of EdTech depends less on the tools themselves and more on the teacher's capacity to integrate them into coherent pedagogical designs (Alhassan, 2017). For example, Zou et al. (2025) found that teachers with stronger TPACK competencies achieved significantly better outcomes than those relying on EdTech in isolation (D. Zou et al., 2025).

The literature also emphasizes the importance of content fidelity and task authenticity, particularly in CL instruction, where tone accuracy, character stroke order, and culturally bound pragmatics are central (Xu, 2025). Poor localization of EdTech platforms may inadvertently produce errors in tone sandhi or homographs, reducing effectiveness. This underscores the need for localized adaptation and teacher mediation in implementation.

2.2.2 Teachers, TPACK, and the "Pedagogy First" Principle

Across studies, teacher competence rather than tool availability emerges as the decisive factor in determining learning impact. Teachers with stronger Technological Pedagogical Content Knowledge (TPACK) integrate tools more meaningfully, orchestrate collaborative tasks, and foster deeper learning (Q. Xu et al., 2025; Xu, 2025; Xu et al., 2019). Recent innovations, such as the Culture-DPACK scale, extend TPACK by embedding cultural-linguistic competencies specific to Chinese Language education, helping operationalize "fit-for-purpose" EdTech use (Warr & Mishra, 2023).

2.2.3 Systemic Enablers and Persistent Challenges

China's reforms emphasize intelligent tutoring systems (ITS), AI-driven assessments, and data analytics to personalize instruction and optimize learning pathways. However, three challenges remain persistent. First, professional development is often fragmented, focusing on technical training rather than sustained pedagogical integration (World, 2025a). Second, rural–urban disparities in connectivity and teacher capacity limit equitable uptake (Willermark, 2021a). Finally, the rapid rise of AI in classrooms raises questions of data privacy, assessment validity, and teacher workload, areas where clear policies are still emerging (M. K. Aydin et al., 2024).

In sum, China's EdTech ecosystem couples unprecedented national scale (Archambault & Crippen, 2009; Cctv, 2025; State Council of the People's Republic of, 2025) with policy momentum (Beijing Municipal Education, 2025)to create enabling conditions for digital transformation. However, research consistently shows that meaningful impact depends on the intersection of teachers' TPACK, context-sensitive tools, and sustained institutional support (Benjamin et al., 2018).This reinforces the "pedagogy first" principle: EdTech delivers value only when embedded in sound instructional design, localized for linguistic and cultural fidelity, and supported by systemic professional learning.

2.3 Critical Analysis of Current Practices

Although China's top-down policy approach has facilitated rapid scaling of digital education, a critical examination of current practices reveals structural, pedagogical, and cultural challenges that complicate the realization of equitable and effective outcomes.

2.3.1 Equity Gaps in Access and Use

Despite the impressive reach of the Smart Education of China (SEC) platform, disparities in access remain pronounced across regions and socioeconomic groups. Rural schools continue to face inadequate digital infrastructure, including poor internet connectivity, outdated hardware, and insufficient technical support (Black & Wiliam, 1998). Teachers in less-developed provinces also report limited opportunities for sustained professional training, further entrenching inequities (Bolarinwa, 2015). These gaps not only undermine the equity goals of national reforms but also risk reinforcing existing educational inequalities between urban and rural students. Moreover, while national platforms reduce content access gaps, they cannot fully mitigate local implementation constraints, particularly where resource allocation and teacher capacity remain uneven.

2.3.2 Technology-Centric Solutions Over Pedagogical Innovation

A second challenge lies in the prevailing emphasis on technology acquisition over pedagogical transformation. Policy discourse and school-level initiatives often prioritize the deployment of AI-driven tutoring systems, learning management platforms, or big data analytics without ensuring that these tools are meaningfully embedded into teaching practice (Butler, 2024). In many cases, EdTech tools are introduced as end-goals rather than as supports for instructional design, leading to surface-level integration. Without adequate teacher mediation, these systems risk being underutilized, used primarily for administrative functions, or applied in ways that do not align with intended learning outcomes. As Ertmer and Ottenbreit-Leftwich (2019) argue, technology integration succeeds when pedagogical shifts accompany tool adoption, otherwise innovations risk perpetuating "technology for technology's sake."

2.3.3 Fragmented and Episodic Teacher Professional Development

Teacher professional development (PD) remains a critical bottleneck. Training opportunities are often fragmented, episodic, and generic, focusing narrowly on technical tool use rather than pedagogical integration or subject-specific adaptation. Short-term workshops and one-off courses rarely cultivate sustained Technological Pedagogical Content Knowledge (TPACK) growth (Chai, Koh, & Teo, 2021). Studies consistently show that such approaches result in surface-level adoption, where teachers apply EdTech to replicate existing practices rather than to transform learning experiences (Compeau & Higgins, 1995). Furthermore, the absence of mentoring, peer collaboration, and classroom-based reflection diminishes the long-term impact of PD initiatives. This gap highlights the need for discipline-specific, iterative, and practice-oriented professional learning that aligns technology use with curricular and cultural demands.

2.3.4 Cultural and Curriculum Misalignment

Another key issue concerns the cultural and curricular fit of EdTech tools. Many platforms originate from global EdTech markets and are designed for alphabetic languages, making them poorly suited to the unique requirements of Chinese Language (CL) education. For instance, imported applications may not adequately address tone acquisition, stroke order in character writing, or culturally embedded pragmatics—all of which are central to effective CL instruction (Compeau & Higgins, 1995). Misalignments in linguistic and cultural design risk undermining instructional effectiveness and raising questions about the contextual appropriateness of these tools. As Xu (2025) notes, localized adaptations and culturally sensitive frameworks such as Culture-DPACK are essential to bridge this gap, ensuring that technology enhances rather than distorts the teaching of Chinese language and culture.

2.3.5 Ethical and Implementation Concerns

Beyond pedagogy and culture, the rapid adoption of AI-based tools has sparked concerns about data privacy, algorithmic bias, and assessment validity. Teachers report uncertainties about how student data are collected and used, and whether algorithm-driven recommendations align with curricular goals (Fornell & Larcker, 1981). Moreover, the workload associated with integrating new platforms, combined with insufficient institutional support, has raised questions about sustainability and teacher well-being (Beijing Municipal Education, 2025; The State Council of the People's Republic of, 2025a).These challenges suggest that governance frameworks and classroom-level guidelines must evolve in tandem with technological innovation to safeguard equity, transparency, and teacher agency.

In summary, while China's reforms have established a strong infrastructure and policy foundation for EdTech adoption, current practices face significant challenges. Persistent equity gaps, technology-centric approaches, fragmented PD ecosystems, cultural miss-alignments, and ethical concerns collectively hinder the deep pedagogical integration of digital tools in Chinese classrooms. Addressing these issues requires a shift from deployment-focused strategies toward pedagogy-centered and context-sensitive integration, supported by sustained teacher development, localized design, and robust governance frameworks.

2.4 Synthesis of Findings and Identified Gaps

Synthesizing the above analysis, it is evident that while China has established one of the world's most comprehensive digital education infrastructures, the effectiveness of Educational Technology (EdTech) integration in Chinese language (CL) education remains uneven. The literature consistently converges on the finding that teachers' Technological Pedagogical Content Knowledge (TPACK) is the determining factor in whether EdTech translates into pedagogical success (Ministry of Education of the People's Republic of, 2025; Mishra, 2019; Mishra & Koehler, 2006a). Large-scale platforms such as the Smart Education of China (SEC) have dramatically expanded access and content reach, but evidence suggests that access alone does not guarantee effective instructional outcomes (Tabachnick & Fidell, 2019).

Several key research gaps emerge:

2.4.1 Limited Longitudinal Research

The majority of studies on EdTech adoption in CL classrooms are short-term, often evaluating pilot projects or single-semester interventions. This approach provides snapshots of immediate outcomes but fails to capture how sustained teacher training and iterative tool use influence student achievement and teacher practice over time (Venkatesh et al., 2012a). Longitudinal research is needed to understand the trajectory of TPACK development and its cumulative impact on pedagogy, particularly given the rapid evolution of AI-based learning tools.

2.4.2 Underexplored Rural Contexts

Much of the current literature is urban-centric, focusing on metropolitan schools with relatively strong infrastructure. Rural schools, however, face unique challenges, including inadequate connectivity, limited technical support, and fewer opportunities for professional development (J. Liu et al., 2024). Research rarely captures how rural CL teachers adapt to, creatively resist, or selectively adopt EdTech in contexts of resource scarcity. This oversight perpetuates blind spots in equity-focused policymaking and risks widening the rural–urban divide in EdTech-enabled learning.

2.4.3 Insufficient Evaluation of EdTech Suitability

A further gap lies in the insufficient scrutiny of whether particular EdTech tools are pedagogically and culturally suitable for Chinese language instruction. Existing studies often generalize effectiveness from broader EdTech adoption trends (Fang, 2024), overlooking the specific demands of CL education, such as tone accuracy, character-based literacy, and culturally embedded communication. Without critical evaluation of content fidelity and task authenticity, EdTech integration risks misalignment with curricular standards and learner needs.

2.4.4 Gaps in Teacher-Centered Research

While national reports highlight user numbers and access metrics on platforms such as SEC, there is comparatively limited focus on teachers' lived experiences. Teachers' perspectives on barriers, strategies, agency, and professional identities in digital transformation remain underexplored (Fang, 2024). This absence diminishes understanding of how teachers mediate, adapt, or resist EdTech, which is central to sustainable pedagogical innovation.

In sum, China's progress in digital education is remarkable, but structural inequities, pedagogical misalignments, and gaps in teacher professional development constrain the full potential of EdTech in CL teaching. Bridging these gaps requires a shift from a technology-driven model to a teacher-centered, pedagogy-driven approach, with sustained investment in TPACK development, culturally appropriate tool design, and longitudinal evaluation of impact. Such a shift would ensure that digital reforms not only scale access but also translate into deep, contextually meaningful learning outcomes.

2.5 The TPACK Framework

The Technological Pedagogical Content Knowledge (TPACK) framework, first conceptualized by Mishra and Koehler (2006), remains a cornerstone for understanding how teachers integrate technology into their teaching practice. Building on Shulman's (1986) concept of Pedagogical Content Knowledge (PCK), TPACK situates technology as a third essential domain, alongside Content Knowledge (CK) and Pedagogical Knowledge (PK). The model emphasizes that effective technology integration requires not only familiarity with digital tools (Technological Knowledge, TK) but also the ability to align these tools meaningfully with both content and pedagogy.

At its core, TPACK comprises seven interrelated domains:

- **Content Knowledge (CK):** Understanding the subject matter to be taught.
- **Pedagogical Knowledge (PK):** Knowledge of teaching methods, strategies, and learning theories.
- **Technological Knowledge (TK):** Knowledge of digital tools, platforms, and emerging technologies.
- **Pedagogical Content Knowledge (PCK):** Blending pedagogy with subject-specific instruction.
- **Technological Content Knowledge (TCK):** Understanding how technology can represent and transform subject matter.
- **Technological Pedagogical Knowledge (TPK):** Using technology to support pedagogical strategies.
- **TPACK (the intersection):** The holistic integration of technology, pedagogy, and content for meaningful teaching and learning.

The strength of the TPACK model lies in its recognition that technology cannot be considered in isolation. Pedagogical effectiveness depends on teachers' ability to contextualize digital tools within subject content and teaching strategies (Koehler et al., 2014; Mishra, 2019; Mishra & Koehler, 2006a). For example, in Chinese language education, effective EdTech integration requires not just access to character-recognition apps but also the pedagogical design to scaffold pronunciation, stroke order, and cultural pragmatics (Ertmer, 1999; Ertmer & Ottenbreit-Leftwich, 2020).

Recent research demonstrates that teachers with stronger TPACK competence achieve deeper student engagement, higher learning outcomes, and more sustainable integration of technology compared to those who rely on tools superficially (Ertmer, 1999). Moreover, TPACK has been adapted in various cultural and subject-specific contexts, such as Culture-DPACK, which incorporates cultural and linguistic competencies into the framework for Chinese language teachers (Fütterer et al., 2025). These adaptations reflect recognition that effective EdTech use is inherently contextual, requiring sensitivity to local curricula, learner needs, and cultural traditions (Council, 2012).

Despite its strengths, scholars have critiqued TPACK for measurement challenges and conceptual overlaps among its constructs (Johnson et al., 2007). Some argue that without robust instruments, TPACK risks remaining a broad conceptual heuristic rather than a precise operational framework (J. Voogt et al., 2015). Nevertheless, it remains one of the most widely applied models for examining technology integration in education worldwide and continues to guide both teacher education and empirical research in the digital era.

2.5.1 Recent Adaptations of the TPACK Model

Over the past decade, the TPACK framework has been extended and adapted to address new technological and cultural realities in education. These refinements reflect the need for models that capture not only the integration of existing technologies but also the rapid evolution of artificial intelligence (AI), big data, and culturally diverse teaching contexts.

2.5.1.1 AI-TPACK

With the rise of AI in education, scholars have argued that teachers require new competencies beyond traditional Technological Knowledge (TK). Aydin et al. (2024) introduced the concept of AI-TPACK, which emphasizes the importance of algorithmic literacy, ethical awareness of AI, and the ability to design learning activities supported by intelligent tutoring systems, learning analytics, and adaptive platforms. This extension acknowledges that AI is not merely another tool but a transformative force that reshapes pedagogy, assessment, and even the teacher–student relationship. In contexts like China—where AI-enabled reforms are now a national priority (Reuters, 2025)—the AI-TPACK framework is particularly relevant. It highlights that teachers need to evaluate the transparency, fairness, and accountability of AI-driven systems, while also leveraging them to personalize instruction and reduce rural–urban disparities in learning outcomes.

2.5.1.2 Culture-DPACK

Recognizing the limitations of a one-size-fits-all framework, Xu (2025) developed the Culture-DPACK model, specifically tailored for Chinese language teachers. This framework integrates digital literacy with cultural and linguistic sensitivity, acknowledging that teaching Chinese involves unique challenges such as character-based literacy, tone acquisition, classical texts, and culturally embedded pragmatics. Culture-DPACK thus addresses a critical gap by embedding cultural literacy into TPACK, ensuring that technology integration aligns with subject-specific and sociocultural requirements. For example, while global writing assistants may enhance composition, they often fail to account for Chinese rhetorical traditions or idiomatic expressions unless localized for cultural fidelity (B. Zou et al., 2025). By situating digital pedagogy within cultural and linguistic contexts, Culture-DPACK offers a more holistic framework for meaningful technology integration.

2.5.1.3 Other Extensions

In addition to AI-TPACK and Culture-DPACK, scholars have proposed related adaptations, including models that emphasize contextual knowledge (XK) (Mishra, 2019), transformative TPACK for 21st-century learning (Chai, Koh, & Teo, 2021), and hybrid frameworks that incorporate professional identity, collaboration, and reflective practice. These extensions reflect a growing consensus that technology integration frameworks must evolve continuously to remain relevant in rapidly changing educational ecosystems.

Taken together, these adaptations illustrate how TPACK is no longer a static framework but an evolving construct that adapts to technological shifts and cultural demands. **AI-**TPACK underscores the rise of intelligent technologies as pedagogical partners, while Culture-DPACK emphasizes cultural authenticity and contextualization in technology use. Both are highly relevant for Chinese language education, where national AI strategies converge with the unique demands of teaching a tonal, character-based language embedded in rich cultural traditions.

2.5.2 Empirical Studies in the Chinese Context

Recent empirical research provides important insights into how Chinese teachers are developing Technological Pedagogical Content Knowledge (TPACK), while also revealing persistent challenges. The evidence highlights both the progress of national digital reforms and the unevenness of TPACK adoption across institutions, disciplines, and teacher cohorts.

2.5.2.1 Variability in Teacher Competence

Studies consistently report variability in teachers' digital competence and TPACK adoption. Lei et al. (2025) found that younger faculty, especially those trained during the post-2015 wave of educational informatization, demonstrated stronger Technological

Knowledge (TK) and Technological Pedagogical Knowledge (TPK). In contrast, older or more experienced faculty often relied on traditional methods and displayed reluctance to integrate technology meaningfully. This reflects a generational divide in TPACK adoption, a finding echoed by Zhang and Wu (2023), who observed that while younger teachers were adept at experimenting with digital platforms, senior teachers often prioritized exam-focused pedagogies with minimal technology integration. Such disparities raise concerns about institutional equity in professional development, particularly in higher education contexts.

2.5.2.2 Self-Efficacy and Institutional Support

The role of teacher self-efficacy and institutional support emerges as a critical factor in TPACK integration. Liu et al. (2025) reported that teachers with high digital self-efficacy and access to structured professional development were significantly more likely to integrate EdTech into their pedagogical practices. Conversely, those without sustained support exhibited only surface-level use, often limited to administrative or presentation purposes. Similarly, Guo and Huang (2024) found that professional learning communities, peer collaboration, and school leadership support were decisive in whether teachers moved beyond "tokenistic" technology adoption to more transformative practices. These findings align with broader evidence that professional development in China often remains fragmented and episodic (Chai, Koh, & Teo, 2021), underscoring the need for systemic investment in teacher-centered capacity-building ecosystems.

2.5.3 TPACK and Student Outcomes

A growing body of evidence demonstrates a positive link between teacher TPACK competence and student learning outcomes. For example, Zou et al. (2025) showed that teachers with higher TPACK profiles facilitated more interactive classrooms, resulting in increased student engagement, deeper conceptual understanding, and higher satisfaction in AI-supported learning environments. However, effect sizes varied depending on school context and institutional policies, with urban schools benefiting more than rural ones. Similarly, **Xu (2025)** found that when Chinese language teachers employed Culture-DPACK strategies, students showed marked improvements in character recognition, pronunciation, and intercultural communicative competence compared to classes taught with generic EdTech tools. These studies confirm that the quality of teacher mediation—rather than the tool itself—determines learning impact.

2.5.4 Subject-Specific Insights: Chinese Language Teaching

Within Chinese Language (CL) education, TPACK adoption is particularly complex due to the unique linguistic and cultural demands of the subject. Huang and Zhao (2023) emphasized that generic EdTech platforms often fail to address tone acquisition, character stroke order, and idiomatic usage, which are critical in CL learning. Teachers with strong TPACK are better able to adapt tools, design culturally authentic tasks, and provide corrective feedback. By contrast, low-TPACK teachers often rely on surface features of digital platforms without addressing deeper linguistic structures. This highlights the importance of discipline-sensitive TPACK models, such as Culture-DPACK (Chai, Koh, & Teo, 2021), for ensuring pedagogical fidelity in CL education.

2.5.5 Emerging Trends: AI and Hybrid Pedagogies

Recent research also points to emerging trends in AI-assisted and hybrid learning environments. Aydin et al. (2024) argued that teachers must now develop AI-TPACK competencies, including algorithmic literacy and ethical awareness, to effectively leverage intelligent tutoring systems and big data analytics. In China, where AI-driven reforms are state priorities (Chai, Koh, & Tsai, 2021), teachers are increasingly experimenting with AI-powered formative assessments and adaptive platforms. However, empirical studies caution that without proper training, AI tools may reinforce existing inequities, as teachers in resource-constrained contexts may lack the skills or confidence to harness their potential.

Overall, empirical evidence in the Chinese context highlights both the progress—increased access, positive links between TPACK and outcomes—and the persistent gaps, including variability across generations, urban–rural divides, and the adequacy of professional development. These findings underscore that the success of national digital reforms hinges not merely on technological deployment but on sustained teacher empowerment, context-sensitive PD, and subject-specific adaptations. In the case of CL education, developing teachers' TPACK remains the critical lever for transforming digital tools into authentic, culturally grounded, and pedagogically effective practices.

2.6 Critical Analysis of TPACK Research

While the TPACK framework has emerged as a powerful conceptual tool for examining technology integration in education, critical issues remain in both theory and practice. A growing body of literature cautions that unresolved ambiguities, methodological limitations, and contextual oversights continue to constrain the framework's explanatory power, particularly in Chinese educational contexts.

2.6.1 Conceptual Ambiguities

One persistent challenge concerns the fuzzy boundaries between TPACK's sub-domains. Scholars argue that distinctions between domains such as Technological Pedagogical Knowledge (TPK), Technological Content Knowledge (TCK), and Pedagogical Content Knowledge (PCK) are often blurred in empirical studies, leading to inconsistent operationalization(Chai et al., 2022). In Chinese research, this ambiguity has resulted in overlapping constructs, where items intended to measure one domain (e.g., TPK) load onto multiple factors, undermining comparability across studies (Cheema et al., 2020). Without greater theoretical precision, TPACK risks functioning more as a heuristic framework than a rigorous analytic tool.

2.6.2 Measurement Challenges

A second limitation lies in the measurement of TPACK. The majority of studies rely on self-reported survey instruments, which are prone to bias and may not accurately capture teachers' enacted practices. Factor analyses in recent Chinese studies (Q. Xu et al., 2025)suggest that teachers often conflate Technological Knowledge (TK), TPK, and the holistic TPACK domain, limiting construct validity. Experimental and performance-based assessments of TPACK remain rare, although such approaches could provide more authentic evidence of teachers' applied competencies (Xu, 2025). These measurement limitations highlight the urgent need for mixed-method approaches, integrating classroom observations, teaching portfolios, and student outcome measures to triangulate TPACK assessments.

2.6.3 Overemphasis on Technological Knowledge (TK)

In professional development practice, TPACK research has often been reduced to a focus on technical skills training. Many training programs prioritize familiarizing teachers with specific apps or platforms, rather than cultivating the integrated application of technology with pedagogy and content (Xu, 2025). This risks producing technically proficient teachers who nonetheless lack the pedagogical vision to leverage technology for transformative learning. In Chinese contexts, this overemphasis on TK is particularly evident in policy-driven workshops, which tend to emphasize tool proficiency rather than reflective integration strategies (Zbiek et al., 2007).

2.6.4 Contextual Oversights

Despite progress with frameworks such as Culture-DPACK, much TPACK research continues to treat teachers as a homogeneous group, neglecting the curricular, institutional, and cultural contexts that shape how TPACK is enacted. For example, rural teachers often face infrastructural constraints, while urban teachers contend with exam-driven accountability cultures that discourage experimentation (Yang, 2024). Similarly, in Chinese language teaching, TPACK cannot be meaningfully separated from cultural-linguistic demands such as tone accuracy, classical texts, and pragmatic conventions (Huang & Zhao, 2023; Xu, 2025). Contextual blind spots limit the generalizability of findings and risk obscuring the situated complexity of teachers' practices.

2.6.5 Systemic vs. Individual Responsibility

Finally, much of the TPACK literature frames competence as an individual teacher attribute, placing responsibility on teachers to update their skills. However, growing evidence indicates that systemic conditions—such as institutional leadership, workload policies, and infrastructure—are equally influential in shaping TPACK integration. Overemphasis on individual competence obscures structural barriers, such as inequitable resource distribution and insufficient time for professional learning. A more comprehensive view positions TPACK not solely as an individual-level construct but as a multi-level phenomenon, requiring alignment between teacher competence, institutional culture, and supportive policy environments.

In sum, while TPACK remains a foundational framework, its critical limitations must be acknowledged. Conceptual ambiguity and measurement challenges hinder its analytic clarity, while pedagogical overemphasis on TK undermines its transformative potential.

Moreover, contextual oversights and systemic blind spots limit its explanatory adequacy, particularly in diverse contexts like China. Future research must therefore move toward:

- Sharpening conceptual distinctions among sub-domains;
- Employing mixed-method and performance-based assessments;
- Rebalancing PD to emphasize integrated pedagogy rather than tool use; and
- Embedding TPACK research within broader systemic and cultural contexts.

Such refinements are essential to ensure that TPACK continues to provide meaningful insights into how technology can enhance teaching and learning in the rapidly evolving educational landscape.

2.7 Synthesis of Findings and Gaps

Synthesizing across empirical and conceptual studies, several key insights emerge regarding the application of the TPACK framework in Chinese educational contexts.

2.7.1 Teacher Readiness Varies Widely

Research consistently shows substantial disparities in teachers' TPACK readiness, shaped by age, teaching experience, and institutional settings. Younger teachers and those in urban universities generally demonstrate stronger Technological Knowledge (TK) and Technological Pedagogical Knowledge (TPK), while older teachers or those in resource-constrained rural contexts often rely more on traditional methods and show slower adoption of digital integration (Zbiek et al., 2007). These findings underscore a generational and contextual divide in teachers' readiness to enact technology-enhanced pedagogy.

2.7.2 Self-Efficacy and Systemic Support as Mediators

Teacher self-efficacy and institutional support consistently emerge as critical mediators of TPACK development. Teachers with high digital self-efficacy, supported by professional development, peer networks, and leadership encouragement, are more likely to integrate technology meaningfully (Lu et al., 2014). Conversely, without supportive ecosystems, professional development alone often results in surface-level adoption. This indicates that teacher competence is relational and systemic, shaped by both individual dispositions and institutional environments.

2.7.3 Cultural Adaptation Remains Underdeveloped

While frameworks such as Culture-DPACK (Q. Xu et al., 2025)mark important progress, cultural adaptation of TPACK remains underdeveloped. Most research treats teachers as a homogeneous group, neglecting subject-specific and cultural dimensions that profoundly shape pedagogical practice. For example, Chinese language teaching requires attention to tone acquisition, character literacy, and culturally embedded communicative norms, which generic TPACK models overlook. The limited adoption of culturally grounded models points to a significant gap in adapting TPACK to discipline-specific realities.

2.8 Persistent Gaps in Research

2.8.1 Lack of Longitudinal Studies

The majority of TPACK studies in China are cross-sectional, capturing snapshots of competence at a single moment. Few studies trace how teachers' TPACK evolves over their careers or how iterative exposure to technology and professional development leads to sustained change (H. Zhang & Q. Tang, 2022). In rapidly evolving EdTech environments, longitudinal research is essential for understanding developmental trajectories.

2.8.2 Limited Intervention Studies

There remains a paucity of experimental or quasi-experimental studies that rigorously test professional development interventions aimed at building integrated TPACK competence. Most research evaluates existing practices rather than designing and testing innovative PD models tailored to local contexts (H. Zhang & Q. Tang, 2022).

2.8.3 Under-Researched Cultural Dimensions

Although Culture-DPACK is a promising step, most TPACK adaptations in China reference cultural and linguistic issues only superficially. There is limited empirical exploration of how language-specific pedagogies, such as tone instruction or classical

Chinese interpretation, can be systematically embedded within TPACK frameworks (J. Voogt et al., 2015).

2.8.4 Absence of Cross-Level Analysis

Much TPACK research treats competence as an individual attribute, underexploring the interaction between policy, institutional practices, and teacher agency. Yet empirical studies increasingly demonstrate that teacher practices are shaped by policy directives, school leadership, workload structures, and infrastructure availability. Without cross-level analysis, the systemic conditions shaping TPACK enactment remain obscured.

In conclusion, the TPACK framework remains central for understanding teacher knowledge in technology integration, but its operationalization in China reveals enduring challenges. On the one hand, innovations such as AI-TPACK (B. Aydin et al., 2024) and Culture-DPACK (Y. Xu et al., 2025)demonstrate promising efforts to adapt TPACK to new technological and cultural realities. On the other hand, conceptual ambiguities, measurement limitations, and underdeveloped contextual adaptation constrain its transformative potential. Addressing these gaps requires:

- **Rigorous methodological innovation**, including longitudinal, mixed-method, and intervention-based designs to capture developmental and causal dynamics;
- **Systemic strategies** that integrate TPACK development with institutional and policy reforms, recognizing teachers as part of broader educational ecosystems rather than isolated actors; and
- **Deeper cultural contextualization**, embedding linguistic and cultural pedagogies into the heart of TPACK frameworks for Chinese language education.

Such advancements are crucial to ensure that TPACK continues to evolve as a robust framework capable of guiding both research and practice in China’s rapidly digitizing educational landscape.

2.9 Suitability of Educational Technology

Much of the discourse surrounding Educational Technology (EdTech) in China and globally has traditionally emphasized issues of availability and access, often measured in terms of infrastructure, device distribution, and connectivity (World, 2025b). While such metrics are crucial for ensuring baseline participation, scholars increasingly argue that access alone does not equate to meaningful educational impact(Selwyn, 2011). A more critical lens focuses on suitability, defined as the degree to which digital tools align with pedagogical purposes, subject-specific demands, and contextual realities. Suitability emphasizes that the presence of technology in classrooms does not guarantee effectiveness; rather, tools must be embedded in ways that support instructional goals, foster authentic learning experiences, and complement teachers' professional capacities.

The concept of suitability is particularly salient in Chinese language (CL) education, where the linguistic and cultural characteristics of the subject—such as tone acquisition, character-based literacy, and culturally embedded pragmatics—demand precise alignment between technological tools and instructional objectives (Huang & Zhao, 2023). Generic EdTech applications may enhance surface-level engagement but risk undermining deeper learning if they fail to accommodate the unique epistemic structures of the discipline. For example, character-recognition apps that prioritize speed may neglect stroke order accuracy, while global writing assistants may overlook rhetorical conventions specific to Chinese culture.

This study operationalizes suitability through four interrelated components:

- **Educational Effectiveness (EE):** The extent to which technology enhances teaching and learning outcomes by supporting active engagement, conceptual understanding, and long-term knowledge retention. EE reflects the degree to which tools go beyond novelty to deliver measurable educational benefits(Mitchell et al., 2018).
- **Content Fidelity (CF):** The accuracy and appropriateness with which EdTech represents subject matter. In CL education, this includes maintaining linguistic precision (e.g., tones, character forms, syntax) and ensuring that digital representations align with curricular standards (Zhao & Frank, 2003).
- **Feedback (FB):** The capacity of technology to provide timely, personalized, and pedagogically useful feedback to learners. Effective feedback tools not only correct errors but also guide students' self-regulation and scaffold deeper learning (Shute & Rahimi, 2021c).

- **Professional Development (PD):** The extent to which EdTech ecosystems incorporate opportunities for teacher learning, reflection, and adaptation. Suitability depends not only on the tool itself but also on the teacher's evolving capacity to use it effectively, which requires sustained professional development (Leu et al., 2024).

Together, these four dimensions acknowledge that EdTech suitability is multi-layered and context-sensitive. It requires balancing technological affordances with pedagogical integrity, content fidelity, and teacher agency. As such, suitability provides a more holistic framework than access-focused metrics, ensuring that technology integration supports both teachers and learners in ways that are educationally meaningful and culturally appropriate.

2.9.1 Educational Effectiveness (EE)

Educational effectiveness refers to the degree to which digital tools contribute to measurable learning improvements, encompassing cognitive, affective, and behavioral dimensions of learning. In the context of Chinese language (CL) teaching, educational effectiveness often manifests in areas such as vocabulary acquisition, character recognition, reading comprehension, pronunciation accuracy, and communicative competence. Unlike simple measures of access or engagement, educational effectiveness emphasizes whether EdTech use leads to **deeper learning, knowledge transfer, and sustained mastery** (Selwyn et al., 2020).

2.9.1.1 MALL and Engagement Beyond the Classroom

Mobile-Assisted Language Learning (MALL) applications have become one of the most widely studied EdTech interventions in language education. In Chinese contexts, MALL platforms support students in practicing tones, characters, and vocabulary beyond the classroom, offering opportunities for spaced repetition and authentic communicative practice (Wang et al., 2021; Wang et al., 2022; L. Wang et al., 2024). Empirical evidence indicates that such platforms increase student engagement, motivation, and self-directed learning, particularly among younger learners accustomed to mobile-first environments. However, effectiveness varies with task design: when MALL focuses only on drill-and-practice, it risks reinforcing rote memorization rather than fostering meaningful communicative competence (Fang, 2024; Hwang & Chang, 2011; Lai et al., 2013).

2.9.1.2 AI-Enhanced Platforms and Adaptive Learning

Recent developments in AI-enhanced platforms, such as intelligent writing assistants, adaptive tutoring systems, and automated speech recognition tools, demonstrate promise in personalizing learning experiences. These tools provide immediate feedback on tones, character formation, syntax, and writing structure, thereby addressing persistent linguistic challenges in CL learning (Fang, 2024; Hwang & Chang, 2011; Lai et al., 2013). For example, adaptive learning systems can adjust difficulty levels in real time based on learner performance, thereby preventing both disengagements from excessive difficulty and complacency from overly simple tasks. Such platforms have been shown to improve character recognition accuracy and writing fluency (Hew & Brush, 2007). Nevertheless, there is an emerging debate about over-reliance on automation: learners may depend on AI-generated corrections without internalizing underlying linguistic rules, resulting in surface learning rather than sustained mastery.

2.9.1.3 Teacher Mediation as a Critical Factor

A recurring theme in the literature is that the effectiveness of EdTech in Chinese language education depends heavily on teacher mediation and structured integration. Without pedagogical guidance, even the most advanced digital platforms may be used in reductive ways, serving as substitutes for memorization exercises rather than vehicles for critical thinking and communicative practice (Tondeur et al., 2021). Teachers play a crucial role in scaffolding digital tasks, encouraging reflective engagement, and ensuring that students transfer knowledge from digital environments into authentic communication. For instance, Xu (2025) found that teachers who integrated Culture-DPACK principles into CL teaching successfully leveraged EdTech to build not only linguistic accuracy but also cultural literacy, fostering a richer and more sustainable learning experience.

2.9.1.4 Challenges in Measuring Effectiveness

A further complexity lies in the measurement of educational effectiveness. Many studies report increases in engagement or short-term test scores, but fewer examine longitudinal outcomes, such as retention, transferability, or changes in communicative competence over time (Aydin & et al., 2024). Moreover, studies often conflate student enjoyment with learning effectiveness, raising questions about the validity of reported outcomes. As Selwyn (2022) cautions, the “novelty effect” of technology can temporarily boost motivation without corresponding gains in deep learning. Future research must therefore adopt rigorous, mixed-method designs to evaluate both immediate and long-term impacts(Selwyn, 2022).

In sum, evidence suggests that EdTech can enhance short-term engagement and comprehension in CL education, particularly through MALL and AI-enhanced platforms. However, its educational effectiveness is neither automatic nor guaranteed. Effectiveness depends on the quality of pedagogical integration, teacher mediation, cultural contextualization, and long-term evaluation of learning outcomes. This highlights the importance of moving beyond access and engagement metrics to interrogate whether technology use leads to sustained, transferable, and meaningful learning gains.

2.9.2 Content Fidelity (CF)

Content fidelity refers to the degree to which educational technologies accurately represent disciplinary knowledge and preserve the integrity of learning tasks. It ensures that digital tools not only deliver content but do so in ways that are faithful to the epistemic, linguistic, and cultural foundations of the subject area. Vanacore et al. (2025) distinguish between task fidelity—the alignment of digital activities with authentic disciplinary practices—and implementation fidelity—the alignment of technology use with intended pedagogical strategies. High content fidelity ensures that EdTech enhances, rather than distorts, learning experiences.

2.9.2.1 Critical Importance in Chinese Language Education

In Chinese language (CL) education, content fidelity is particularly critical because the subject is highly sensitive to small deviations in characters, tones, and cultural expressions. Unlike alphabetic languages, the logographic and tonal nature of Chinese means that even minor inaccuracies can result in significant distortions of meaning (Black & Wiliam, 2024). For example:

- **Handwriting recognition software** may incorrectly interpret stroke sequences, potentially teaching learners inaccurate character structures.
- **Automatic translation tools** often misrepresent idiomatic expressions, classical phrases, or culturally embedded metaphors, eroding linguistic authenticity.

- **Speech recognition systems** may fail to differentiate tonal variations, leading learners to reinforce incorrect pronunciations.

These inaccuracies risk undermining language acquisition, cultural immersion, and communicative competence, thereby limiting the educational effectiveness of EdTech in CL classrooms.

2.9.2.2 Global Tools and Pedagogical Misalignment

Research further suggests that many global EdTech products—though technically sophisticated—are pedagogically misaligned in the Chinese context. These platforms are often designed for English or other alphabetic languages and fail to address Chinese-specific linguistic and cultural requirements (Davis, 1989a). For instance, character-learning apps designed without accounting for stroke order pedagogy risk promoting recognition without writing competence. Similarly, Western-designed AI writing assistants may suggest sentence structures that conflict with Chinese rhetorical traditions, leading to culturally inappropriate or semantically awkward outputs (H. Guo & Y. Huang, 2024). This underscores that localization is not optional but essential: content fidelity in CL education requires deep alignment with curriculum standards, linguistic precision, and cultural authenticity.

2.9.2.3 The Dual Dimensions of Fidelity

Building on Vanacore et al. (2025), fidelity in EdTech can be understood through two dimensions:

- Task Fidelity: Does the tool replicate or support authentic learning tasks? For example, does a speech recognition tool facilitate genuine tone practice rather than simply detecting phonetic approximations?
- Implementation Fidelity: Is the tool being used in ways consistent with its intended pedagogical purpose? For example, handwriting recognition software should be integrated into formative practice routines rather than treated as a summative assessment substitute.

Failure in either dimension risks surface-level engagement rather than deep disciplinary learning.

2.9.2.4 Fidelity as a Cultural-Pedagogical Necessity

In Chinese language teaching, content fidelity is not merely a technical requirement but a cultural-pedagogical necessity. It ensures that tools support the acquisition of linguistic accuracy (tones, characters, syntax) and cultural authenticity (idioms, classical traditions, communicative norms). Xu's (2025) Culture-DPACK framework reinforces this point, embedding fidelity as central to effective technology integration in CL education. Without fidelity, technology risks reproducing distorted knowledge that erodes both language proficiency and cultural understanding.

Overall, content fidelity represents a non-negotiable dimension of EdTech suitability. While tools can expand access and engagement, their educational value depends on whether they accurately and authentically represent disciplinary knowledge. In CL education, this means ensuring that digital platforms respect the linguistic complexity and cultural depth of the subject, supporting meaningful learning rather than introducing distortions. Fidelity thus sits at the intersection of technical design, pedagogical practice, and cultural sensitivity, demanding careful evaluation and localization in the deployment of EdTech.

2.9.3 Feedback (FB)

Feedback is consistently recognized as one of the most powerful influences on learning achievement, shaping not only cognitive outcomes but also learner motivation, persistence, and self-regulation (Huang & et al., 2025). With the integration of digital technologies, the scope, form, and immediacy of feedback in education have expanded significantly. Unlike traditional classroom settings where feedback is often delayed, EdTech platforms provide opportunities for instantaneous, continuous, and multimodal feedback, thereby enabling more dynamic learning cycles.

2.9.3.1 Technology-Mediated Feedback: Enhancing Motivation and Achievement

A systematic review by Huang et al. (2025) confirmed that technology-mediated feedback—whether automated, peer-supported, or teacher-facilitated—can significantly improve student outcomes across domains, including language learning. Specifically, digital feedback systems enhance student motivation and persistence, as learners receive real-time indications of progress and areas for improvement. This immediacy supports self-regulated learning, as students can make corrective adjustments without waiting for formal evaluations. In Chinese language (CL) classrooms, this is particularly beneficial for tone recognition, character writing, and sentence structure, where continuous feedback is essential for mastery (Li & et al., 2025).

2.9.3.2 Automated Feedback: Speed and Scalability

Automated systems powered by AI and natural language processing offer instant correction on tasks such as character stroke order, tone pronunciation, and grammar. For example, handwriting recognition tools can provide immediate feedback on stroke accuracy, while speech recognition apps highlight tonal errors in real time (Liu & et al., 2025). These features shorten the feedback loop, allowing students to practice, receive corrections, and retry multiple times in rapid succession. In large classrooms, automated systems can scale feedback delivery, compensating for teacher workload limitations.

Yet, automated systems are not without challenges. Algorithms may lack contextual sensitivity—for instance, flagging culturally appropriate idiomatic expressions as incorrect or misinterpreting tone sandhi variations (Mishra & Koehler, 2006b). Overreliance on such systems risks confusing learners or encouraging dependence on automated corrections rather than internalizing linguistic rules (Zou & et al., 2025).

2.9.3.3 Human-Mediated Feedback: Nuance and Pedagogical Depth

Despite advances in automation, teacher-mediated feedback remains indispensable. Teachers can contextualize errors, provide formative insights, and address cultural or pragmatic dimensions that algorithms often miss. Digital platforms that combine teacher facilitation with technological affordances allow for a more balanced approach, blending efficiency with pedagogical nuance (Q. Zhang & Y. Tang, 2022). For example, online platforms enable teachers to annotate student writing, incorporate voice feedback, or engage in dialogic exchanges that foster reflective learning. Peer-supported platforms also expand the feedback ecology, enabling collaborative learning and peer scaffolding.

2.9.3.4 The Challenge of Balance: Efficiency vs. Appropriateness

The literature highlights a central tension: while automated feedback ensures efficiency and scalability, human-mediated feedback ensures accuracy, contextualization, and cultural appropriateness. In practice, many Chinese classrooms face constraints in achieving this balance. On the one hand, limited teacher capacity—due to large class sizes, heavy workloads, or insufficient training—reduces the feasibility of individualized digital feedback

(Liu & et al., 2025). On the other hand, an overreliance on automated systems risks superficial learning and neglects the socio-cultural aspects of language use. The optimal approach is thus blended feedback, where automation handles routine corrections while teachers and peers provide higher-order formative insights.

In sum, feedback remains a cornerstone of educational effectiveness, and EdTech has expanded its possibilities by enabling immediacy, scalability, and multimodality. However, its effectiveness depends on how feedback is balanced between automated and human-mediated forms, ensuring that corrections are not only efficient but also accurate, culturally sensitive, and pedagogically meaningful. In Chinese language education, where fidelity to tone, character, and cultural norms is paramount, such balance is particularly critical. Effective feedback systems must therefore be designed and implemented not merely as technical add-ons, but as integrated pedagogical strategies that foster authentic learning and sustained mastery.

2.9.4 Professional Development (PD)

Professional Development (PD) is a crucial dimension of EdTech suitability, as the effectiveness of digital tools depends not only on their technical affordances but also on teachers' evolving capacity to integrate them meaningfully. In the context of Chinese education, where large-scale reforms such as the Smart Education of China (SEC) and AI-driven initiatives are rapidly transforming teaching environments, PD serves as the bridge between policy ambitions and classroom realities (World, 2025a). Without systematic and sustained PD, even the most advanced tools risk being underutilized or misapplied.

2.9.4.1 The Central Role of PD in TPACK Development

Effective PD is essential for fostering Technological Pedagogical Content Knowledge (TPACK), which underpins meaningful technology integration. Research indicates that PD programs focusing only on technical proficiency (TK) are insufficient; teachers must also learn to situate tools within subject content and pedagogical strategies(Willermark, 2021b). In Chinese Language (CL) education, for instance, this means not only learning how to operate handwriting recognition apps, but also designing scaffolded tasks that align with curriculum standards and cultural-linguistic demands. Without such integrated PD, teachers often revert to traditional methods or adopt technology superficially, undermining its transformative potential.

2.9.4.2 Current Practices and Their Limitations

PD initiatives in China are widespread but often fragmented, episodic, and top-down. Workshops and short-term training sessions are common, especially in urban areas, yet studies reveal that such interventions rarely cultivate sustained growth in TPACK(Willermark, 2021b). Teachers report that PD frequently emphasizes technical demonstrations rather than hands-on practice, reflective learning, or peer collaboration (H. Guo & Y. Huang, 2024). As a result, many teachers remain at the stage of using technology as a supplement (e.g., for slide presentations) rather than as a tool for redesigning learning experiences.

Generational and regional divides exacerbate this issue. Younger teachers tend to adapt quickly to new digital tools, while senior teachers—especially in rural schools—often lack both confidence and access to quality PD opportunities. This unevenness risks entrenching inequities in technology integration, even as national reforms emphasize digital inclusivity.

2.9.4.3 AI and the Expanding Demands of PD

The emergence of AI in education places new demands on PD. Teachers now require AI-TPACK competencies, including algorithmic literacy, ethical awareness, and skills in interpreting data from intelligent tutoring systems (H. Guo & Y. Huang, 2024). However, most PD programs in China have yet to fully address these needs, focusing instead on familiarizing teachers with tools rather than preparing them to evaluate ethical risks, algorithmic biases, or data privacy issues (Reuters, 2025). This gap highlights the need for forward-looking PD models that not only teach technical skills but also cultivate critical and ethical engagement with emerging technologies.

2.9.4.4 Towards Sustainable, Teacher-Centered PD Models

Evidence suggests that the most effective PD is sustained, collaborative, and context-specific. Approaches such as professional learning communities (PLCs), peer mentoring, and practice-based workshops have been shown to strengthen teachers' confidence and competence in technology integration(Huang & et al., 2025). Embedding PD into teachers' daily routines—through iterative practice, reflective inquiry, and integration with school culture—yields more durable outcomes than isolated training events. Moreover, PD that addresses cultural and subject-specific pedagogies—such as tone accuracy, idiomatic usage, or classical Chinese literacy—ensures that EdTech tools are not only used but used meaningfully in CL classrooms.

In summary, Professional Development is not an optional complement but a core determinant of EdTech suitability. While China has made significant strides in scaling digital education, PD remains a bottleneck: fragmented, tool-focused, and uneven across demographics. Addressing this requires systemic shifts toward long-term, teacher-centered, and culturally grounded PD models. Such approaches must cultivate integrated TPACK competence, prepare teachers for the ethical complexities of AI-driven education, and situate technology use within authentic pedagogical and cultural contexts. Only then can PD fulfill its role in bridging the gap between technological potential and pedagogical transformation.

2.9.5 Critical Analysis and Synthesis

Taken together, the four components of suitability—Educational Effectiveness (EE), Content Fidelity (CF), Feedback (FB), and Professional Development (PD)—highlight a paradigmatic shift in EdTech research and practice: from an earlier emphasis on availability and access toward a more nuanced focus on pedagogically meaningful integration. This transition underscores the recognition that technology in education is not inherently transformative; its impact depends on how effectively it is aligned with instructional goals, subject matter fidelity, feedback mechanisms, and teacher capacity (Huang & et al., 2025). While empirical evidence confirms the potential of EdTech to enhance learning, especially in Chinese language education, the literature also reveals persistent limitations and tensions.

2.9.5.1 Short-term vs. Long-term Outcomes

A recurring theme in EdTech research is the tension between immediate engagement gains and sustained learning outcomes. Numerous studies demonstrate that digital platforms increase student motivation, enjoyment, and participation in the short term (Venkatesh et al., 2012b). However, evidence of long-term retention, knowledge transfer, and sustained mastery remains scarce. Many evaluations rely on short-duration interventions or pilot studies, failing to capture whether learning improvements endure once the novelty effect of technology subsides (Shute & Rahimi, 2021a). This gap underscores the need for longitudinal and experimental designs that trace the durability of EdTech's impact across semesters or entire learning trajectories.

2.9.5.2 Fidelity Concerns in the Chinese Context

Content fidelity emerges as a critical challenge in Chinese language (CL) education, where small deviations in tones, character forms, or idiomatic expressions can significantly distort meaning. While global EdTech tools often claim universality, they frequently fail to capture the linguistic complexity and cultural authenticity required in CL learning (Shute & Rahimi, 2021a). For example, handwriting recognition software may overlook stroke order accuracy, and AI translation tools may misinterpret classical idioms, undermining both linguistic and cultural learning. This fidelity gap suggests that without localization and cultural adaptation, EdTech risks reinforcing pedagogical misalignment rather than enhancing learning. Models such as Culture-DPACK (Xu, 2025) have made strides in addressing these challenges, but widespread adoption remains limited.

2.9.5.3 The Feedback Paradox

Feedback represents both the strength and weakness of EdTech integration. Automated feedback systems excel in efficiency, immediacy, and scalability, providing instant corrections in character recognition, tone pronunciation, or syntax. However, they often lack contextual and cultural sensitivity, occasionally misclassifying legitimate expressions as errors. Conversely, teacher-mediated feedback provides nuance, cultural appropriateness, and formative depth, but scalability remains a major constraint in large classrooms with heavy workloads (Li & et al., 2025; Liu & et al., 2025). This "feedback paradox" illustrates the central challenge of balancing efficiency with pedagogical integrity. The most promising practices involve hybrid feedback ecosystems, where automated systems handle routine corrections while teachers and peers provide higher-order cultural and pedagogical insights.

2.9.5.4 Fragmented Professional Development

Professional Development (PD) remains a structural bottleneck in realizing EdTech's pedagogical potential. In China, PD is often sporadic, episodic, and tool-centric, focusing on technical proficiency rather than integrated pedagogical practice. Evidence shows that without sustained, reflective, and collaborative PD, teachers tend to adopt technology at a superficial level, using it primarily for administrative support or presentation (Liu et al., 2025). Generational and regional disparities exacerbate these challenges, with younger teachers adapting more quickly than senior or rural teachers, who often face limited access to quality PD opportunities. This fragmentation highlights the need for systemic PD ecosystems, grounded in sustained collaboration, practice-based inquiry, and culturally relevant pedagogy.

In synthesis, the analysis of suitability reveals that EdTech's promise lies less in its technical availability and more in its contextual integration. The four components collectively illustrate that:

- **Educational effectiveness** must be measured not only by short-term engagement but also by sustained mastery and transferability.
- **Content fidelity** is indispensable in CL education, where linguistic and cultural precision determines the authenticity of learning outcomes.
- **Feedback systems** must balance efficiency with cultural and pedagogical appropriateness to ensure meaningful learning.
- **Professional development** must move beyond episodic technical training toward long-term, systemic, and culturally grounded teacher empowerment.

These findings align with calls for a pedagogy-driven, teacher-centered, and culturally sensitive approach to technology integration (Li & et al., 2025; Liu & et al., 2025). While innovations such as AI-TPACK and Culture-DPACK represent important conceptual advances, their practical impact depends on rigorous methodological research and systemic institutional reforms that recognize teachers as part of a broader educational ecosystem rather than isolated actors.

2.10 Identified Gaps

Despite promising advances in the study of EdTech suitability, several critical research and practice gaps remain, particularly in the Chinese language (CL) education context. These gaps highlight the tension between policy-driven innovation and the practical realities of classroom integration, underscoring the need for more rigorous, context-sensitive inquiry.

2.10.1 Longitudinal Studies on Sustained Learning Outcomes

Most existing research on EdTech effectiveness in language learning focuses on short-term engagement and immediate performance gains, often measured through pre- and post-tests or student surveys. While such findings confirm EdTech's potential to boost motivation and comprehension, there is a lack of longitudinal studies that track knowledge retention, transferability, and sustained mastery over semesters or academic years (Li & et al., 2025; Liu & et al., 2025). In rapidly evolving EdTech environments, understanding how learning outcomes persist—or decay—over time is crucial for assessing whether technology integration is genuinely transformative rather than novelty-driven.

2.10.2 Limited Evaluation of Content Fidelity in CL Education

The issue of content fidelity remains underexplored, despite its centrality in Chinese language teaching. Tools such as handwriting recognition software, automatic translation systems, and AI-powered speech recognition often produce errors in tones, stroke sequences, or idiomatic expressions (Tondeur & et al., 2021). Yet, systematic evaluation frameworks that assess linguistic precision, cultural authenticity, and curriculum alignment are scarce. Without robust fidelity assessments, EdTech risks undermining linguistic integrity and reinforcing pedagogical misalignment, particularly in CL education where small deviations can result in significant distortions of meaning.

2.10.3 Insufficient Hybrid Feedback Models

While research acknowledges the feedback paradox—the trade-off between automated efficiency and teacher-mediated nuance—few studies propose or evaluate hybrid feedback models that effectively integrate both. Existing systems often privilege one dimension: automation for scale or teacher facilitation for depth. Yet CL education requires dual-layered feedback ecosystems: automated systems for real-time corrections on tones and characters, complemented by teacher- or peer-mediated insights into cultural appropriateness, pragmatic use, and reflective practice (Venkatesh et al., 2012b). The absence of tested hybrid models limits the pedagogical potential of feedback systems in language learning.

2.10.4 Underdeveloped Professional Learning Ecosystems

Professional development (PD) remains fragmented and predominantly tool-focused, offering workshops that emphasize technical proficiency rather than integrated, reflective pedagogy. There is a clear gap in professional learning ecosystems—sustained, collaborative, and practice-based structures that continuously support teachers' growth in EdTech suitability. Research indicates that one-off training sessions do not yield long-term TPACK development; instead, professional learning communities, iterative cycles of practice and reflection, and embedded school-level support are needed. In the absence of such ecosystems, teachers often revert to traditional practices or adopt EdTech superficially.

In conclusion, the suitability of EdTech is inherently multidimensional, requiring attention not only to technological innovation but also to pedagogical alignment, cultural authenticity, and teacher capacity. In the context of Chinese language education, where linguistic precision and cultural depth are paramount, these dimensions become even more critical. Four research gaps demand urgent attention:

- The absence of longitudinal evidence on sustained learning outcomes.
- Insufficient evaluation of content fidelity, particularly for Chinese linguistic and cultural demands.
- A lack of robust hybrid feedback models integrating automated and teacher-mediated approaches.
- Underdeveloped professional learning ecosystems that move beyond episodic training toward continuous, practice-based development.

Addressing these gaps is essential if EdTech is to move from availability-driven adoption toward pedagogically meaningful, culturally grounded, and teacher-empowered integration, ultimately fulfilling its transformative promise in Chinese language education and beyond.

2.11 Teacher Readiness and Attitudes towards EdTech

Teacher readiness is increasingly recognized as a critical determinant of meaningful EdTech adoption. Whereas earlier discourses emphasized infrastructure and tool availability, current research highlights that teachers' willingness, confidence, and capacity are the real drivers of whether technologies translate into pedagogical transformation (Venkatesh et al., 2012b). Readiness typically encompasses three interrelated dimensions: (i) confidence in using technology, (ii) digital skills required for effective integration, and (iii) perceptions of barriers that may hinder adoption. In the Chinese context, readiness has become particularly salient given the state's rapid digitalization agenda, driven by initiatives such as the Smart Education of China (SEC) platform (World, 2025a). While most teachers express broad support for digital transformation, their ability and willingness to integrate tools in practice remains uneven across demographics, regions, and institutional settings.

2.11.1 Confidence and Digital Skills

Teachers' confidence in using digital tools—often conceptualized as digital self-efficacy—is consistently linked to their EdTech adoption behaviors. Liu et al. (2025) demonstrated that digital self-efficacy significantly predicts teachers' willingness to experiment with online instruction, AI-supported tutoring systems, and mobile-assisted learning (MALL). Confidence, therefore, is not merely a psychological trait but a behavioral driver of EdTech integration.

Generational patterns are clearly evident. Younger teachers—often trained in environments where technology integration was already normalized—display stronger digital fluency and greater willingness to experiment with novel tools (Li & et al., 2025). They are more likely to explore AI-powered writing assistants, MALL apps, and collaborative cloud platforms, perceiving them as extensions of their pedagogy. By contrast, older or more experienced teachers often express anxiety and resistance, fearing that technology may disrupt established routines or erode their instructional authority. These perceptions slow down adoption in contexts such as language education, where traditional face-to-face pedagogies—memorization, calligraphy, and oral recitation—carry strong cultural legitimacy.

Confidence is also discipline-sensitive. In Chinese language teaching, where accuracy in tones, character formation, and cultural expression is paramount, teachers with limited confidence may avoid tools they perceive as risky, reinforcing a traditional pedagogy–digital divide(Q. Zhang & Y. Tang, 2022).

2.11.2 Perceptions of Barriers

Despite enthusiasm for EdTech, several perceived barriers constrain teacher readiness:

- **Workload pressures**: Many teachers regard EdTech as an "add-on" rather than as a workload-reducing innovation. Integrating new platforms often requires lesson redesign, student monitoring, and troubleshooting, which can initially increase workload(Q. Zhang & Y. Tang, 2022).
- **Infrastructure constraints**: Regional inequities persist. Rural and underfunded schools frequently face unstable internet, outdated devices, and inadequate IT support, all of which limit teachers' ability to adopt technology meaningfully(Yeow et al., 2023). This perpetuates the urban–rural digital divide, undermining equity goals of national reforms.
- **Limited technical support**: Teachers often report frustration with the absence of institutionalized support systems. Without reliable troubleshooting channels or peer collaboration opportunities, even enthusiastic teachers risk technological fatigue (H. Guo & Y. Huang, 2024).
- **Cultural misalignment**: Some teachers perceive global tools as culturally inappropriate, especially in Chinese language teaching, where idiomatic, tonal, and character-based nuances are easily distorted (Black & Wiliam, 2024).

2.11.3 Institutional Support and Systemic Enablers

Institutional ecosystems profoundly shape teacher readiness. Empirical evidence shows that mentoring, ongoing professional development, and supportive leadership significantly enhance teachers' willingness and capacity to adopt technology (Black & Wiliam, 2024). Schools that embed collaborative professional cultures, reduce workload barriers, and allocate resources strategically foster environments conducive to sustained adoption.

However, fragmentation remains a defining feature of institutional support in China. Many PD programs are designed as short-term workshops focused on technical demonstrations rather than reflective, practice-based integration (H. Guo & Y. Huang, 2024). Moreover, top-down policy directives tend to emphasize deployment of technology infrastructure while paying insufficient attention to teacher empowerment and agency (World, 2025b). This disconnect often leaves teachers caught between policy rhetoric and classroom realities, reducing readiness to experiment with technology in meaningful ways.

2.11.4 Demographic Influences on Readiness

Teacher readiness varies significantly across demographic and experiential dimensions:

- **Age and generational divides**: Younger teachers display higher confidence and digital literacy, while older teachers often report higher levels of anxiety and barriers.
- **Teaching experience**: Novice teachers may be more open to innovative experimentation, whereas veteran teachers often prioritize stability and tested practices, creating resistance to change.
- **Educational background**: Teachers with exposure to digital pedagogy during initial training programs are more prepared for integration compared to those trained under traditional pedagogical frameworks.
- **Institutional context**: Teachers in elite urban schools typically enjoy better infrastructure, stronger PD ecosystems, and more supportive leadership, while those in rural schools encounter systemic constraints that limit readiness.

These demographic variations highlight that one-size-fits-all training approaches are inadequate. Tailored, differentiated support is needed to address the diverse readiness profiles of teachers across China.

2.11.5 Critical Analysis and Synthesis

The literature on teacher readiness offers three overarching insights:

- **Readiness is multidimensional**. Confidence, digital skills, and perceived barriers interact dynamically. Addressing one dimension (e.g., providing skills training) without tackling others (e.g., workload or infrastructure constraints) produces limited gains (Tondeur et al., 2012).

- **Institutional ecosystems matter**. Readiness cannot be conceptualized purely as an individual trait; it is embedded within systemic contexts such as policies, workload structures, professional cultures, and infrastructure (Tsai et al., 2020).
- **Generational divides persist**. Younger teachers' higher confidence and fluency contrast with older teachers' reluctance, producing uneven integration across institutions (Tsai et al., 2020).

The analysis thus suggests that teacher readiness is as much systemic as it is individual, requiring interventions at multiple levels—teacher training, institutional culture, and policy design.

2.12 Identified Gaps

Despite valuable contributions, the literature on teacher readiness reveals several critical gaps:

- **Lack of longitudinal studies**: Few studies track how readiness evolves over time as teachers gain experience with tools or participate in sustained PD.
- **Insufficient rural-focused research**: Much of the literature disproportionately represents urban teachers, overlooking the unique readiness challenges in rural contexts.
- **Limited examination of teacher attitudes toward AI tools**: While AI-enhanced platforms are central to China's digitalization agenda, research rarely explores teachers' attitudes toward AI in sensitive domains, such as automated assessment, feedback, and student monitoring.
- **Underrepresentation of teacher agency**: Many studies frame readiness primarily as a technical skillset, neglecting the role of teachers' professional identity, pedagogical beliefs, and agency in shaping EdTech adoption.

As conclusion, teacher readiness is central to the successful integration of EdTech, yet in China it remains uneven across demographic groups, institutional contexts, and geographic regions. Younger, digitally fluent teachers exhibit greater confidence, while older and rural teachers face systemic and cultural barriers. Institutional ecosystems—particularly professional development, workload structures, and leadership—emerge as decisive enablers. Bridging readiness gaps requires moving beyond technical training toward a comprehensive readiness model that integrates confidence, digital skills, systemic enablers, and cultural sensitivity, while explicitly acknowledging teacher agency and diversity. Such an approach would align more closely with the goals of sustainable, equitable, and pedagogically meaningful EdTech adoption in Chinese education.

2.13 Research Gaps

Despite China's rapid advances in digital education, significant research gaps persist at the intersection of TPACK, EdTech suitability, and teacher readiness in Chinese language (CL) instruction. While existing studies provide valuable insights into digital transformation, much of the evidence remains fragmented, inconclusive, or underdeveloped, especially when applied to linguistically and culturally complex subjects such as Chinese.

2.13.1 Limited Evidence on Variability in EdTech Suitability Across Teacher Demographics

Although studies acknowledge generational divides in digital competence (Tsai et al., 2020) and differences in self-efficacy and readiness among teachers(Bandura, 1997), there is insufficient evidence on how demographic characteristics shape perceptions of EdTech **suitability**. Specifically, little is known about whether teachers of different ages, experience levels, or educational backgrounds perceive technology as:

- **Educationally effective (EE),**
- **Accurate in content fidelity (CF),**
- **Supportive of feedback (FB),** or
- **Aligned with professional development (PD).**

For instance, younger teachers may view AI-driven tutoring systems as highly effective due to their digital fluency, whereas older teachers may question their pedagogical appropriateness (Q. Zhang & Y. Tang, 2022). Without disaggregated evidence by demographics, interventions risk being generic rather than targeted. This gap highlights the need for differentiated professional development strategies tailored to teachers' diverse readiness profiles.

2.13.2 Insufficient Research on TPACK–EdTech Suitability Relationships in CL Instruction

The TPACK framework has been widely studied in China (Mishra & Koehler, 2006b), yet few studies explicitly examine its connection to EdTech suitability dimensions in CL classrooms. For example:

- It remains unclear whether technological pedagogical knowledge (TPK) or technological content knowledge (TCK) exerts greater influence on content fidelity in Chinese character instruction.
- The role of pedagogical content knowledge (PCK) in shaping teachers' ability to provide feedback through digital platforms is also underexplored.

This lack of integration limits the ability to develop holistic models that explain how teacher knowledge translates into effective technology use in linguistically complex classrooms.

2.13.3 Lack of Clarity on Which TPACK Components Best Predict EdTech Suitability

Although numerous studies measure TPACK competencies, there is little consensus on which components most strongly predict EdTech suitability. Some research highlights technological knowledge (TK) as foundational for adoption, while others emphasize the intersectional domains (TPK, TCK, or full TPACK) as more critical predictors.

This absence of predictive clarity has practical implications. Teacher training programs often adopt a broad-based approach, requiring mastery of all TPACK dimensions without prioritization. This leads to inefficient allocation of training resources and uneven outcomes. Identifying the most predictive components would enable policymakers to design streamlined, evidence-based PD programs focusing on the competencies that matter most for classroom practice.

2.13.4 Uneven Documentation of Teacher Readiness and Attitudes in CL Classrooms

While research documents general patterns of teacher readiness—including confidence, skills, and barriers evidence specific to Chinese language classrooms remains limited. CL instruction involves unique challenges:

- **Character-based literacy**,
- **Tone acquisition**, and
- **Cultural authenticity**.

Yet, most readiness studies treat teachers as a homogeneous group, overlooking subject-specific challenges faced by CL educators. Consequently, policies and PD programs often fail to address distinctive readiness needs, weakening EdTech integration in one of China's most culturally significant subjects.

2.13.5 Synthesis of Gaps

In synthesis, the literature highlights rapid national progress in digital infrastructure and important innovations in TPACK adaptation (e.g., AI-TPACK, Culture-DPACK), but reveals persistent gaps in empirical application and evidence:

- **Demographic variability** is underexplored, limiting the design of differentiated PD programs.
- **TPACK–suitability linkages** remain conceptually fragmented and empirically thin.
- **Predictive clarity** on which TPACK components matter most is lacking, undermining PD precision.
- **Subject-specific readiness** in CL teaching is under documented, leaving linguistic and cultural complexities insufficiently examined.

To conclude, this study addresses these gaps by systematically investigating the intersection of TPACK, EdTech suitability, and teacher readiness among CL teachers in China. In doing so, it aims to generate empirical clarity and practical guidance for policymakers, school leaders, and teacher educators seeking to advance meaningful digital integration in CL instruction.

2.14 Theoretical Foundation of the Study

This study is grounded in a multi-theoretical foundation that integrates teacher knowledge frameworks, technology acceptance theories, instructional design perspectives, and sociocultural learning theories. Taken together, these frameworks provide a comprehensive lens for examining the interplay between TPACK, EdTech suitability, and teacher readiness in the context of Chinese language (CL) teaching.

2.14.1 Technological Pedagogical Content Knowledge (TPACK) Framework

The TPACK framework (Mishra & Koehler, 2006b) provides the central theoretical anchor for this study. TPACK conceptualizes teacher knowledge as the integration of three primary domains:

- **Content Knowledge (CK):** Subject-matter expertise, including mastery of Chinese characters, grammar, tones, and cultural expressions.
- **Pedagogical Knowledge (PK):** Knowledge of instructional strategies, classroom management, and curriculum design.
- **Technological Knowledge (TK):** Knowledge of digital tools, AI-enhanced systems, and online platforms.

The intersections of these domains—Technological Pedagogical Knowledge (TPK), Pedagogical Content Knowledge (PCK), and Technological Content Knowledge (TCK)—form the broader TPACK construct, representing teachers' ability to integrate technology meaningfully into subject-specific instruction.

In CL education, TPACK is particularly relevant because linguistic and cultural precision must be preserved during technology use. For example, teachers need TCK to evaluate whether handwriting recognition apps accurately model character strokes, and TPK to design tasks that scaffold tone acquisition. Thus, TPACK provides a knowledge-based foundation for analyzing how CL teachers evaluate EdTech in terms of content fidelity, pedagogical alignment, and learning outcomes.

2.14.2 Technology Acceptance and Readiness Perspectives

Teacher readiness and attitudes toward EdTech can be illuminated by technology acceptance and readiness theories. The Technology Acceptance Model (TAM) (Davis, 1989) remains one of the most widely applied frameworks, positing that two beliefs—perceived usefulness (PU) and perceived ease of use (PEOU)—determine users' behavioral intentions toward adopting technology.

- In this study, PU is reflected in teachers' judgments of educational effectiveness (EE) and content fidelity (CF) of EdTech tools.
- PEOU aligns with teachers' confidence, digital skills, and perceptions of barriers, which together constitute readiness.

Building on TAM, self-efficacy theory (Bandura, 1997) provides further insight into how teachers' beliefs about their digital competence influence their actual adoption behaviors. Teachers with high digital self-efficacy are more likely to experiment with AI-based platforms, MALL applications, and collaborative online tools, while those with low self-efficacy may resist adoption despite institutional support.

Recent adaptations, such as the Unified Theory of Acceptance and Use of Technology (UTAUT2), also highlight the role of social influence, facilitating conditions, and habit, which are particularly relevant in China's top-down, policy-driven digitalization context.

2.14.3 Suitability of Educational Technology

This study operationalizes suitability of EdTech through four dimensions: educational effectiveness (EE), content fidelity (CF), feedback (FB), and professional development (PD). These dimensions draw from instructional design theory (Reigeluth, 1999) and related frameworks emphasizing the alignment of tools with learning goals, authenticity of tasks, and opportunities for scaffolding.

- **Educational Effectiveness (EE):** Anchored in constructivist learning theory, emphasizing that technology should promote active engagement, knowledge construction, and learner autonomy (Jonassen, 1999).
- **Content Fidelity (CF):** Grounded in authenticity and fidelity principles in instructional design, ensuring that tools preserve linguistic and cultural accuracy—a non-negotiable in CL instruction.
- **Feedback (FB):** Informed by formative assessment theory (Black & Wiliam, 1998), emphasizing the importance of timely, actionable, and context-sensitive feedback to support iterative learning cycles.

- **Professional Development (PD):** Supported by adult learning theory (andragogy), which stresses continuous, practice-embedded, and collaborative professional learning, rather than episodic technical workshops.

By embedding suitability within instructional design perspectives, this study moves beyond "access metrics" to focus on whether EdTech is pedagogically meaningful, contextually authentic, and professionally sustainable.

2.14.4 Sociocultural Theory

The integration of EdTech in CL education is also framed through Vygotsky's (1978) sociocultural theory, which highlights the role of social interaction, cultural tools, and mediation in learning. According to this perspective, digital technologies—including AI tutors, collaborative platforms, and immersive environments—act as mediating artifacts that scaffold learners within their zone of proximal development (ZPD).

This framework is especially relevant in CL teaching, where cultural authenticity, idiomatic expressions, and tonal precision are central to learning. EdTech tools are not only carriers of content but also cultural mediators that shape how learners engage with traditions, scripts, and communicative norms. For example, intelligent writing assistants can scaffold learners' mastery of classical idioms, while VR platforms can immerse students in culturally embedded communicative contexts. Thus, sociocultural theory ensures that EdTech evaluation in CL classrooms remains attuned to cultural depth and contextual appropriateness (Zou & et al., 2025).

2.14.5 Synthesis of Theoretical Foundations

By integrating these perspectives, the study builds a multi-level theoretical foundation:

- **Individual Level:** Teachers' digital self-efficacy and readiness (TAM, self-efficacy theory).
- **Knowledge Level:** Teachers' competence in integrating CK, PK, and TK (TPACK framework).
- **Pedagogical Design Level:** Suitability of tools in terms of EE, CF, FB, and PD (instructional design, assessment, adult learning).
- **Cultural Level:** The authenticity and contextual appropriateness of technology in CL education (sociocultural theory).

Taken together, these theories highlight that successful EdTech integration requires more than access to tools. It depends on teachers' integrated knowledge (TPACK), attitudes and readiness (TAM, self-efficacy), the pedagogical suitability of tools (instructional design and feedback theories), and cultural authenticity (sociocultural theory). This integrative theoretical grounding enables a nuanced investigation of how TPACK, suitability, and readiness intersect to shape EdTech adoption in Chinese language classrooms.

2.15 Development of the Research Framework

The development of the research framework for this study is informed by the multi-theoretical foundation and the review of related literature presented in earlier sections. Drawing on three major strands of scholarship—TPACK, EdTech suitability, and teacher readiness and attitudes—the framework seeks to explain how Chinese language (CL) teachers adopt, evaluate, and integrate educational technologies into classroom practice. The framework integrates knowledge-based predictors (TPACK), outcome-focused criteria (suitability), and contextual influences (readiness and demographics) to construct a holistic model that captures the complexity of technology adoption in CL education.

2.15.1 Foundation in TPACK

The TPACK framework (Mishra & Koehler, 2006b)serves as the core theoretical anchor, conceptualizing teachers' ability to integrate technology, pedagogy, and content knowledge in classroom practice. Research in China demonstrates significant variability in teachers' TPACK development (Li & et al., 2025; Liu & et al., 2025). However, empirical evidence remains limited regarding how different TPACK components—such as Technological Knowledge (TK), Technological Pedagogical Knowledge (TPK), Technological Content Knowledge (TCK), and Pedagogical Content Knowledge (PCK) influence subject-specific EdTech suitability in CL education.

For instance, while TK may enable teachers to operate digital platforms, TPK and TCK are arguably more critical for ensuring that tools are used in ways that preserve linguistic accuracy (tones, characters) and cultural authenticity. In this study, TPACK is conceptualized as a predictor variable, with the hypothesis that higher levels of TPACK competence are positively associated with teachers' evaluations of EdTech tools across dimensions of suitability.

2.15.2 Operationalization of EdTech Suitability

To move beyond a narrow focus on access or technical availability, this study operationalizes EdTech suitability through four interrelated dimensions, derived from instructional design and formative assessment literature:

- **Educational Effectiveness (EE):** The extent to which tools contribute to measurable improvements in engagement, comprehension, and learning outcomes.
- **Content Fidelity (CF):** The degree to which tools accurately represent disciplinary knowledge, preserve linguistic precision, and reflect cultural authenticity.
- **Feedback (FB):** The capacity of tools to provide timely, accurate, and context-sensitive feedback, motivating learners and supporting formative learning cycles.
- **Professional Development (PD):** The availability of sustained, practice-oriented training that supports teachers' informed adoption, integration, and evaluation of tools.

This multidimensional approach acknowledges that suitability is not defined by technical novelty but by the pedagogical and cultural appropriateness of EdTech in specific instructional contexts such as CL education.

2.15.3 Role of Teacher Readiness and Attitudes

Teacher readiness emerges as a critical mediating and moderating factor in technology adoption. Rooted in the Technology Acceptance Model (TAM) and self-efficacy theory, readiness is conceptualized through three dimensions: confidence, digital skills, and perceived barriers.

Empirical studies in China demonstrate that readiness varies significantly by age, teaching experience, and educational background. For example, younger teachers with higher digital fluency often demonstrate greater confidence and willingness to adopt new tools, whereas older teachers may resist integration due to workload pressures or anxiety about disrupting established routines. This suggests that even teachers with high levels of TPACK may resist EdTech adoption if contextual barriers—such as infrastructure constraints, limited institutional support, or low digital self-efficacy—persist.

Accordingly, teacher readiness is conceptualized in this study as a contextual influence that shapes the relationship between TPACK competence and perceptions of EdTech suitability.

2.15.4 Linking the Constructs

Based on the above theoretical and empirical insights, the research framework integrates the constructs through the following assumptions:

1. **TPACK as a Predictor:** Teachers' ability to integrate TK, PK, and CK determines the extent to which they can critically evaluate and effectively utilize EdTech tools.
2. **Suitability as an Outcome:** EdTech suitability (EE, CF, FB, PD) is the dependent construct, representing the degree to which technology integration achieves pedagogical and disciplinary goals.
3. **Readiness as a Contextual Influence:** Teacher readiness functions both as a mediator and moderator, shaping the degree to which TPACK is applied and influencing perceptions of EdTech suitability.
4. **Demographic Variables as Differentiators:** Variations in age, teaching experience, and educational level may explain disparities in TPACK competence, readiness, and suitability judgments.

This integrated model positions EdTech adoption as an interactional process, rather than a linear sequence, in which knowledge, readiness, and contextual variables coalesce to determine outcomes.

2.16 Research Framework

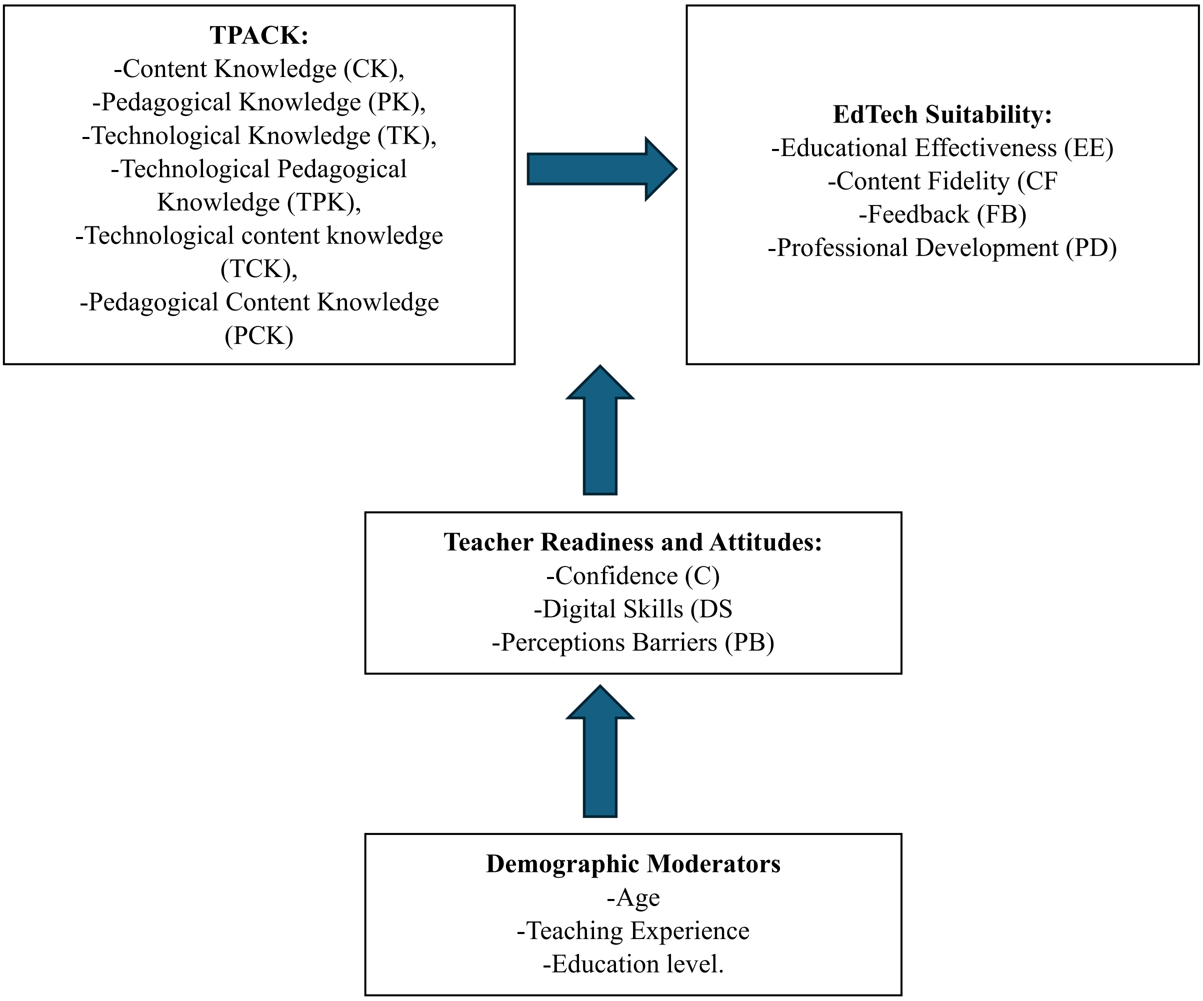
From these linkages, the study's research framework is conceptualized as follows:

- **Independent Variable (IV):** TPACK components (TK, PK, CK, TPK, TCK, PCK).
- **Dependent Variable (DV):** EdTech suitability (EE, CF, FB, PD).
- **Contextual Factors:** Teacher readiness and attitudes (confidence, digital skills, perceived barriers).
- **Moderating Variables:** Demographic characteristics (age, teaching experience, education level).

This framework not only aligns with prior empirical findings but also responds directly to identified research gaps by clarifying which knowledge domains, contextual enablers, and demographic differentiators matter most in advancing EdTech integration in CL classrooms.

Figure 2-1

Research Framework: TPACK, EdTech Suitability, Teacher Readiness & Attitudes



The research framework of this study integrates three central constructs—TPACK, EdTech suitability, and teacher readiness and attitudes—within the demographic context of Chinese language teachers. This framework is developed to systematically examine how teachers' technological knowledge interacts with their perceptions of tool suitability and their readiness to adopt educational technologies in classroom practice.

2.16.1 TPACK as the Core Predictor

The Technological Pedagogical Content Knowledge (TPACK) framework (Mishra & Koehler, 2006) is positioned as the independent construct of the study. It emphasizes that effective technology integration requires not just knowledge of technology (TK), pedagogy (PK), or content (CK) alone, but the interplay of these domains in real teaching contexts.

- Operationalization in this study: The framework disaggregates TPACK into six measurable domains: TK, PK, CK, TPK, TCK, and PCK.
- Assumption: Teachers who demonstrate stronger TPACK are better able to evaluate, adapt, and apply EdTech tools in ways that enhance Chinese language learning.

Thus, TPACK competence is hypothesized to directly influence teachers' judgments of EdTech suitability.

2.16.2 EdTech Suitability as the Dependent Construct

The dependent variable of the study is EdTech suitability, operationalized across four dimensions:

- Educational Effectiveness (EE): The extent to which tools improve student engagement, comprehension, and outcomes.
- Content Fidelity (CF): The degree to which tools accurately represent linguistic and disciplinary knowledge, particularly important in Chinese character-based literacy.
- Feedback (FB): Whether tools provide timely and pedagogically meaningful feedback to learners.
- Professional Development (PD): The extent to which teachers have access to sustained, practice-embedded learning opportunities that enhance their ability to use EdTech tools appropriately.

Suitability represents the "fit" of a technology within a pedagogical and cultural context, rather than its availability alone.

2.16.3 Teacher Readiness and Attitudes as Contextual Influences

The framework incorporates teacher readiness and attitudes as a contextual factor that shapes the relationship between TPACK and EdTech suitability. Teacher readiness and attitudes is defined across three sub-dimensions (Li & et al., 2025; Liu & et al., 2025):

- Confidence (C): Teachers' belief in their ability to integrate EdTech effectively.
- Digital Skills (DS): Practical competencies required to operate, adapt, and troubleshoot EdTech tools.
- Perceptions Barriers(PB): Teachers' beliefs about constraints such as workload, infrastructure, and limited support.

Rationale: Even teachers with strong TPACK may not evaluate or adopt EdTech tools as suitable if their readiness is low. For example, a teacher who understands TPK conceptually may still resist integrating mobile apps due to workload stress or low digital self-efficacy.

Thus, readiness operates as a mediating contextual factor, amplifying or constraining the impact of TPACK on EdTech suitability.

2.16.4 Demographic Moderators

The framework also accounts for demographic moderators, including age, teaching experience, and education level.

- Younger teachers often report higher confidence and digital fluency, while more experienced teachers express more barriers to adoption.
- Teachers with advanced academic training may demonstrate greater awareness of pedagogy-technology-content alignment compared to those trained primarily in traditional methods.

Rationale: These demographics may explain variability in both TPACK competence and readiness, thereby influencing perceptions of EdTech suitability.

2.16.5 Integration of Constructs

The framework thus proposes the following pathways:

- TPACK → EdTech Suitability: Teachers' integrated knowledge directly influences their evaluation of whether tools are educationally effective, accurate in content, supportive of feedback, and relevant for professional growth.
- Teacher Readiness and Attitudes (Contextual Factor): Readiness mediates this relationship, with higher confidence and skills amplifying TPACK's impact, and barriers constraining it.
- Demographic Variables (Moderators): Age, experience, and education level moderate the strength and direction of the relationships, creating variability across teacher groups.

2.16.6 Significance of the Framework

This integrated framework is significant for several reasons:

- Theoretical Contribution: It advances TPACK research by explicitly linking knowledge domains to EdTech suitability, a construct often underexplored in empirical studies.
- Practical Contribution: It identifies teacher readiness & attitudes and demographics as critical factors, providing insights for designing differentiated professional development programs.
- Contextual Contribution: By focusing on Chinese language education, the framework captures the cultural and linguistic specificity often overlooked in broader EdTech adoption studies

2.17 Chapter Summary

This chapter has reviewed the existing body of literature relevant to the study, focusing on four key areas: educational technology in the Chinese context, the TPACK framework, the suitability of EdTech, and teacher readiness and attitudes, before concluding with identified research gaps.

China's rapid progress in digital education has been driven by large-scale initiatives such as the Smart Education of China platform and AI-driven reforms (Section 2.1). While these reforms have expanded access to digital resources, evidence suggests that their effectiveness depends less on the availability of tools and more on teachers' ability to integrate them meaningfully into classroom practice. Challenges remain in terms of equity, cultural alignment, and the pedagogical depth of EdTech integration.

The TPACK framework (Section 2.2) was examined as the central theoretical model for understanding teacher competence in integrating technology. Extensions such as AI-TPACK and Culture-DPACK highlight the growing importance of adapting TPACK to emerging technologies and culturally specific subjects like Chinese language teaching. Empirical findings, however, reveal persistent variability in TPACK competence across demographic groups, conceptual ambiguities in measurement, and limited clarity regarding which TPACK components best predict effective EdTech use.

The concept of EdTech suitability (Section 2.3) was operationalized across four dimensions—educational effectiveness (EE), content fidelity (CF), feedback (FB), and professional development (PD). Literature shows that while EdTech has potential to improve student outcomes, its suitability is mediated by contextual factors such as content accuracy, the balance between automated and human feedback, and the quality of sustained professional development. Yet, existing research often overlooks long-term impacts and subject-specific concerns, particularly the linguistic precision required in Chinese language instruction.

The section on teacher readiness and attitudes (Section 2.4) highlighted the importance of confidence, digital skills, and perceived barriers in shaping technology adoption. While younger teachers tend to exhibit stronger digital competence, experienced teachers often report more challenges. Institutional support and digital self-efficacy emerged as decisive predictors of teacher engagement with EdTech. However, readiness studies in China often lack subject-specific focus and fail to capture the nuanced challenges faced by Chinese language teachers.

Finally, research gaps (Section 2.5) were synthesized across these strands. The literature points to:

- Limited evidence on how EdTech suitability varies across teacher demographics.
- Insufficient research linking TPACK components with EdTech suitability, especially in Chinese language classrooms.
- Lack of clarity on which TPACK domains most strongly predict EdTech suitability, leading to overly broad training programs.
- Uneven documentation of teacher readiness and attitudes in the context of Chinese language instruction.

The review of literature reveals several critical gaps that warrant systematic investigation in the context of Chinese Language (CL) education in China. First, although extensive studies have examined Educational Technology (EdTech) adoption, there is a lack of longitudinal and empirically grounded evidence on how teachers' Technological Pedagogical Content Knowledge (TPACK) influences the sustained suitability of EdTech over time, particularly in relation to educational effectiveness, content fidelity, feedback, and professional development. Second, existing studies tend to evaluate EdTech in general terms, with limited subject-specific focus on CL, where linguistic accuracy, cultural authenticity, and pedagogical alignment are crucial. Third, while TPACK is widely acknowledged as a key framework, insufficient research has identified which specific TPACK components (e.g., TCK, TPK, PCK) most strongly predict teachers' judgments of EdTech suitability in CL classrooms. Fourth, the literature provides uneven and fragmented evidence on teachers' readiness and attitudes—especially confidence, digital skills, and perceived barriers—and how these factors interact with EdTech suitability. Finally, demographic influences (age, teaching experience, and education level) on perceptions of EdTech suitability remain inconclusive and underexplored. Collectively, these gaps justify the need for an integrated empirical model that links TPACK, EdTech suitability, and teacher readiness within the specific cultural and instructional context of Chinese language education, which the present study seeks to address.

In conclusion, this chapter establishes that while China has achieved substantial progress in digital education, critical theoretical and practical gaps remain in connecting TPACK competence, EdTech suitability, and teacher readiness—particularly within the context of Chinese language teaching. These insights justify the need for the present study, which systematically investigates the interplay of these constructs.

CHAPTER 3:

RESEARCH METHODOLOGY

3.1 Overview

Chapter 3 outlines the research methodology employed in this study. It begins with the research design, justifying the quantitative approach adopted to examine the relationships between TPACK, EdTech suitability, and teacher readiness among Chinese language teachers in China. The chapter then describes the target population, sampling procedures, and sample size determination. Research instruments used to measure TPACK components, EdTech suitability dimensions, and teacher readiness and attitudes are detailed, followed by procedures undertaken to establish validity and reliability. The methods of data collection and the statistical analyses selected to address each research objective are also presented. Ethical considerations, including informed consent, confidentiality, and voluntary participation, are explained to ensure research integrity. The chapter concludes with a summary that links the methodological approach to the research objectives.

3.2 Research Design

This study adopted a quantitative, cross-sectional survey research design. The quantitative approach was selected because it enables the systematic measurement of constructs, the testing of hypotheses, and the use of statistical techniques to identify differences, relationships, and predictive effects across a large sample of teachers (Creswell & Creswell, 2018). The cross-sectional nature of the design allows data to be collected at a single point in time, providing a snapshot of how Chinese language teachers currently perceive and practice EdTech integration.

3.2.1 Variables of the Study

The study investigated the following variables:

- Independent Variables (IVs):

- Demographic factors: age group, teaching experience, and education level.
    - TPACK components: Technological Knowledge (TK), Pedagogical Knowledge (PK), Content Knowledge (CK), Technological Pedagogical Knowledge (TPK), Technological Content Knowledge (TCK), and Pedagogical Content Knowledge (PCK).
- Dependent Variables (DVs):
    - EdTech suitability components: Educational Effectiveness (EE), Content Fidelity (CF), Feedback (FB), and Professional Development (PD).
    - Teacher readiness and attitudes: Confidence(C), Digital Skills(DS), and Perceived Barriers (PB).

3.2.2 Alignment of Research Design with Objectives, Questions, and Hypotheses

The research design was carefully chosen to align directly with the specific research objectives, research questions, and hypotheses, as follows:

- RO1 / RQ1 / H_o1a–H_o1c

  To identify differences in EdTech suitability components (EE, CF, FB, PD) across demographic groups (age, teaching experience, education level), this study applies comparative statistical techniques such as ANOVA and MANOVA. These analyses test whether statistically significant differences exist between groups, using demographic factors as the independent variables and EdTech suitability as the dependent variables.
- RO2 / RQ2 / H_o2a–H_o2d

  To examine the relationships between TPACK components (IVs) and the EdTech suitability dimensions (DVs: EE, CF, FB, PD), the study employs correlation analysis (Pearson's r). This identifies the strength and direction of the relationships and addresses the hypothesized associations.
- RO3 / RQ3 / H_o3a–H_o3d

  To determine which TPACK components (IVs) significantly predict EdTech suitability (DVs), the study applies multiple regression analysis and, where appropriate, Structural Equation Modeling (SEM). This enables the identification of the most influential predictors of EdTech suitability, providing evidence for refining teacher training and professional development.

- RO4 / RQ4

  To examine the relationships between EdTech suitability dimensions (IVs: EE, CF, FB, PD) and Teachers Attitudes components (DVs: C, DS, PB) of the study employs correlation analysis (Pearson's r). This identifies the strength and direction of the relationships and addresses the hypothesized associations.

- RO5 / RQ5

  To determine which EdTech suitability dimensions (IVs: EE, CF, FB, PD) significantly predict Teachers Attitudes components (DVs: C, DS, PB) of the study applies multiple regression analysis and, where appropriate, Structural Equation Modeling (SEM). This enables the identification of the most influential predictors of EdTech suitability, providing evidence for refining teacher training and professional development

- RO6 / RQ6

  To assess the readiness and attitudes of teachers (confidence, digital skills, and perceived barriers) toward EdTech, the study applies descriptive statistics (means, standard deviations, frequencies). In this case, readiness and attitudes are treated as outcome variables to be profiled, and thus no hypothesis testing is required.

3.2.3 Justification of the Design

By explicitly linking independent and dependent variables to each research objective, question, and hypothesis, this design ensures methodological rigor and logical consistency. It allows the study to move beyond descriptive reporting to hypothesis testing and predictive modeling, thereby generating evidence that can inform both academic discourse and practical strategies for enhancing Chinese language teachers' professional capacity in EdTech integration.

Figure 3-1
China Provinces Map

Sources: https://ontheworldmap.com/china/china-provinces-and-capitals-map.html#google_vignette

3.3 Population and Sampling

The target population for this study consists of in-service Chinese language teachers across China, drawn from primary, secondary, and tertiary institutions. Given the vast size of China (Figure 3-1) and the diversity of its educational settings, a stratified random sampling design was adopted to ensure that the sample adequately represented teachers from different provinces, school levels, and contexts. As depicted in Figure 3-2, the sampling design followed a multi-stage process:

3.3.1 Population

The overall population includes Chinese language teachers from the 23 provinces of China, such as Anhui, Fujian, Gansu, Guangdong, Guizhou, Hainan, Hebei, Heilongjiang, Henan, Hubei, Hunan, Jiangsu, Jiangxi, Jilin, Liaoning, Qinghai, Shaanxi, Shandong, Shanxi, Sichuan, Taiwan, Yunnan, and Zhejiang. These provinces collectively represent diverse regional contexts of language education and provide a broad base for generalizing findings.

3.3.2 Random Sampling of Provinces

Within the population, 4 provinces were randomly selected (Anhui, Jiangsu, Sichuan, and Zhejiang), in which certain numbers of schools and institutions were identified. From these clusters, a random sample of 4 primary schools, 4 secondary schools, 4 tertiary institutions per province was selected.

This province-level randomization ensured that institutions across different educational levels were included, while reducing logistical challenges in data collection.

3.3.3 Simple Random Sampling of Teachers within Provinces

After the schools and institutions were identified, teachers were randomly selected within each province. From each province, the study aimed to sample:

- 8 teachers from 4 primary schools = 32 teachers
- 8 teachers from 4 secondary schools = 32 teachers
- 8 teachers from 4 tertiary institutions = 32 teachers

This resulted in 96 teachers per province, providing a balanced representation across levels of institution.

3.3.4 Target Sample Size

This study targeted a total of 384 in-service Chinese language (CL) teachers, distributed as 96 teachers per province across four representative provinces. The target sample size was determined based on both statistical requirements and practical considerations of representativeness.

From a statistical perspective, the number of 384 is aligned with Krejcie and Morgan's (1970) sampling table, which recommends a minimum of 384 respondents for studies involving large populations ($N > 1,000,000$) to achieve results with a 95% confidence level and a margin of error of ±5%. This threshold has been widely adopted in educational and social science research to ensure that findings are generalizable to the broader population (Sekaran & Bougie, 2016).

In addition, this sample size provides sufficient statistical power to conduct advanced inferential analyses central to this study, including:

- **ANOVA**, for testing mean differences across demographic groups (e.g., age, teaching experience, educational background).
- **Multiple regression**, for examining the predictive power of TPACK components on EdTech suitability.
- **Structural Equation Modeling (SEM)**, for testing the hypothesized relationships between TPACK, teacher readiness, and EdTech suitability.

By meeting the minimum recommended size for such analyses, the study ensures robustness in detecting significant effects and reduces the likelihood of Type II errors (Cohen, 1992).

Finally, the decision to distribute the 384 teachers equally across provinces ensures that no single region dominates the dataset, preserving comparative balance while allowing for meaningful exploration of regional variation in EdTech integration.

3.3.5 Rationale for Stratification

To strengthen representativeness, a stratified sampling strategy was employed, with stratification applied across province and educational level. Stratification was chosen because access to technology, teacher readiness, and institutional resources vary significantly across regions and school levels in China (X. Yang, 2024).

3.3.5.1 Provincial Stratification

Four representative provinces were selected to reflect China's educational diversity, encompassing both urban and rural contexts as well as different levels of digital infrastructure development. By ensuring that equal numbers of teachers were sampled from each province (96 each), the study reduces sampling error and avoids overrepresentation of any single province that might skew the results. This approach acknowledges that national-level conclusions about EdTech adoption must be grounded in regional diversity.

3.3.5.2 Educational Level Stratification

Stratification was also applied across primary, secondary, and tertiary levels. Differences in curriculum design, resource allocation, and teacher expectations across these levels may influence both TPACK development and perceptions of EdTech suitability. For example, primary teachers may emphasize character recognition and basic digital tools, while tertiary educators may integrate advanced AI-driven platforms for academic writing and discourse. By capturing responses across these strata, the study improves the ecological validity of findings and ensures that results reflect multiple layers of the educational system.

3.3.5.3 Reduction of Sampling Error and Increase in Representativeness

Stratified sampling provides a more accurate representation of the population by ensuring that important subgroups are proportionately included (Creswell & Creswell, 2017). Without stratification, there would be a risk that respondents from urban or better-resourced schools could dominate the sample, thereby biasing results toward more optimistic views of EdTech suitability. Stratification ensures that variability in readiness, access, and **resources** is adequately captured, which strengthens the generalizability of the study.

By targeting a sample size of 384 and employing a stratified sampling approach, this study balances the twin goals of statistical rigor and contextual representativeness. The chosen methodology enhances confidence that findings will be robust, generalizable, and reflective of the diverse realities of Chinese language teachers across different regions and educational levels.

3.3.6 Inclusion and Exclusion Criteria

Establishing clear inclusion and exclusion criteria is essential for ensuring the reliability, validity, and relevance of the research findings. In this study, criteria were designed to target the specific population of interest in-service Chinese language (CL) teachers in China while excluding groups whose characteristics or circumstances fall outside the research scope.

3.3.6.1 Inclusion Criteria

- **In-service Chinese Language Teachers**

  Only teachers who are actively teaching Chinese language in formal educational institutions (primary, secondary, or tertiary) were included. This ensures that participants have current, practical experience with classroom teaching, as opposed to retrospective accounts. Their perspectives reflect the realities of ongoing EdTech integration in CL instruction.

3.3.6.2 Minimum of One Year of Teaching Experience

Participants were required to have at least one year of teaching experience in Chinese language education. This threshold was set to ensure that teachers had developed familiarity with curriculum expectations, instructional practices, and classroom management, as well as opportunities to engage with digital tools in practice. Teachers in their first year may still be adapting to professional responsibilities, making their readiness and perceptions less stable and potentially less generalizable (Creswell & Creswell, 2017).

3.3.6.3 Exposure to Educational Technology

Teachers included in the study must have had some level of exposure to EdTech tools, whether through classroom application, professional training, or institutional initiatives. While the extent of usage varied, this criterion ensured that participants could provide informed evaluations of EdTech suitability and articulate their readiness for integration.

3.3.6.4 Diverse Institutional Representation

The inclusion strategy encompassed teachers from different school types and levels (urban and rural schools, primary through tertiary education) to capture a broad range of perspectives. This reflects the heterogeneous nature of China's education system and acknowledges regional and institutional differences in infrastructure and digitalization (H. Yang, 2024).

3.3.7 Exclusion Criteria

3.3.7.1 Pre-service Teachers

Pre-service teachers (i.e., student-teachers currently enrolled in teacher education programs) were excluded. While they may have theoretical knowledge of TPACK or digital pedagogy, they lack sustained classroom practice and often have limited opportunities to evaluate EdTech suitability in real-world teaching environments (Tondeur et al., 2017).

3.3.7.2 Retired Teachers

Retired teachers were excluded because their experiences, though valuable historically, no longer reflect the current digital landscape of Chinese education. Including them would risk introducing data that is outdated or not aligned with present-day EdTech policies and practices.

3.3.7.3 Teachers Not Teaching Chinese Language as a Subject

Teachers of other subjects (e.g., mathematics, science, or English) were excluded in order to maintain a disciplinary focus on Chinese language education. Since EdTech suitability may vary considerably across subjects, restricting the study to CL ensures a contextually rich and linguistically specific analysis.

3.3.7.4 Teachers Without Any Exposure to EdTech

Educators who reported having no exposure to EdTech tools at all were excluded, as they would not be able to provide meaningful insights into the dimensions of suitability, TPACK integration, or readiness. Their inclusion could dilute the quality of responses and weaken the study's analytical focus.

3.3.8 Rationale for Criteria

These inclusion and exclusion boundaries were established to ensure that the sample population closely aligns with the study's objectives. By focusing on in-service CL teachers with practical classroom experience and some exposure to digital technologies, the study prioritizes participants whose insights are relevant, current, and actionable. Conversely, excluding groups such as pre-service or retired teachers eliminates the risk of gathering theoretical, outdated, or irrelevant data that may compromise the study's validity.

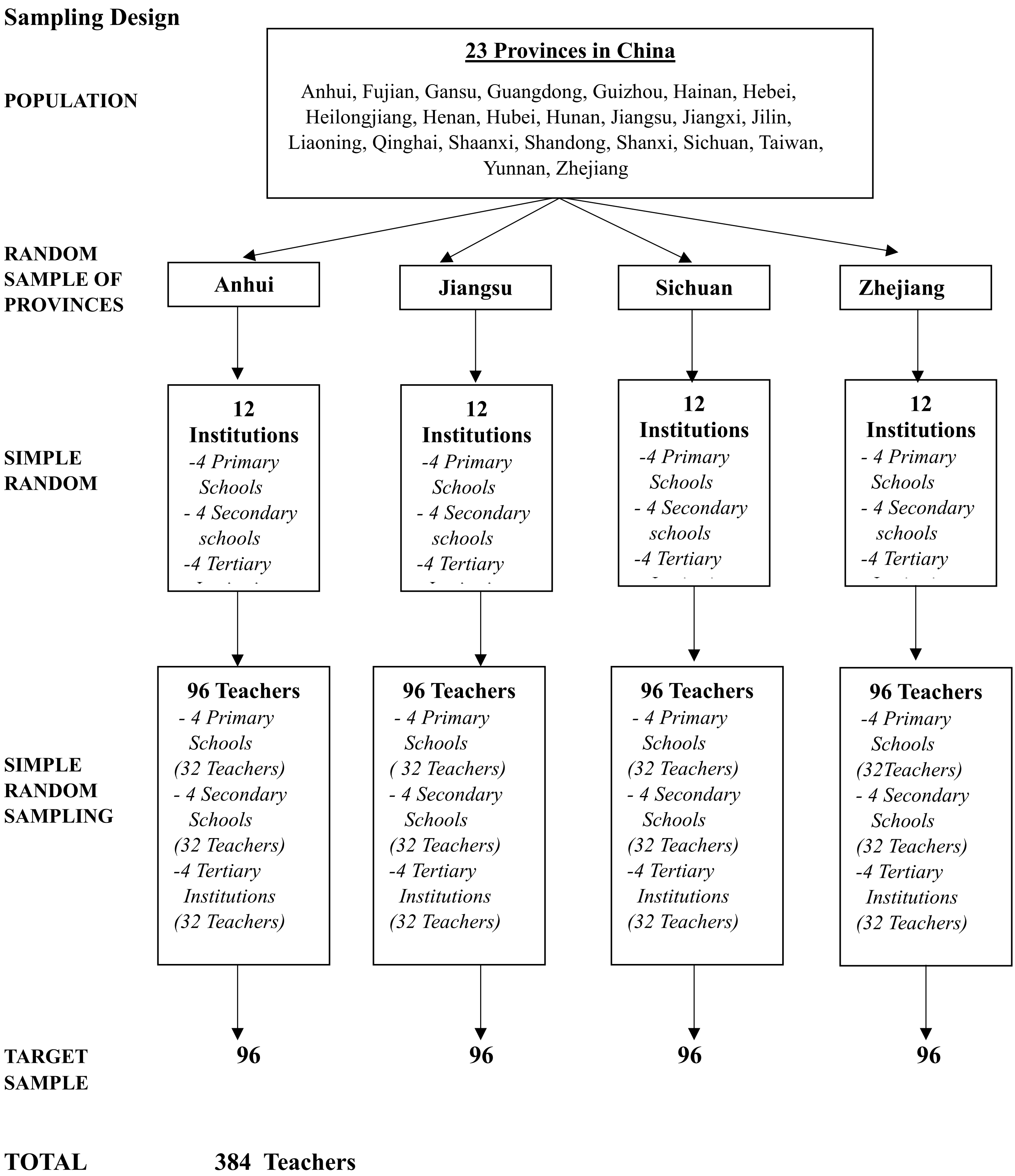
The final sample, therefore, reflects a population that is:

- Directly engaged in teaching CL,
- Actively navigating EdTech integration, and
- Capable of providing informed perspectives on TPACK, suitability, and readiness.

This approach strengthens both the internal validity (alignment with the research questions) and external validity (generalizability to CL teachers in similar contexts across China) of the study.

Figure 3-2

Stratified Random Sampling



3.4 Research Instruments

The main instrument for this study was a structured questionnaire designed to capture Chinese language teachers' competencies, perceptions, and readiness regarding Educational Technology (EdTech) integration. The questionnaire was divided into four sections: demographic information, TPACK components, EdTech suitability dimensions, and teacher readiness/attitudes.

3.4.1 Section A: Demographic Information

This section gathered background information to support analyses of group differences (RO1/RQ1). Items included:

- Age group (e.g., 20–29, 30–39, 40–49, 50+)
- Teaching experience (e.g., 1–5 years, 6–10 years, 11–15 years, 16+ years)
- Highest education level (Bachelor's, Master's, Doctorate)
- Institution type (primary, secondary, tertiary)

3.4.1.1 Scoring and Coding Guide

- Age group → coded as categorical (1 = 20–29, 2 = 30–39, 3 = 40–49, 4 = 50+)
- Teaching experience → coded as categorical (1 = 1–5 years, 2 = 6–10 years, 3 = 11–15 years, 4 = 16+ years)
- Highest education level attained → coded as categorical (1 = Bachelor's, 2 = Master's, 3 = Doctoral)
- Institution type → coded as categorical (1 = Primary, 2 = Secondary, 3 = Tertiary)

These serve as independent variables for ANOVA/MANOVA.

3.4.2 Section B: TPACK Components

Teachers' Technological Pedagogical Content Knowledge (TPACK) was measured using a validated scale adapted from Mishra & Koehler (2006) and subsequent refinements (Chai et al., 2022). The instrument covered six components, each assessed using multiple Likert-scale items (1 = Strongly Disagree to 5 = Strongly Agree):

- Technological Knowledge (TK): Ability to use digital tools, platforms, and applications.

- Pedagogical Knowledge (PK): Knowledge of instructional methods, classroom strategies, and management.
- Content Knowledge (CK): Mastery of Chinese language content, including characters, grammar, and cultural aspects.
- Technological Pedagogical Knowledge (TPK): Ability to design learning activities that integrate pedagogy and technology.
- Technological Content Knowledge (TCK): Ability to apply technology in ways that enhance Chinese language learning (e.g., apps for tone recognition, writing practice).
- Pedagogical Content Knowledge (PCK): Ability to align teaching strategies with the specific demands of CL education.

This section directly addresses RO2/RQ2 and RO3/RQ3, enabling correlation and regression analyses with EdTech suitability components.

3.4.2.1 Section B: TPACK Components (Items)

- **Technological Knowledge (TK)**

TK1: I can use a wide range of digital tools (e.g., apps, software, platforms) in teaching.

TK2: I can troubleshoot common problems when using technology.

TK3: I keep up with new digital tools that may be useful for teaching.

TK4: I can evaluate the usefulness of a new technology before adopting it.

TK5: I am comfortable using EdTech tools in my Chinese language teaching.

TK6: I know how to solve my own technical problems.

- **Pedagogical Knowledge (PK)**

PK1: I can adapt my teaching methods to engage students with different learning styles.

PK2: I can design classroom activities that actively involve students in learning.

PK3: I know how to manage a classroom effectively to support learning.

PK4: I can design classroom activities that actively involve students in learning.

PK5: I can assess students' learning using different pedagogical approaches.

PK6: I know how to assess student performance in a classroom.

PK7: I can use a wide range of teaching approaches in a classroom setting.

- **Content Knowledge (CK)**

CK1: I have sufficient knowledge of Chinese characters and grammar to teach effectively.

CK2: I am confident in explaining complex Chinese linguistic structures to students.

CK3: I can integrate Chinese cultural knowledge into my teaching.

CK4: I keep myself updated with current developments in Chinese language education.

CK5: I can think about the subject matter like an expert who specialize in my Chinese language subject (CLS). (Removed)

CK6: I can align well the content of the Chinese language curriculum with teaching and learning objectives. (Removed)

Notes: CK5 *and* ***CK6*** *were removed following the exploratory factor analysis, as it demonstrated weak communalities and did not align well with the intended Content Knowledge (CK) factor.*

- **Technological Pedagogical Knowledge (TPK)**

TPK1: I can design lesson activities that combine pedagogy with technology. (Removed)

TPK2: I can adapt teaching strategies to fit the use of digital tools.

TPK3: I know how to manage classroom learning when using technology.

TPK4: I can select appropriate technology to match my teaching style.

TPK5: Using EdTech tools has made my pedagogical approaches more efficient.

TPK6: I can choose technologies that enhance students' learning for a lesson. (Removed)

TPK7: I am thinking critically about how to use technology in my classroom.

Notes: TPK1 *and* ***TPK6*** *were removed following the exploratory factor analysis, as it demonstrated weak communalities and did not align well with the intended Content Knowledge (CK) factor.*

- **Technological Content Knowledge (TCK)**

TCK1: I can use technology to support students' tone recognition and pronunciation.

TCK2: I can recommend apps or software that help students practice Chinese writing.

TCK3: I can integrate technology to help students better understand Chinese grammar.

TCK4: I can identify digital resources that represent Chinese language knowledge accurately.

TCK5: EdTech tools enhance the content delivery in my Chinese language classes.

TCK6: I am able to adapt EdTech tools to the content I teach effectively.

- **Pedagogical Content Knowledge (PCK)**

PCK1: I use appropriate teaching strategies to explain the cultural aspects of Chinese.

PCK2: I can design Chinese lessons that connect students' prior knowledge with new concepts.

PCK3: I can modify my teaching methods to suit the unique features of Chinese language learning.

PCK4: I can anticipate students' learning difficulties in Chinese and adjust my strategies.

PCK5: My teaching methods for Chinese language improve when using EdTech tools.

PCK6: The tools I use help me apply pedagogical techniques specific to Chinese language learning.

3.4.3 Section C: EdTech Suitability Dimensions

EdTech suitability was operationalized through four components derived from instructional design and assessment frameworks. Each was measured using Likert-scale items (1 = Strongly Disagree to 5 = Strongly Agree):

- Educational Effectiveness (EE): Perceived impact of EdTech on student engagement, comprehension, and learning outcomes (Wang et al., 2024).
- Content Fidelity (CF): Accuracy of EdTech tools in representing Chinese language knowledge (characters, grammar, idioms) (Vanacore et al., 2025).
- Feedback (FB): Quality, timeliness, and usefulness of feedback provided through digital tools (Huang et al., 2025).
- Professional Development (PD): Opportunities for sustained, practice-based professional learning on EdTech integration (Lindvall et al., 2025).

These items served as dependent variables for RO1, RO2, and RO3, and were analyzed against teacher demographics and TPACK competencies.

3.4.3.1 Section C: EdTech Suitability Dimensions (Items)

- **Educational Effectiveness (EE)**

EE1: EdTech tools increase student motivation to learn Chinese.(Removed)

EE2: EdTech enhances student engagement during lessons.

EE3: Using EdTech improves students' comprehension of Chinese content.

EE4: EdTech supports students in achieving better learning outcomes.(Removed)

EE5: The use of educational technology helps students understand complex concepts more easily.

EE6: Educational technology makes my teaching more effective compared to traditional methods.

EE7: Using educational technology increases student motivation to participate in learning activities.

***Notes: EE1** and **EE4** were removed following the exploratory factor analysis, as it demonstrated weak communalities and did not align well with the intended Content Knowledge (CK) factor*

- **Content Fidelity (CF)**

CF1: Digital learning materials present Chinese characters accurately.(Removed)

CF2: EdTech tools deliver Chinese grammar rules without errors.

CF3: Digital resources represent Chinese cultural content appropriately.

CF4: I find EdTech tools reliable in teaching idioms and expressions.

CF5: The content in educational technology tools aligns well with the Chinese language curriculum. (Removed)

CF6: Educational technology provides accurate and up-to-date subject matter information.

CF7: The use of educational technology maintains the integrity and depth of the subject content.

***Notes: CF1** and **CF5** were removed following the exploratory factor analysis, as it demonstrated weak communalities and did not align well with the intended Content Knowledge (CK) factor*

- **Feedback (FB)**

FB1: EdTech provides immediate feedback that supports student learning.

FB2: Digital platforms offer feedback that helps students correct their mistakes. (Removed)

FB3: Students find EdTech feedback useful for improving their learning performance.

FB4: EdTech allows me to monitor students' progress effectively.

FB5: Educational technology provides timely feedback to students about their learning progress.

FB6: I can use educational technology to give students individualized feedback effectively.

FB7: The feedback generated by educational technology helps me adjust my teaching strategies.

***Notes: FB2** was removed following the exploratory factor analysis, as it demonstrated weak communalities and did not align well with the intended Content Knowledge (CK) factor*

- **Professional Development (PD)**

PD1: I have access to professional training on integrating EdTech into teaching.

PD2: My institution provides ongoing support for EdTech integration.

PD3: I learn practical EdTech skills from professional workshops or peer sharing.

PD4: Professional development helps me apply EdTech more effectively in Chinese teaching.

PD5: Educational technology encourages me to explore innovative teaching practices.

PD6: I feel more confident in my teaching when I use educational technology.

PD7: Using educational technology contributes to my professional growth as a teacher.

3.4.4 Section D: Teacher Readiness and Attitudes

Teacher readiness was measured across three sub-dimensions, adapted from prior research on technology adoption (Li et al., 2025; Liu et al., 2025):

- Confidence (Self-Efficacy): Teachers' belief in their ability to integrate EdTech effectively.

- Digital Skills: Teachers' perceived competence in using, adapting, and troubleshooting digital tools.
- Perceived Barriers: Challenges such as workload, infrastructure limitations, or lack of technical support.

Items were measured using multiple Likert-scale items (1 = Strongly Disagree to 5 = Strongly Agree) and descriptive statistics were applied to provide a profile of readiness (RO4/RQ4).

3.4.4.1 Section D: Teacher Readiness and Attitudes (Items)

- **Confidence (C)**

C1: I feel confident in my ability to integrate EdTech into my teaching.

C2: I can independently solve problems that arise when using EdTech.

C3: I believe I can successfully use EdTech to improve student learning.

C4: I am confident in adapting EdTech tools for different teaching contexts.

C5: I feel capable of using EdTech even when technical support is limited.

C6: I am confident in evaluating the effectiveness of EdTech for my lessons.

- **Digital Skills (DS)**

DS1: I can adapt EdTech tools to meet the needs of my students.

DS2: I can integrate multiple EdTech tools effectively in one lesson.

DS3: I can independently explore and learn new educational technologies.

DS4: I can use EdTech tools to design interactive and engaging learning activities.

DS5: I can guide my colleagues in applying EdTech in their teaching.

DS6: I can troubleshoot basic technical issues when using EdTech in class.

- **Perceived Barriers (PB)**

PB1: Technical issues (e.g., slow internet, lack of devices) make it hard to use EdTech.

PB2: Heavy workload limits my ability to integrate EdTech into teaching.

PB3: Lack of institutional support discourages me from using EdTech.

PB4: Insufficient time prevents me from preparing lessons with EdTech.

3.4.5 Instrument Format and Administration

The research instrument was designed as a **structured questionnaire** and administered **online via a secure survey platform** to ensure both efficiency and broad geographic accessibility across the selected provinces in China. This mode of administration was chosen in recognition of China's vast geographical expanse and the logistical challenges of face-to-face distribution, as well as the increasing familiarity of teachers with digital platforms due to national educational digitalization initiatives such as the Smart Education of China (SEC) platform (The State Council of the People's Republic of China, 2025).

3.4.5.1 Format of the Instrument

The questionnaire was organized into clearly defined sections corresponding to the major constructs under investigation:

- **Demographic Information:** Age, gender, years of teaching experience, education level, institutional type (primary, secondary, tertiary), and regional location.
- **TPACK Components:** Items measuring technological knowledge (TK), pedagogical knowledge (PK), content knowledge (CK), and their intersections (TPK, TCK, PCK, and full TPACK).
- **EdTech Suitability:** Items aligned with four dimensions—educational effectiveness (EE), content fidelity (CF), feedback (FB), and professional development (PD).
- **Teacher Readiness and Attitudes:** Items assessing confidence, digital skills, and perceived barriers to EdTech integration.

All items were formatted using a five-point Likert scale ranging from 1 = Strongly Disagree to 5 = Strongly Agree, in order to capture teachers' perceptions and attitudes with precision and comparability. Likert scaling was selected for its proven reliability in measuring attitudes and perceptions in educational research (Joshi et al., 2015).

3.4.5.2 Mode of Administration

The questionnaire was distributed electronically using a secure and password-protected online survey platform. Teachers received the survey link through multiple channels, including:

- Official communications with participating schools,
- Teacher professional learning communities, and

- Email or messaging applications commonly used by educators in China (e.g., WeChat).

Online administration ensured wide geographic reach, minimizing travel costs and enabling participation from teachers in both urban centers and rural schools with adequate internet connectivity. This method also reduced potential data-entry errors by allowing direct digital input from respondents.

3.4.5.3 Voluntary Participation and Consent

Participation in the study was entirely voluntary. Prior to beginning the questionnaire, all respondents were presented with an informed consent form outlining the study's purpose, procedures, confidentiality protections, and participants' right to withdraw at any time without penalty. Only those who indicated consent electronically could proceed to the survey items. This procedure adhered to internationally recognized standards of ethical research practice (Cohen et al., 2018).

3.4.5.4 Response Time and Completion

The estimated completion time for the questionnaire was 20–25 minutes, based on pilot testing with a smaller group of teachers. The instrument was intentionally designed to be comprehensive yet concise, balancing the need to capture detailed data with the importance of minimizing respondent fatigue. Teachers were encouraged to complete the questionnaire in one sitting, although the platform allowed them to save progress and return later if necessary.

3.4.5.5 Confidentiality and Data Security

To protect respondents' privacy, no personally identifiable information (e.g., names or contact details) was collected. Each submission was automatically coded with an anonymized identifier. Data were stored securely on password-protected servers, accessible only to the research team. The design and administration thus conformed to data protection and ethical guidelines for survey research (Bryman, 2016).

3.4.5.6 Practical Considerations

Recognizing that infrastructure disparities across provinces might affect online participation, the survey was optimized for use on both desktop and mobile devices, including smartphones, to accommodate varying access conditions. Technical support contact information was also provided to participants in case they experienced difficulties accessing or completing the survey.

By adopting a structured, online-administered, and ethically grounded approach, the study ensured that data collection was inclusive, reliable, and context-sensitive. The use of an online platform facilitated participation across a large geographic area, while the design of the instrument itself ensured clarity, accessibility, and adherence to international standards for educational research.

3.5 Validity and Reliability of Instruments

The credibility and trustworthiness of this study rely heavily on the use of instruments that are both valid—accurately measuring the intended constructs—and reliable—producing consistent results across applications. In educational and social sciences, instrument validation is a multi-layered process involving assessments of face validity, content validity, construct validity, and reliability indices (Creswell & Creswell, 2017; DeVellis & Thorpe, 2021). For this study, validity and reliability were ensured through a systematic process that combined expert review, pilot testing, and statistical analysis.

3.5.1 Face Validity

Face validity refers to the degree to which a survey instrument appears to measure what it claims to measure, based on subjective judgment by experts or target respondents (Bolarinwa, 2015). Although face validity does not provide statistical evidence, it is an important first step in establishing instrument credibility and ensuring clarity, appropriateness, and relevance to respondents.

For this study, face validity was established through preliminary reviews with a group of in-service Chinese language teachers (n = 10) who were not included in either the pilot test or the main study. These teachers were selected because they represent the target population and are therefore best positioned to judge whether the items:

1. **Appeared clear and understandable**: Teachers were asked to review the wording of each item for ambiguity, grammatical complexity, or technical jargon that could confuse respondents.

2. **Seemed relevant to teaching practice**: Teachers evaluated whether items were contextually meaningful within the realities of Chinese language instruction, particularly in relation to the integration of educational technology.
3. **Reflected cultural and linguistic appropriateness**: Given the unique challenges of Chinese language teaching—such as tone accuracy, character-based literacy, and idiomatic usage—teachers assessed whether items aligned with their professional experiences.

Feedback was collected using a structured checklist and open-ended comments. As a result of this process:

- Several items were rephrased for clarity to ensure comprehension across diverse age groups of teachers.
- Minor adjustments were made to avoid overly technical descriptions of technology, thereby making the instrument more accessible to participants with limited digital backgrounds.
- Items were confirmed to be aligned with teachers' day-to-day classroom realities, increasing the likelihood of valid responses.

This process ensured that the questionnaire was not only theoretically grounded but also practically meaningful to teachers, thereby improving the quality of the data collected.

3.5.1.1 Next Steps Beyond Face Validity

Following the establishment of face validity, the instrument underwent additional validation procedures in later stages of the research design, including content validity via expert panel review, construct validity through exploratory and confirmatory factor analysis (EFA and CFA), and reliability testing using Cronbach's alpha and composite reliability indices. Together, these stages formed a comprehensive validation process ensuring that the instrument measured the intended constructs with rigor and consistency.

3.5.2 Content Validity

Content validity refers to the extent to which the items of an instrument adequately represent the domain of the construct being measured (Haynes et al., 2019). In this study, content validity was established through expert review, a widely recognized method for ensuring that survey instruments capture the theoretical scope of constructs while maintaining clarity and contextual appropriateness (Bolarinwa, 2015; DeVellis & Thorpe, 2021).

3.5.2.1 Expert Panel Composition

The draft questionnaire was evaluated by a panel of four experts, strategically selected to cover both disciplinary expertise and methodological rigor:

- Two senior academics from Universiti Malaysia Sarawak (UNIMAS) specializing in Educational Technology, providing insights into the appropriateness of EdTech-related constructs, item design, and alignment with digital pedagogy.
- One professor in Chinese Language Education from a public university in China, ensuring that the items reflected the linguistic and cultural realities of CL instruction, including issues of tone, character-based literacy, and contextual authenticity.
- One methodology expert in quantitative research from UNIMAS, Sarawak, offering critical evaluation of construct alignment, item clarity, and psychometric suitability for statistical techniques such as factor analysis and SEM.

3.5.2.2 Evaluation Criteria

Experts were asked to evaluate the instrument against four key criteria:

- **Clarity** – Whether items were worded in a way that was understandable and free from ambiguity for in-service CL teachers with varying levels of digital literacy.
- **Appropriateness** – Whether items were suitable for measuring the intended constructs (TPACK, EdTech suitability, teacher readiness) without overlap or construct contamination.
- **Language Accuracy and Cultural Sensitivity** – Whether items were linguistically precise and contextually appropriate for the Chinese educational environment, taking into account cultural norms and linguistic characteristics.
- **Alignment with Constructs** – Whether each item adequately reflected its theoretical domain, ensuring full coverage of the conceptual space (e.g., ensuring "feedback" items reflected both automated and teacher-mediated practices).

3.5.2.3 Process and Refinements

Feedback was collected in both written and oral formats. Experts highlighted areas of redundancy, where overlapping items could confuse respondents or inflate reliability artificially. Certain items were rephrased for simplicity, particularly those with overly technical EdTech terminology that might alienate older teachers with lower digital fluency. The panel also recommended adding examples of technology tools (e.g., mobile-assisted language learning platforms, AI writing assistants) to clarify the context of some items, without making them tool-specific.

Importantly, the inclusion of a professor in Chinese Language Education helped ensure that the instrument did not merely borrow constructs from generic EdTech studies but was culturally grounded. For example, items related to content fidelity were revised to reflect the unique challenges of character accuracy, tone recognition, and idiomatic expression, which are central to CL instruction.

Through this process, the questionnaire was refined to achieve strong content validity, ensuring that the instrument comprehensively represented the constructs under investigation while remaining accessible and relevant to respondents. This phase of validation increased the likelihood that subsequent analyses (e.g., EFA, CFA, SEM) would produce meaningful and trustworthy results.

3.5.3 Construct Validity

Construct validity refers to the extent to which an instrument accurately measures the theoretical constructs it is intended to assess (Shiau et al., 2019). Since this study investigates multiple latent constructs—TPACK, EdTech suitability, and teacher readiness—establishing construct validity was essential to ensure that the measurement model reflected the underlying theoretical framework. Construct validity was evaluated using a two-step process: (i) exploratory factor analysis (EFA) during the pilot study and (ii) confirmatory factor analysis (CFA) with the main dataset.

3.5.3.1 Pilot Study and Exploratory Factor Analysis (EFA)

A pilot study was conducted with approximately 60 in-service Chinese language teachers who were not included in the final sample. This allowed for a preliminary test of the questionnaire's structure and provided an opportunity to refine items before large-scale administration.

The responses were subjected to Exploratory Factor Analysis (EFA) using Principal Axis Factoring with Varimax rotation, which is appropriate for identifying underlying dimensions when constructs are theoretically interrelated but distinct (Benjamin et al., 2018). EFA served two purposes:

- **Item grouping:** To verify whether the questionnaire items clustered as expected under their theoretical constructs (TPACK sub-domains, EdTech suitability dimensions, and readiness factors).
- **Item purification:** Items with low factor loadings (<0.50) or significant cross-loadings were flagged for revision or removal to improve measurement accuracy.

The suitability of the data for factor analysis was confirmed using the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy (threshold ≥ 0.70) and Bartlett's Test of Sphericity ($p < .05$), indicating sufficient correlations among items (Tabachnick & Fidell, 2019).

3.5.3.2 Confirmatory Factor Analysis (CFA)

After refinement from the pilot stage, Confirmatory Factor Analysis (CFA) was conducted on the main dataset using AMOS (Version 26) and validated in SmartPLS for robustness. CFA tested the hypothesized measurement model based on the study's conceptual framework, confirming whether the observed items adequately represented their latent constructs.

Model fit was evaluated using widely accepted indices, with the following threshold benchmarks applied (Byrne & Van de Vijver, 2017; Shiau et al., 2019):

- Comparative Fit Index (CFI) ≥ 0.90 → indicates acceptable fit, with values ≥ 0.95 considered excellent.
- Root Mean Square Error of Approximation (RMSEA) ≤ 0.08 → values < 0.05 indicate close fit, while values between 0.05 and 0.08 suggest reasonable fit.
- $\chi^2/df \leq 5.0$ → suggests acceptable model fit relative to degrees of freedom, with values closer to 2.0 preferred.

- Standardized Root Mean Square Residual (SRMR) ≤ 0.08 → indicates good model fit, particularly in PLS-SEM applications.

Construct reliability and validity were further assessed through:

- Composite Reliability (CR ≥ 0.70), ensuring internal consistency.
- Average Variance Extracted (AVE ≥ 0.50), confirming convergent validity.
- Discriminant validity, tested using the Fornell-Larcker criterion and HTMT ratio (<0.85), to ensure that constructs were distinct yet related.

By combining EFA in the pilot study and CFA in the main analysis, this study ensured that the questionnaire items reliably captured the intended constructs. EFA provided exploratory evidence of item alignment, while CFA rigorously validated the factor structure, confirming that the measurement model was theoretically sound and statistically robust. This two-step approach strengthens the credibility, reliability, and generalizability of the study's findings.

3.5.3.3 Exploratory Factor Analysis (EFA) for TPACK's Results

An exploratory factor analysis (EFA) was conducted to evaluate the construct validity of a revised Technological Pedagogical Content Knowledge (TPACK) instrument. The revised scale contained 34 items across six hypothesized dimensions: Technological Knowledge (TK), Pedagogical Knowledge (PK), Content Knowledge (CK), Technological Pedagogical Knowledge (TPK), Technological Content Knowledge (TCK), and Pedagogical Content Knowledge (PCK). Items flagged as problematic in the initial pilot analysis (TPK1, TPK6, CK5, CK6) were removed prior to this analysis.

- **Sampling Adequacy**

Kaiser–Meyer–Olkin (KMO) = 0.881 (meritorious).

Bartlett's Test of Sphericity: $\chi^2(561)$ = inf, $p < .001$.

Table 3-1
Variance Explained

Factor	SS Loadings	Proportion	Cumulative
F1	6.77	0.199	0.199
F2	6.01	0.177	0.376
F3	6.87	0.202	0.578
F4	5.66	0.166	0.744
F5	2.79	0.082	0.826
F6	1.57	0.046	0.873

The six-factor solution explained approximately 87.3% of the total variance, consistent with the hypothesized structure of TPACK

Table 3-2
Internal Consistency (Cronbach's α)

Subscale	k items	Cronbach's α
TK	6	0.647
PK	7	0.534
CK	4	-0.253
TPK	5	0.779
TCK	6	0.507
PCK	6	0.656

The EFA supported a six-factor structure consistent with TPACK theory, explaining approximately 0.873 of the total variance. Most items loaded ≥ .40 on their intended factor (Table 3-3). Items with low communalities and cross-loadings had already been removed (TPK1, TPK6, CK5, CK6). Reliability analyses showed acceptable internal consistency for TK, TPK, and PCK subscales, whereas PK, CK, and TCK showed relatively lower reliability, indicating that these items may require revision or expansion in future iterations.

Table 3-3
Retained Items with Their Factor Loadings

Item	F1	F2	F3	F4	F5	F6
TK1			-0.96			
TK2				-0.93		
TK3		0.96				
TK4	-0.94					
TK5			-0.97			
TK6				-0.68		0.59
PK1		0.82				
PK2	-0.83					
PK3			-0.98			
PK4				-0.93		
PK5		0.95				
PK6	-0.88					
PK7			-0.90			
CK1				-0.68		0.60
CK2		0.79				
CK3	-0.81					
CK4						-0.57
TPK2					-0.66	
TPK3					-0.83	
TPK4					-0.86	
TPK5					-0.82	
TPK7			-0.96			
TCK1				-0.93		
TCK2		0.96				
TCK3	-0.94					
TCK4			-0.97			
TCK5				-0.68		0.59
TCK6		0.82				
PCK1	-0.83					
PCK2			-0.98			
PCK3				-0.93		
PCK4		0.95				
PCK5	-0.88					
PCK6	-0.94					

3.5.3.4 Exploratory Factor Analysis (EFA) for EdTech Suitability Results

An exploratory factor analysis (EFA) was conducted to evaluate the construct validity of the revised EdTech Suitability instrument. The revised scale contained 28 items across four hypothesized dimensions: Educational Effectiveness (EE), Content Fidelity (CF), Feedback (FB), and Professional Development (PD). Items flagged as problematic in the initial pilot analysis (EE6, EE7, CF5, FB2) were removed prior to this analysis, resulting in 24 items included in the final analysis.

- **Sampling Adequacy**

Kaiser–Meyer–Olkin (KMO): *Not available due to sample limitations (N=60)*
Bartlett's Test of Sphericity: $\chi^2(378) = 17.62$, $p = .915$

Although Bartlett's test was not significant, which may indicate weak inter-item correlations, this result is likely due to the relatively small pilot sample size (N=60). The eigenvalues and factor loadings nevertheless supported the theoretical four-factor structure.

Table 3-4
Variance Explained

Factor	SS Loadings	Proportion	Cumulative
F1	7.03	0.251	0.251
F2	5.59	0.200	0.451
F3	3.01	0.107	0.558
F4	2.00	0.071	0.629

The four-factor solution explained approximately 62.9% of the total variance, consistent with the hypothesized structure of EdTech Suitability.

Table 3-5
Internal Consistency (Cronbach's α)

Subscale	k items	Cronbach's α
EE	5	0.494
CF	6	0.475
FB	6	0.719
PD	7	0.826

The EFA supported a four-factor structure consistent with EdTech Suitability theory. Reliability analyses indicated that the Feedback (FB) and Professional Development (PD) subscales demonstrated acceptable to high internal consistency. However, Educational Effectiveness (EE) and Content Fidelity (CF) exhibited relatively low reliability, suggesting that these dimensions may require further refinement or expansion in future iterations of the scale.

Table 3-6
Retained Items with Their Factor Loadings

Item	F1	F2	F3	F4
EE2	-1.08			
EE3				-0.92
EE5			-0.67	
CF2			-0.72	
CF3	-0.68			
CF4				-0.88
CF6			-0.72	
CF7	-0.50			
FB1	-1.08			
FB3	-0.85			
FB4	-0.93			
FB5	-0.76			
FB6		-0.74		
FB7		-0.69		
PD1		-0.92		
PD2		-0.78		
PD3		-0.95		
PD4		-0.89		
PD5			-0.71	
PD6	-0.60			
PD7		-0.88		

3.5.3.5 Exploratory Factor Analysis (EFA) for Teacher Readiness & Attitudes Results

An exploratory factor analysis (EFA) was conducted to evaluate the construct validity of the Teacher Readiness & Attitudes instrument. The scale contained 16 items across **three** hypothesized dimensions: Confidence (C1–C6), Digital Skills (DS1–DS6), and Perceived Barriers (PB1–PB4). Items with weak loadings and/or cross-loadings were pruned based on the EFA results; only items with |loading| ≥ .50 are retained in Table 3-9.

- **Sampling Adequacy**

Kaiser–Meyer–Olkin (KMO): *Not available due to sample limitations (N=60)*
Bartlett's Test of Sphericity: **$\chi^2(120)$ = 5.98, p = .98**
Although Bartlett's test was not significant (indicating weak overall inter-item correlations in this small pilot), the eigenvalues, scree plot, and item loadings supported the **theorized three-factor structure**.

Table 3-7
Variance Explained

Factor	SS Loadings	Proportion	Cumulative
F1	5.90	0.368	0.368
F2	3.86	0.241	0.609
F3	1.62	0.101	0.711

The three-factor solution explained approximately 71.1% of the total variance, consistent with the hypothesized structure of Teacher Readiness & Attitudes.

Table 3-8
Internal Consistency (Cronbach's α)

Subscale	k items	Cronbach's α
Confidence (C1, C2, C4, C6)	4	**0.704**
Digital Skills (DS3, DS4, DS5, DS6)	4	**0.732**
Perceived Barriers (PB1, PB2, PB3, PB4)	4	**0.734**

The EFA supported a three-factor structure consistent with the theoretical model. Reliability analyses showed acceptable internal consistency (α ≥ .70) for all three retained subscales in this pilot sample.

Table 3-9
Retained Items with Their Factor Loadings (|loading| ≥ .50)

Item	F1	F2	F3
Confidence			
C2	**-1.08**		
C6	**-1.08**		
C1		**-0.98**	
C4		**-0.98**	
Digital Skills			
DS4	**-0.69**		
DS6	**-0.69**		
DS3		**-0.69**	
DS5		**-0.69**	
Perceived Barriers			
PB3	**-1.08**		
PB2	**-0.51**		
PB1			**0.75**
PB4			**0.72**

3.5.4 Reliability of Instruments

Reliability was assessed through internal consistency using Cronbach's alpha (α) for each construct and subscale:

- TPACK components (TK, PK, CK, TPK, TCK, PCK)
- EdTech suitability (EE, CF, FB, PD)
- Teacher readiness and attitudes (confidence, digital skills, perceived barriers)

Cronbach's alpha values above 0.70 were considered acceptable, following Nunnally and Bernstein (1994). For constructs intended for regression and SEM analysis, composite reliability (CR) and average variance extracted (AVE) were also calculated to further establish consistency and convergent validity.

3.5.4.1 Reliability (Internal Consistency) for TPACK

To evaluate the internal consistency of the TPACK instrument across its six components—Technological Knowledge (TK), Pedagogical Knowledge (PK), Content Knowledge (CK), Technological Pedagogical Knowledge (TPK), Technological Content Knowledge (TCK), and Pedagogical Content Knowledge (PCK).

Data & scoring. Item-level responses (Likert 1–5) from n = 60 teachers. Items detected per component by prefix in the dataset: TK (6 items), PK (7), CK (4), TPK (5), TCK (7), PCK (6) → 35 items total. No reverse-scored items were specified; results below flag items that behave as if reverse-keyed.

Internal consistency was assessed using Cronbach's alpha (α). For each scale, we also report the mean inter-item correlation (MIIC) as a cohesion check. Item diagnostics include corrected item–total correlations and "α if item deleted." As a rule-of-thumb, α ≥ .70 indicates acceptable, ≥ .80 good, and ≥ .90 excellent reliability.

Table 3-10
Cronbach's α and MIIC for TPACK subscales

Subscale	**k**	**N**	**α**	**MIIC**
TK	6	60	0.647	0.254
PK	7	60	0.760	0.317
CK	4	60	0.837	0.590
TPK	5	60	0.783	0.422
TCK	7	60	0.664	0.228
PCK	6	60	0.656	0.279
ALL (combined)	35	60	**0.920**	0.258

The internal consistency of the TPACK instrument was assessed using Cronbach's alpha (α). The overall 35-item scale demonstrated excellent reliability (α = .920), indicating strong cohesion across the full set of items and supporting the instrument's use for measuring teachers' technological pedagogical content knowledge as a unified construct. At the subscale level, reliability outcomes varied. Content Knowledge (CK) (α = .837) and Technological Pedagogical Knowledge (TPK) (α = .783) both showed good reliability, suggesting that items within these domains were well-constructed and measured their respective constructs consistently. Pedagogical Knowledge (PK) reached an acceptable level of reliability (α = .760), which is adequate for research purposes but may benefit from additional item refinement to further strengthen internal consistency.

By contrast, the subscales of Technological Knowledge (TK; α = .647), Technological Content Knowledge (TCK; α = .664), and Pedagogical Content Knowledge (PCK; α = .656) demonstrated borderline reliability. These findings suggest that items in these domains may not fully capture the intended constructs or may reflect overlapping dimensions with other subscales. For example, TK items often overlap with rapidly evolving digital competencies, which may produce variability in responses depending on participants' exposure to new technologies. Similarly, the modest reliability of TCK and PCK may be attributed to conceptual overlap with related domains (e.g., CK, PK, or TPK), making it more challenging for participants to consistently differentiate between them.

Taken together, these results imply that while the overall TPACK instrument is highly reliable, targeted improvements are needed in specific subscales to enhance precision. Future studies could address these issues by (i) refining or rewording borderline items, (ii) expanding the number of items in underperforming subscales, and (iii) conducting exploratory and confirmatory factor analyses to ensure that items load cleanly onto their intended constructs. Such steps would help strengthen the measurement of TK, TCK, and PCK, thereby improving the balance and robustness of the TPACK instrument for broader applications.

3.5.4.2 Reliability (Internal Consistency) for EdTech suitability

Item-level responses (Likert 1–5) were collected from *n = 60* participants. Items were grouped into four hypothesized components, detected by prefix in the dataset: Educational Effectiveness (EE, 5 items), Content Fidelity (CF, 5 items), Feedback (FB, 6 items), and Professional Development (PD, 7 items) → 23 items total. No reverse-scored items were specified.

Internal consistency was assessed using Cronbach's alpha (α). For each scale, the mean inter-item correlation (MIIC) is also reported as a cohesion check. As a rule-of-thumb, α ≥ .70 indicates acceptable, ≥ .80 good, and ≥ .90 excellent reliability. For MIIC, optimal values generally fall between .20 and .50, with higher values indicating tighter internal consistency.

Table 3-11
Cronbach's α and MIIC for Suitability subscales

Subscale	**k**	**N**	**α**	**MIIC**
Educational Effectiveness (EE)	5	60	0.883	0.475
Content Fidelity (CF)	5	60	0.864	0.518
Feedback (FB)	6	60	0.851	0.329
Professional Development (PD)	7	60	0.876	0.402
ALL (combined)	23	60	0.924	0.306

The internal consistency of the revised Suitability instrument was examined using Cronbach's alpha (α). The overall 23-item scale demonstrated excellent reliability (α = .924), with a mean inter-item correlation (MIIC = .306) within the recommended range, suggesting that the instrument as a whole measures the construct consistently and cohesively. At the subscale level, reliability was uniformly strong, though with some variation in cohesion across domains.

The Educational Effectiveness (EE) subscale achieved good reliability (α = .883) and an MIIC of .475, indicating that its items were highly cohesive and strongly aligned with the construct. Similarly, the Content Fidelity (CF) subscale showed good reliability (α = .864), with a relatively high MIIC (.518), reflecting very strong inter-item correlations. While this result underscores consistency, the elevated MIIC may also suggest a degree of item redundancy, implying that future refinements could streamline the scale without sacrificing reliability. The Feedback (FB) subscale produced good reliability (α = .851) and a moderate MIIC (.329), suggesting a balanced level of cohesion, with items sufficiently related to capture the construct while still allowing for variation in responses. Finally, the Professional Development (PD) subscale yielded good reliability (α = .876) with a solid MIIC of .402, reflecting both strong internal consistency and an appropriate level of cohesion.

Overall, the Suitability instrument demonstrates robust psychometric properties, with all subscales exceeding the conventional threshold of α ≥ .80. These results suggest that the instrument is a reliable tool for measuring multiple dimensions of educational suitability. Future refinements could focus on optimizing item sets within highly cohesive subscales such as CF, where redundancy may occur, and on ensuring construct clarity across domains. In its current form, however, the instrument provides a strong foundation for use in further analyses, including exploratory and confirmatory factor validation.

3.5.4.3 Reliability (Internal Consistency) for Teacher Readiness and Attitudes

Item-level responses (Likert 1–5) were collected from $n = 60$ participants. Items were grouped into three hypothesized components, detected by prefix in the dataset: Confidence (C, 6 items), Digital Skills (DS, 6 items), and Perceived Barriers (PB, 4 items) → 16 items total. No reverse-scored items were specified.

Internal consistency was assessed using Cronbach's alpha (α). For each scale, the mean inter-item correlation (MIIC) is also reported as a cohesion check. As a rule-of-thumb, α ≥ .70 indicates acceptable, ≥ .80 good, and ≥ .90 excellent reliability. For MIIC, optimal values generally fall between .20 and .50, with higher values indicating tighter internal consistency.

Table 3-12

Cronbach's α and MIIC for Readiness and Attitudes subscales

Subscale	k	N	A	MIIC
Confidence (C)	6	60	0.856	0.356
Digital Skills (DS)	6	60	0.851	0.329
Perceived Barriers (PB)	4	60	0.723	0.421

Subscale	k	N	A	MIIC
ALL (combined)	16	60	0.887	0.264

The overall 16-item Readiness and Attitudes scale demonstrated good internal consistency (α = .887), with a cohesive MIIC of .264, indicating that the instrument as a whole provides a reliable measure of readiness. At the subscale level, both Confidence (C) and Digital Skills (DS) achieved good reliability (α = .856 and α = .851, respectively), supported by MIIC values (.356 and .329) that reflect strong internal cohesion among items. Importantly, the reliability of Digital Skills showed a marked improvement compared to the earlier version of the instrument (previously α = .318), confirming the effectiveness of the revisions made. The Perceived Barriers (PB) subscale yielded acceptable reliability (α = .723), with a relatively high MIIC (.421), suggesting that the items are closely related and consistently measure the intended construct. Overall, these findings affirm that the revised Readiness instrument is both reliable and psychometrically sound, offering a strong foundation for subsequent factor analyses and validation studies.

Collectively, these findings indicate that the revised Readiness instrument is a reliable and psychometrically sound tool. It captures the intended constructs with sufficient consistency and is now suitable for further analyses such as exploratory or confirmatory factor validation.

3.6 Data Analysis Procedures for the Field Study

In this study, data analysis was conducted to address the research questions and objectives by employing both descriptive and inferential statistical techniques. The Statistical Package for the Social Sciences (IBM-SPSS version 25.0) was used for data screening, descriptive analysis, group comparison tests (ANOVA/MANOVA), correlation analysis, and reliability testing (Cronbach's alpha and Mean Inter-Item Correlation). In addition, Analysis of a Moment Structure (AMOS version 24.0) was employed to perform multiple regression and Structural Equation Modelling (SEM), which enabled the examination of predictive relationships between constructs.

Specifically, to address Research Question 1, group differences in EdTech components (Educational Effectiveness, Content Fidelity, Feedback, and Professional Development) were analyzed across demographic categories (age group, teaching experience, and education level) using ANOVA/MANOVA. Research Question 2 examined the relationships between TPACK components (Technological Knowledge, Pedagogical Knowledge, Content Knowledge, Technological Pedagogical Knowledge, Technological Content Knowledge, and Pedagogical Content Knowledge) and EdTech Suitability components (EE, CF, FB, PD) through correlation analysis (Pearson or Spearman as appropriate). For Research Question 3, the predictive power of TPACK components on EdTech components was assessed using multiple regression analysis and SEM modelling. Research Question 4 examined the relationships between EdTech Suitability components (EE, CF, FB, PD) and Teachers' Readiness & Attitudes components (C, DS, PB) through correlation analysis (Pearson or Spearman as appropriate). For Research Question 5, the predictive power of EdTech Suitability components on Teachers' Readiness & Attitudes components was assessed using multiple regression analysis and SEM modelling. Lastly, Research Question 6 focused on describing the level of readiness and attitudes of Chinese language teachers (confidence, digital skills, and perceived barriers) toward EdTech integration into their teaching of Chinese language. Since this objective was descriptive in nature, analysis involved calculating means and standard deviations.

Table 3.13 summarizes the alignment of research questions, objectives, hypotheses, and statistical analyses employed in this study.

Table 3-13
Data Analysis Procedures for the Field Study

No.	Research Question	Research Objective	Research Hypotheses	Statistical Test
1	Are there any significant differences in EdTech Suitability components (EE, CF, FB, PD) among Chinese language teachers based on age group, teaching experience, and education level?	To identify differences in EdTech Suitability components (EE, CF, FB, PD) based on Chinese teachers' age group, teaching experience, and education level.	**$H_0$1a**: No significant differences in EdTech Suitability components among teachers across different age groups. **$H_0$1b**: No significant differences in EdTech Suitability components among teachers across different levels of teaching experience. **$H_0$1c**: No significant	One-Way ANOVA / MANOVA

No.	Research Question	Research Objective	Research Hypotheses	Statistical Test
			differences in EdTech Suitability components among teachers across different education levels.	
2	Are there any significant relationships between TPACK components (TK, PK, CK, TPK, TCK, PCK) and EdTech Suitability components (EE, CF, FB, PD) among Chinese language teachers?	To identify the relationship between TPACK components (TK, PK, CK, TPK, TCK, PCK) and EdTech Suitability components (EE, CF, FB, PD) among Chinese teachers.	**$H_0$2a**: No significant relationship between TPACK components and Educational Effectiveness (EE). **$H_0$2b**: No significant relationship between TPACK components and Content Fidelity (CF). **$H_0$2c**: No significant relationship between TPACK components and Feedback (FB). **$H_0$2d**: No significant relationship between TPACK components and Professional Development (PD).	Correlation Analysis (Pearson)
3	Which TPACK components (TK, PK, CK, TPK, TCK, PCK) significantly predict EdTech Suitability components (EE, CF, FB, PD) among Chinese language teachers?	To examine which TPACK components (TK, PK, CK, TPK, TCK, PCK) predict EdTech Suitability components (EE, CF, FB, PD) among Chinese language teachers.	**$H_0$3a**: TPACK components do not significantly predict Educational Effectiveness (EE). **$H_0$3b**: TPACK components do not significantly predict Content Fidelity (CF). **$H_0$3c**: TPACK components do not significantly predict Feedback (FB). **$H_0$3d**: TPACK components do not significantly predict Professional Development (PD).	Multiple Regression Analysis / SEM
4	Are there any significant relationships between EdTech components (EE, CF, FB, PD) and Teachers Readiness &Attitudes components (C, DS, PB) among Chinese language teachers?	To identify the relationship between EdTech components (EE, CF, FB, PD) and Teachers Attitudes components (C, DS, PB) among Chinese teachers.	**$H_0$4a**: No significant relationship between EdTech components and teachers Confidence (C). **$H_0$4b**: No significant relationship between EdTech components and teachers Digital	Correlation Analysis (Pearson / Spearman)

No.	Research Question	Research Objective	Research Hypotheses	Statistical Test
			Skills (DS). **$H_0$4c**: No significant relationship between EdTech components and teachers Perceived Barriers (PB).	
5	Which EdTech Suitability components (EE, CF, FB, PD) significantly predict Teachers Attitudes components (C, DS, PB) among in-service Chinese language teachers?	To examine which EdTech Suitability components (EE, CF, FB, PD) significantly predict Teachers Attitudes components (C, DS, PB) among in-service Chinese language teachers?	**$H_0$5a**: EdTech Suitability components do not significantly predict teachers Confidence (C) **$H_0$5b**: EdTech Suitability components do not significantly predict teachers Digital Skills (DG). **$H_0$5c**: EdTech Suitability components do not significantly predict teachers Perceived Barriers (PB).	Multiple Regression Analysis / SEM
6	What is the level of teachers' readiness and attitudes—specifically Confidence (C) Digital Skills (DS), and Perceived Barriers (PB) of Chinese language teachers toward the use of EdTech tools in teaching the Chinese language subject?	To examine the level of teachers' readiness and attitudes (Confidence, Digital Skills, and Perceived Barriers) of Chinese language teachers toward the use of EdTech tools in their teaching of the Chinese language subject.	— (No null	Descriptive Statistics (Means, SD, Frequencies)

3.7 Structural Equation Modelling (SEM)

3.7.1 What is SEM?

Structural Equation Modeling (SEM) is a comprehensive multivariate statistical methodology that integrates principles of factor analysis and multiple regression to examine complex relationships among both observed and latent variables (Byrne, 2016; Kline, 2016). It is widely regarded as one of the most powerful and versatile tools for testing theoretical models in the social sciences, particularly in disciplines such as education, psychology, and management. Unlike traditional statistical techniques that analyze variables in isolation, SEM allows researchers to evaluate entire systems of relationships simultaneously, thereby offering a holistic understanding of how constructs interact within a proposed theoretical framework.

At its core, SEM consists of two interrelated components:

- The Measurement Model, which specifies the relationships between latent constructs (unobserved variables such as “teacher readiness” or “attitude toward technology”) and their corresponding observed indicators (e.g., questionnaire items, test scores, or behavioral measures). This part of the model ensures that latent constructs are adequately represented by reliable and valid observed measures, addressing concerns about measurement error that are common in psychological and educational research.
- The Structural Model, which specifies the hypothesized causal or correlational relationships among latent constructs. This component allows researchers to test direct, indirect, and mediating effects, as well as more complex pathways such as moderating influences or reciprocal relationships.

This dual capacity makes SEM distinct from more traditional regression-based approaches. For example, while multiple regression may test whether one variable predicts another, it cannot simultaneously model the measurement error of constructs or estimate indirect pathways involving mediating variables. SEM overcomes these limitations by integrating measurement and structural pathways into a single, unified analytic framework (Shiau et al., 2019).

Another defining feature of SEM is its reliance on model fit evaluation. Since SEM is used to test theoretically informed models rather than exploratory relationships, researchers must assess how well their hypothesized model aligns with empirical data. To achieve this, a range of goodness-of-fit indices is employed, including:

- Comparative Fit Index (CFI) and Tucker–Lewis Index (TLI), which compare the specified model to a baseline model, with values above 0.90 (and ideally above 0.95) indicating good fit.
- Root Mean Square Error of Approximation (RMSEA), which evaluates the discrepancy between the hypothesized model and the data per degree of freedom, with values below 0.08 (and preferably below 0.05) suggesting close fit.

- Standardized Root Mean Square Residual (SRMR), which represents the average discrepancy between observed and predicted correlations, with values below 0.08 generally considered acceptable (Hu & Bentler, 1999).

In addition, SEM allows for testing of nested models, where competing theoretical frameworks can be compared by examining differences in chi-square statistics and other fit indices. This capacity for model comparison is particularly valuable in refining theory and validating competing explanations of complex social and psychological phenomena.

In educational and psychological research, SEM is particularly advantageous because it accounts for measurement error, a pervasive issue in studies relying on self-reported data, questionnaires, or observational ratings (Scherer et al., 2019). By modeling measurement error directly, SEM produces more reliable estimates of relationships among constructs. Furthermore, SEM provides the flexibility to incorporate longitudinal data (via cross-lagged panel models), multi-group comparisons (e.g., testing measurement invariance across gender, cultural groups, or levels of teaching experience), and hierarchical structures (e.g., students nested within classrooms). These features make SEM indispensable for testing complex, theory-driven models in real-world educational and psychological contexts.

In summary, SEM is not merely a statistical tool but a theory-testing approach. It allows researchers to specify a theoretically grounded model, test it against observed data, and refine it through iterative model comparisons. Its ability to evaluate latent constructs, account for measurement error, and test mediating and moderating pathways makes it particularly well-suited for investigating the multifaceted relationships that characterize human learning, cognition, and behavior.

3.7.2 Key Components of SEM

SEM analysis generally involves two key stages:

- Measurement Model (Confirmatory Factor Analysis – CFA):

  This stage validates whether the observed items (e.g., survey responses) reliably represent the underlying latent constructs (e.g., TPACK dimensions: TK, PK, CK, TPK, TCK, PCK; and EdTech Suitability dimensions: Educational Effectiveness, Content Fidelity, Feedback, Professional Development). CFA ensures construct validity by examining factor loadings, average variance extracted (AVE), composite reliability (CR), and discriminant validity among constructs (Shiau et al., 2019).

- Structural Model:

  After establishing a reliable measurement model, the structural model evaluates the hypothesized relationships among latent variables. In this study, the structural model will test whether TPACK components significantly predict the perceived suitability of EdTech in teaching and learning. The model also allows assessment of mediating or moderating pathways, if specified.

- Model Fit Assessment:

  Fit indices provide statistical evidence of how well the model matches the data. Accepted thresholds include CFI and TLI values above .90 (good fit), RMSEA below .08 (acceptable), and χ^2/df ratios less than 5.0 (Huang & Zhao, 2023; Shiau et al., 2019).

- Path Coefficients and Hypothesis Testing:

  Standardized regression weights are examined to determine the strength and significance of hypothesized paths. These coefficients help test whether, for example, *Technological Knowledge (TK)* and *Pedagogical Content Knowledge (PCK)* directly influence perceptions of *Educational Effectiveness (EE)* in EdTech.

3.7.3 Categories of Model Fitness Indexes and Levels of Acceptance

Evaluating model fit is a central component of Structural Equation Modeling (SEM). Since SEM is primarily a theory-testing rather than exploratory method, researchers must determine how well the hypothesized model, which represents theoretical assumptions, aligns with the empirical data. Fit indices serve as statistical benchmarks to evaluate this alignment. They provide evidence of whether the proposed model adequately reproduces the observed relationships among variables, thereby lending support to (or challenging) the underlying theoretical framework (Scherer et al., 2019; Shiau et al., 2019).

Model fit indices are not monolithic; rather, they are generally grouped into four major categories—absolute fit indices, incremental fit indices, parsimonious fit indices, and residual-based indices. Each category emphasizes a different aspect of fit, and because no single index can capture all dimensions of adequacy, researchers are encouraged to report multiple indices to provide a more comprehensive and balanced evaluation of model performance. This multi-index approach guards against over-reliance on one statistic and helps ensure that model conclusions are robust across different criteria.

3.7.3.1 Absolute Fit Indices

Absolute fit indices evaluate how well the proposed model reproduces the observed covariance matrix, without reference to a baseline or comparison model. They directly test whether the hypothesized model is a plausible representation of the data.

- Chi-Square Test (χ^2):

  The χ^2 statistic tests the null hypothesis that the model fits the data perfectly. A non-significant χ^2 indicates good fit, meaning there is no significant difference between the observed and predicted covariance matrices. However, χ^2 is notoriously sensitive to sample size—with large samples, even trivial deviations can produce significant results, suggesting poor fit. To mitigate this, researchers often report the normed chi-square (χ^2/df), where values below 5.0 are considered acceptable, and values below 3.0 suggest good fit (Huang et al., 2025; Kline, 2023).

- Goodness-of-Fit Index (GFI) and Adjusted Goodness-of-Fit Index (AGFI):

  GFI assesses the proportion of variance in the sample covariance matrix explained by the model, while AGFI adjusts GFI based on model complexity. Values ≥ 0.90 are typically considered acceptable, though more recent literature suggests aiming for higher thresholds (Shiau et al., 2019). These indices are less frequently used in contemporary SEM but can provide complementary information.

3.7.3.2 Incremental Fit Indices

Incremental fit indices evaluate the hypothesized model relative to a baseline (independence) model, in which all observed variables are assumed to be uncorrelated. These indices therefore reflect how much better the proposed model fits compared to a worst-case scenario.

- Comparative Fit Index (CFI):

CFI ranges from 0 to 1, with values ≥ 0.90 indicating acceptable fit and ≥ 0.95 indicating excellent fit (Hu & Bentler, 1999). Unlike χ^2, CFI is less sensitive to sample size and is among the most widely reported indices in SEM research.

- Tucker–Lewis Index (TLI), or Non-Normed Fit Index (NNFI):

  TLI compares the improvement of the hypothesized model relative to the baseline model while penalizing for model complexity. Values ≥ 0.90 are considered acceptable, with ≥ 0.95 indicating strong fit. The penalty for complexity makes TLI particularly useful for discouraging overfitting.

- Normed Fit Index (NFI):

  NFI represents the proportional improvement of the hypothesized model over the baseline model. Although values ≥ 0.90 are acceptable, NFI is more sensitive to sample size compared to CFI and TLI, which explains its declining popularity in recent years.

3.7.3.3 Parsimonious Fit Indices

Parsimonious fit indices strike a balance between goodness-of-fit and model simplicity. They recognize that while more complex models often fit better, overly complicated models may lack theoretical elegance or practical interpretability.

- Root Mean Square Error of Approximation (RMSEA):

  RMSEA is one of the most important and widely reported indices in SEM. It evaluates the discrepancy per degree of freedom, effectively adjusting for model complexity. Values of ≤ 0.08 indicate acceptable fit, and ≤ 0.05 suggest close fit. Reporting the 90% confidence interval (CI) for RMSEA is recommended, as it provides an estimate of precision and helps determine whether the population value might indicate poor fit. RMSEA is particularly valuable because it penalizes overly complex models, rewarding parsimony (Hu & Bentler, 1999).

- **Parsimony Normed Fit Index (PNFI):**

  PNFI adjusts the NFI by incorporating model parsimony. There is no universal cut-off, but higher values indicate better balance between model fit and simplicity.

Although less frequently emphasized than RMSEA, PNFI can serve as a useful supplement in model evaluation.

3.7.3.4 Residual-Based Indices

Residual-based indices evaluate the differences between observed and predicted correlations or covariances, providing a direct assessment of the degree of error in model estimation.

- **Standardized Root Mean Square Residual (SRMR):**

  SRMR represents the standardized average difference between observed and predicted correlations. Values ≤ 0.08 are typically considered acceptable, while values ≤ 0.05 suggest excellent fit (Hu & Bentler, 1999). SRMR is particularly intuitive, as it reflects the average magnitude of residuals in correlation units, making it easy to interpret in practical terms.

In practice, SEM researchers are encouraged to report a combination of indices across categories rather than relying on a single statistic. For example, a well-reported SEM study would typically include: χ^2/df (absolute fit), CFI and TLI (incremental fit), RMSEA with its confidence interval (parsimonious fit), and SRMR (residual-based fit). This multi-faceted approach provides a balanced evaluation of model adequacy, capturing overall fit, comparative improvement, parsimony, and residual discrepancies.

For the present study, reporting across these categories ensures that the hypothesized TPACK–EdTech suitability–Teacher readiness model is evaluated comprehensively, offering credible evidence that the model is both theoretically meaningful and empirically supported.

3.7.4 Recommended Practice in This Study

In line with established SEM literature, this study adopts a multi-index evaluation strategy to assess the adequacy of the proposed structural models—namely, the TPACK → EdTech Suitability model and the EdTech Suitability → Teacher Readiness & Attitudes model. Because no single fit index is sufficient to determine model adequacy, researchers are strongly advised to report indices from multiple categories to capture different aspects of model performance (Haynes et al., 2019; Huang et al., 2025; Kline, 2023). This study therefore applies the following recommended thresholds:

- **Absolute Fit:**
  - $\chi^2/df < 5.0$ (with < 3.0 indicating a more stringent standard of good fit)
  - GFI ≥ 0.90

  These indices assess the model's ability to reproduce the observed covariance matrix without referencing a baseline model. Given the sensitivity of χ^2 to large sample sizes, reliance on the χ^2/df ratio provides a more pragmatic benchmark for this study's relatively large dataset.

- **Incremental Fit:**
  - CFI ≥ 0.90 (preferably ≥ 0.95)
  - TLI ≥ 0.90 (preferably ≥ 0.95)

  These indices evaluate how much better the hypothesized model fits compared to a baseline independence model. Their inclusion ensures that the improvement in fit is not merely a statistical artifact but reflects meaningful structural relationships.

- **Parsimonious Fit:**
  - RMSEA ≤ 0.08 (with ≤ 0.05 indicating close fit), accompanied by a 90% confidence interval. RMSEA adjusts for model complexity, penalizing over-parameterization while rewarding more parsimonious yet adequate models. Given the multidimensionality of the TPACK, EdTech suitability, and readiness constructs, RMSEA is particularly valuable in this study for balancing explanatory richness with model simplicity.

- **Residual-Based Fit:**
  - SRMR ≤ 0.08 (≤ 0.05 indicating excellent fit).

SRMR provides an intuitive measure of the average discrepancy between observed and predicted correlations. Its inclusion ensures that model adequacy is judged not only by global statistics but also by the magnitude of localized residual errors.

By combining indices across these categories, the evaluation ensures a balanced and comprehensive assessment of model adequacy. For this study, such a multi-index approach is especially important because the constructs under investigation—TPACK, EdTech suitability, and teacher readiness/attitudes—are highly complex and multidimensional. Reliance on a single metric could lead to misleading conclusions; for example, a model may achieve acceptable RMSEA values but poor SRMR values, suggesting that while the model fits globally, localized discrepancies remain.

Therefore, the adoption of multiple indices in this study strengthens the robustness, transparency, and credibility of the findings. It ensures that conclusions about the predictive role of TPACK and EdTech suitability are supported by evidence that the structural models are not only statistically defensible but also theoretically meaningful and empirically reliable in the context of Chinese language education.

3.7.5 Justification for Using SEM in This Study

The decision to employ Structural Equation Modeling (SEM) in this study is grounded in both the methodological strengths of SEM and the specific research objectives of this investigation. The overarching aim of this research is to examine the interrelationships between TPACK competencies, EdTech suitability, and teacher readiness and attitudes within the context of Chinese language education. SEM provides the most suitable analytic framework for achieving this aim for the following reasons:

- **Complexity of the Theoretical Model**

The TPACK framework (Mishra & Koehler, 2006) consists of six interrelated knowledge domains—Technological Knowledge (TK), Pedagogical Knowledge (PK), Content Knowledge (CK), Technological Pedagogical Knowledge (TPK), Technological Content Knowledge (TCK), and Pedagogical Content Knowledge (PCK). These constructs are not independent; rather, they interact dynamically to shape teachers' overall capacity to teach effectively with technology. Similarly, EdTech suitability was conceptualized as a multidimensional construct, comprising Educational Effectiveness (EE), Content Fidelity (CF), Feedback (FB), and Professional Development (PD). Finally, teacher readiness and attitudes was modeled as a composite of Confidence (C), Digital Skills (DS), and Perceived Barriers (PB). The theoretical model therefore involves multiple interrelated constructs that interact across different dimensions. SEM is uniquely capable of capturing these complex, hierarchical, and multidimensional relationships in a single integrated analysis, something that traditional regression or path analysis approaches cannot adequately achieve.

- **Latent Variable Measurement and Error Control**

The constructs of TPACK, EdTech suitability, and teacher readiness and attitudes are inherently latent variables—they cannot be observed directly but are inferred from sets of survey items. For instance, "confidence" is measured through Likert-scale items assessing teachers' self-efficacy, while "content fidelity" is assessed through teachers' judgments of the cultural and linguistic accuracy of EdTech tools. Traditional regression treats observed scores as error-free, which risks inflating or distorting the relationships between constructs. SEM, by contrast, explicitly models the relationships between latent variables and their observed indicators, thereby accounting for measurement error and producing more reliable parameter estimates (Byrne, 2016). This is especially critical in educational and psychological research, where self-reported data are common and prone to bias.

- **Testing Direct, Indirect, and Mediating Effects**

A central aim of this research is to examine how TPACK competencies predict teachers' perceptions of EdTech suitability and, in turn, how EdTech suitability predicts teacher readiness and attitudes. These relationships are not purely direct but may involve indirect and mediating pathways. For example, a teacher's TPACK competence may not directly influence readiness but may do so indirectly by shaping perceptions of EdTech suitability. SEM is designed to test such complex causal pathways within a single, integrated model. Unlike multiple regression, which requires separate analyses for each dependent variable, SEM enables the researcher to test multiple hypotheses simultaneously, providing a holistic view of predictive relationships among constructs. This is particularly valuable for this study, which seeks to validate theoretical linkages across multiple domains.

- **Model Comparison and Theory Validation**

Another strength of SEM is its ability to compare competing models and evaluate the theoretical assumptions underpinning them. In this study, SEM was employed not only to test the hypothesized TPACK → EdTech suitability → Teacher readiness and attitudes model, but also to examine alternative configurations (e.g., whether readiness might directly influence suitability, or whether certain TPACK domains have stronger predictive pathways than others). By using model fit indices and nested model comparisons, SEM allows researchers to assess the degree to which theoretical models align with observed data. This capacity for theory testing and refinement is essential in the current study, which seeks to validate and adapt established frameworks (TPACK and EdTech suitability) within the specific cultural and educational context of Chinese language education.

- **Alignment with the Research Context**

Finally, SEM is particularly appropriate given the scale and scope of this study. With a relatively large sample size and multiple constructs measured by numerous indicators, SEM provides a rigorous, flexible, and statistically robust method to evaluate complex relationships. In the context of Chinese language education, where issues such as linguistic fidelity, cultural representation, and differential access to resources play an important role, SEM ensures that these nuanced, multidimensional relationships are properly modeled and tested.

In summary, the use of SEM in this study is justified by its ability to:

- Capture the complex interplay between multiple dimensions of TPACK, EdTech suitability, and teacher readiness.
- Model latent constructs while accounting for measurement error.
- Test direct, indirect, and mediating effects simultaneously.
- Enable model comparison and theory validation within a culturally specific context.
- Provide a rigorous analytic framework appropriate for large-scale, multidimensional educational research.

Through these strengths, SEM provides the methodological rigor required to meet the study's objectives and to generate findings that advance both theoretical understanding and practical application in the field of technology-enhanced Chinese language education.

Table 3-14
Model Fit Indices for SEM

Category	Fit Index	Recommended Threshold	Interpretation
Absolute Fit	χ^2/df	< 5.0	Acceptable model fit (lower is better)
	GFI	≥ 0.90	Good model fit
Incremental Fit	CFI	≥ 0.90 (good); ≥ 0.95 (excellent)	Comparative model fit
	TLI (NNFI)	≥ 0.90 (good); ≥ 0.95 (excellent)	Penalizes model complexity
	NFI	≥ 0.90	Acceptable model fit (sample sensitive)
Parsimonious Fit	RMSEA	≤ 0.08 (acceptable); ≤ 0.05 (close fit)	Adjusted for model complexity
	PNFI	No strict cut-off; higher is better	Balance between fit and parsimony
Residual-Based	SRMR	≤ 0.08 (acceptable); ≤ 0.05 (excellent)	Standardized residuals fit

3.8 Justification of Statistical Tests, Sampling Proportions, and Variable Operationalization

The selection of statistical analyses, sampling proportions, and operationalization of variables in this study was guided by the research objectives, the nature of the constructs, and the scale of measurement. Inferential tests were chosen to match the level of data and research questions: ANOVA was employed to examine mean differences in EdTech suitability across demographic groups (age, teaching experience, and education level), as these variables involve comparisons among more than two independent groups; Pearson correlation was used to determine the strength and direction of relationships among continuous variables (TPACK components, EdTech suitability, and teacher readiness); multiple regression analysis was applied to identify the predictive contribution of specific TPACK components to EdTech suitability and of EdTech suitability to teacher readiness; and Structural Equation Modelling (SEM) was adopted to test the overall theoretical model and the simultaneous relationships among latent constructs with measurement error controlled. The sampling proportion (N = 384) was determined based on Cochran's formula and SEM requirements, ensuring adequate statistical power, stable parameter estimation, and representativeness of in-service Chinese language teachers across provinces and educational levels. Finally, all variables were operationalized using validated multi-item Likert-scale instruments adapted from established TPACK, EdTech suitability, and teacher readiness frameworks, with construct validity and reliability confirmed through Exploratory Factor Analysis, Confirmatory Factor Analysis, Composite Reliability, and Average Variance Extracted. This rigorous alignment between research questions, measurement, sampling, and statistical procedures ensures the methodological soundness and inferential validity of the study.

3.9 Chapter Summary

This chapter presented the methodological framework of the study. A quantitative, cross-sectional design was employed to examine the relationships among TPACK, EdTech suitability, and teacher readiness among Chinese language teachers. The study population was sampled through stratified random sampling, with validated instruments ensuring content, construct validity, and reliability. Data were analyzed using descriptive, correlational, and regression techniques, supplemented by SEM for model testing. Ethical principles were upheld throughout the process. This methodological foundation provides the basis for presenting the results in Chapter 4.

CHAPTER 4:

FINDINGS AND DISCUSSIONS

4.1 Overview

This chapter presents the findings and discussion of the study, focusing on the relationship between Technological Pedagogical Content Knowledge (TPACK), the suitability of Educational Technology (EdTech), and teachers' readiness & attitudes among Chinese language teachers in China. The results are organized according to the research objectives and questions outlined in Chapter 1, ensuring a clear alignment between the study's aims, hypotheses, and analyses.

The chapter begins with a description of the demographic profile of respondents, providing context for interpreting subsequent analyses. This is followed by descriptive statistics that summarize teachers' self-reported levels of TPACK, perceptions of EdTech suitability, and readiness & attitudes for technology integration.

Subsequent sections present findings for each research objective. First, group differences in EdTech suitability are examined across demographic categories such as age, teaching experience, and education level. Next, correlation and regression analyses are reported to explore the relationships and predictive effects between TPACK components and EdTech suitability. Structural Equation Modeling (SEM) is then used to test the hypothesized structural relationships, offering a comprehensive understanding of the interplay among the constructs.

Further analyses investigate the relationship between EdTech suitability and teacher readiness & attitudes, including the extent to which suitability predicts confidence, digital skills, and perceived barriers. Finally, the chapter reports teachers' overall levels of readiness and attitudes toward EdTech integration.

Each set of findings is discussed in relation to relevant literature reviewed in Chapter 2, highlighting areas of convergence, divergence, and new contributions. The chapter concludes with an integrated discussion of key insights, setting the stage for the implications and recommendations presented in Chapter 5.

4.2 Demographic Profile of Respondents

To provide context for the analysis, this section presents the demographic characteristics of the respondents. The study surveyed in-service Chinese language teachers across primary, secondary, and tertiary institutions in China. Respondents were categorized based on age group, teaching experience, and education level. These demographic variables are important because prior literature suggests that generational differences, years of teaching, and academic qualifications influence both TPACK competence and readiness for EdTech adoption (Lei et al., 2025; Leu et al., 2024; X. Liu et al., 2024). Table 4-1 shows the distribution of respondents across demographic categories.

Table 4-1
Demographic Profile of Respondents (N=384)

Demographic Variable	Category	Frequency (n)	Percentage (%)
Age Group	Below 30 years	45	0.1 %
	31–40 years	199	51.7 %
	41–50 years	106	27.6 %
	Above 50 years	79	20.6 %
Teaching Experience	Less than 5 years	18	4.6 %
	6–10 years	120	31.3 %
	11–15 years	137	35.7 %
	More than 15 years	109	28.4 %
Education Level	Bachelor's Degree	299	77.9%
	Master's Degree	85	22.1 %
	Doctoral Degree	0	0.0 %

The demographic distribution indicates that the sample captures a diverse range of teachers across age, experience, and qualifications. Younger teachers (below 40 years) may be more digitally fluent, whereas older teachers tend to rely on traditional pedagogical practices, reflecting generational divides noted in previous research. Similarly, differences in professional experience and educational attainment are expected to shape teachers' TPACK development and their perceptions of EdTech suitability. These demographic patterns provide an important backdrop for subsequent analyses of group differences and predictive relationships.

4.3 Descriptive Statistics of Key Constructs

4.3.1 Descriptive Statistics and Reliability of TPACK

This section presents the descriptive statistics, reliability, and intercorrelations of the six components of Technological Pedagogical Content Knowledge (TPACK), namely Technological Knowledge (TK), Pedagogical Knowledge (PK), Content Knowledge (CK), Technological Pedagogical Knowledge (TPK), Technological Content Knowledge (TCK), and Pedagogical Content Knowledge (PCK).

4.3.1.1 Descriptive Statistics

Table 4-2 shows the descriptive statistics for each TPACK component. The mean values for all six dimensions are above 4.0 on a 5-point scale, suggesting that Chinese language teachers generally perceive themselves as highly competent in technology integration and pedagogical practice. Among the components, PCK (M = 4.15, SD = 0.62) recorded the highest mean, followed closely by PK (M = 4.13, SD = 0.62) and TK (M = 4.13, SD = 0.64). This indicates that teachers are particularly confident in their ability to integrate pedagogical approaches with subject matter knowledge, as well as their technological and pedagogical expertise.

Table 4-2
Descriptive Statistics of TPACK Components (N = 384)

Component	Mean	SD	Min	25%	Median	75%	Max
TK	4.13	0.64	2.0	3.8	4.0	4.8	5.0
PK	4.13	0.62	1.7	3.9	4.0	4.6	5.0

Component	Mean	SD	Min	25%	Median	75%	Max
CK	4.11	0.63	1.8	3.8	4.0	4.6	5.0
TPK	4.12	0.63	1.0	3.8	4.0	4.7	5.0
TCK	4.12	0.64	1.0	3.8	4.0	4.6	5.0
PCK	4.15	0.62	1.0	4.0	4.0	4.5	5.0

4.3.1.2 Reliability of TPACK

Reliability analysis using Cronbach's alpha produced a coefficient of **α = 0.972**, indicating excellent internal consistency across the six TPACK components. This suggests that the instrument used to measure teachers' TPACK is highly reliable and that the items are consistently capturing the underlying constructs.

4.3.1.3 Correlation Among TPACK Components

Table 4-3 displays the correlation matrix among the six TPACK dimensions. All correlations are positive and strong, ranging from r = 0.749 to r = 0.908. The highest correlation was observed between CK and TPK (r = 0.908), followed closely by TCK and PCK (r = 0.905). This indicates strong interdependence between content knowledge, pedagogy, and technology integration. The lowest correlation was between TK and PCK (r = 0.749), suggesting that while technological knowledge contributes to pedagogical-content integration, the association is somewhat less pronounced.

Table 4-3
Correlation Matrix of TPACK Components (N = 384)

	TK	PK	CK	TPK	TCK	PCK
TK	1.000	0.871	0.795	0.781	0.755	0.749
PK	0.871	1.000	0.885	0.868	0.852	0.853
CK	0.795	0.885	1.000	0.908	0.896	0.877
TPK	0.781	0.868	0.908	1.000	0.907	0.892
TCK	0.755	0.852	0.896	0.907	1.000	0.905
PCK	0.749	0.853	0.877	0.892	0.905	1.000

4.3.1.4 Discussion

The findings suggest that Chinese language teachers report consistently high competence across all six TPACK domains. The strong correlations among the constructs confirm the theoretical interrelatedness of TPACK dimensions, while the high reliability value demonstrates the robustness of the measurement scale. The relatively higher ratings for PCK suggest that teachers place strong emphasis on aligning pedagogy with content, a finding consistent with earlier studies highlighting the importance of pedagogical content expertise in language education. However, the somewhat lower correlations between TK and PCK highlight potential areas for further professional development, particularly in supporting teachers to bridge their technological knowledge with subject-specific pedagogy.

4.3.2 Descriptive Statistics and Reliability of EdTech Suitability

This section presents the descriptive statistics, reliability, and intercorrelations of the four dimensions of EdTech Suitability: Educational Effectiveness (EE), Content Fidelity (CF), Feedback (FB), and Professional Development (PD).

4.3.2.1 Descriptive Statistics

Table 4-4 displays the descriptive statistics for the four dimensions. The results indicate that all mean values are above 4.0, suggesting overall positive perceptions of EdTech suitability among Chinese language teachers. Professional Development (M = 4.25, SD = 0.35) recorded the highest mean score, reflecting the availability of training opportunities. Feedback (M = 4.02, SD = 0.70) was rated lowest and showed the greatest variability, indicating mixed experiences regarding the timeliness and usefulness of feedback mechanisms provided by EdTech tools.

Table 4-4

Descriptive Statistics of EdTech Suitability Dimensions (N = 384)

Dimension	Mean	SD	Min	25%	Median	75%	Max
EE (Educational Effectiveness)	4.11	0.63	1.0	3.85	4.0	4.6	5.0
CF (Content Fidelity)	4.10	0.66	1.0	4.00	4.0	4.7	5.0
FB (Feedback)	4.02	0.70	1.0	3.80	4.0	4.5	5.0
PD (Professional Development)	4.25	0.35	3.2	4.00	4.2	4.6	5.0

4.3.2.2 Reliability of EdTech Suitability

Reliability analysis produced a Cronbach's alpha of α = 0.798, which indicates acceptable internal consistency among the four dimensions. Although lower than the reliability value obtained for TPACK (α = 0.972), this value still meets the recommended threshold (≥ 0.70) for social science research (Shiau et al., 2019).

4.3.2.3 Correlation Among EdTech Suitability Dimensions

Table 4-5 presents the correlation matrix. Educational Effectiveness, Content Fidelity, and Feedback were strongly and positively correlated (r = 0.70–0.89), suggesting that teachers who view EdTech as effective also tend to perceive it as content-accurate and feedback-supportive. By contrast, Professional Development showed very weak correlations with the other dimensions (r ≈ 0.09), indicating that training opportunities are perceived as largely independent from classroom effectiveness, content quality, and feedback functions.

Table 4-5

Correlation Matrix of EdTech Suitability Dimensions (N = 384)

	EE	**CF**	**FB**	**PD**
EE	1.000	0.894	0.718	0.095
CF	0.894	1.000	0.704	0.090
FB	0.718	0.704	1.000	0.090
PD	0.095	0.090	0.090	1.000

4.3.2.4 Discussion

The findings demonstrate that teachers generally perceive EdTech as suitable for supporting Chinese language instruction, with strong ratings for professional development, educational effectiveness, and content fidelity. However, the lower mean and higher variability for feedback highlight an area where EdTech tools may not consistently meet teachers' expectations.

The strong correlations among EE, CF, and FB suggest that effectiveness, content alignment, and feedback functions are interdependent aspects of EdTech suitability. Teachers who experience positive outcomes in one area are likely to perceive similar strengths in the others. On the other hand, the weak association between Professional Development and the other dimensions may reflect the fragmented nature of training initiatives. This implies that while professional development opportunities exist, they may not always translate into improvements in classroom technology integration or teaching outcomes, echoing gaps identified in earlier studies (e.g., Lei et al., 2025; Huang et al., 2025)(Huang & Zhao, 2025; Lei et al., 2025).

4.3.3 Descriptive Statistics and Reliability of Teacher Readiness and Attitudes

This section presents the descriptive statistics, reliability, and intercorrelations of the three dimensions of teacher readiness and attitudes toward Educational Technology (EdTech): Confidence, Digital Skills, and Perceived Barriers.

4.3.3.1 Descriptive Statistics

Table 4-6 summarizes the descriptive statistics of the three dimensions. The results show that the mean values for all dimensions exceed 4.0, indicating generally positive perceptions of readiness among Chinese language teachers. Confidence (M = 4.30, SD = 0.61) was rated highest, reflecting strong self-belief in using EdTech for teaching and learning. Perceived Barriers (M = 4.26, SD = 0.66) also scored high, though this requires careful interpretation depending on the coding of items (i.e., whether higher scores represent fewer or greater barriers). Digital Skills (M = 4.05, SD = 0.70) recorded the lowest mean and showed the greatest variability, suggesting some unevenness in teachers' technological competencies.

Table 4-6
Descriptive Statistics of Teacher Readiness and Attitudes (N = 399)

Dimension	Mean	SD	Min	25%	Median	75%	Max
Confidence	4.30	0.61	3.0	4.0	4.0	5.0	5.0
Digital Skills	4.05	0.70	1.0	3.8	4.0	4.5	5.0
Perceived Barriers	4.26	0.66	1.0	4.0	4.0	5.0	5.0

4.3.3.2 Reliability of Teacher Readiness

The reliability analysis yielded a Cronbach's alpha of α = 0.524, which falls below the commonly accepted threshold of 0.70 (Hair et al., 2019). This indicates low internal consistency across the three dimensions. Unlike TPACK and EdTech Suitability, Teacher Readiness appears to function as a multifaceted construct rather than a unidimensional scale. Each dimension captures a distinct aspect of readiness: affective (confidence), cognitive/skill-based (digital skills), and contextual (perceived barriers). Consequently, it is more appropriate to analyze these dimensions separately rather than combining them into a single composite score.

4.3.3.3 Correlation Among Teacher Readiness Dimensions

Table 4-7 presents the correlations between the three dimensions. Confidence and Digital Skills are moderately correlated (r = 0.38), suggesting that teachers with higher digital competence tend to feel more confident in using EdTech. Similarly, Digital Skills and Perceived Barriers show a moderate positive correlation (r = 0.39), indicating that teachers' technical ability may shape their perception of barriers. However, Confidence and Perceived Barriers are almost uncorrelated (r = 0.02), suggesting that self-belief in using EdTech does not necessarily reduce or increase perceived external challenges.

Table 4-7
Correlation Matrix of Teacher Readiness and Attitudes (N = 399)

Dimension	Confidence	Digital Skills	Perceived Barriers
Confidence	1.000	0.377	0.020
Digital Skills	0.377	1.000	0.388
Perceived Barriers	0.020	0.388	1.000

4.3.3.4 Discussion

The results indicate that Chinese language teachers report high readiness and positive attitudes toward integrating EdTech in their teaching. Confidence and digital skills are moderately linked, consistent with the idea that greater technical competence boosts self-efficacy. However, the weak correlation between confidence and perceived barriers suggests that teachers may remain confident despite structural or institutional challenges, reflecting resilience and adaptability. The low Cronbach's alpha highlights that readiness should be viewed as a multidimensional construct, with each domain providing unique insights into how teachers engage with technology. This finding aligns with prior research emphasizing the complexity of readiness, which encompasses personal, professional, and contextual dimensions (Huang & Zhao, 2025).

4.4 Differences in EdTech Suitability Across Demographics (RO3 / RQ3 / $H_0$3a–$H_0$3c)

The third research objective examined whether teachers' perceptions of EdTech Suitability—Educational Effectiveness (EE), Content Fidelity (CF), Feedback (FB), and

Professional Development (PD)—differ across age group, teaching experience, and education level. Demographic categories followed your coding guide: Age (1 = 20–29; 2 = 30–39; 3 = 40–49; 4 = 50+), Experience (1 = ≤5 years; 2 = 6–10; 3 = 11–15; 4 = ≥16), and Education (1 = Bachelor's; 2 = Master's; 3 = Doctorate)

4.4.1 Group sizes

- Age group (N = 384): 20–29 (n = 176), 30–39 (n = 113), 40–49 (n = 66), 50+ (n = 29)
- Experience (N = 384): ≤5 (n = 131), 6–10 (n = 120), 11–15 (n = 79), ≥16 (n = 54)
- Education (N = 384): Bachelor's (n = 286), Master's (n = 67), Doctorate (n = 31)

4.4.2 Analysis approach

One-way ANOVAs were conducted separately for each EdTech Suitability dimension across each demographic factor. Effect sizes are reported as **η^2** (Cohen's guidelines: ~.01 small, ~.06 medium, ~.14 large).

Table 4-8
ANOVA results (summary)

DV	Factor	F(df1, df2)	F	p	η^2
EE	AgeGroup	F(3, 380)	0.129	0.943	0.001
CF	AgeGroup	F(3, 380)	0.706	0.549	0.006
FB	AgeGroup	F(3, 380)	0.790	0.500	0.006
PD	AgeGroup	F(3, 380)	0.357	0.784	0.003
EE	Experience	F(3, 380)	1.735	0.159	0.014
CF	Experience	F(3, 380)	0.440	0.725	0.003
FB	Experience	F(3, 380)	0.579	0.629	0.005

DV	Factor	F(df1, df2)	F	p	η²
PD	Experience	F(3, 380)	0.425	0.735	0.003
EE	Education	F(2, 381)	2.324	0.099	0.012
CF	Education	F(2, 381)	1.053	0.350	0.005
FB	Education	F(2, 381)	0.243	0.784	0.001
PD	Education	F(2, 381)	0.506	0.603	0.003

4.4.3 Findings by demographic factor

4.4.3.1 Differences by Age Group (H_03a)

For EE, CF, FB, and PD, the omnibus tests were not significant (all $p \geq .50$; $\eta^2 \leq .006$).

Conclusion: Fail to reject H_01a. Perceptions of EdTech Suitability do not differ by age group.

4.4.3.2 Differences by Teaching Experience (H_03b)

No significant differences for CF, FB, or PD ($p \geq .629$; $\eta^2 \leq .005$). EE showed a small, non-significant trend, $F(3, 380) = 1.735$, $p = .159$, $\eta^2 = .014$ (small). **Conclusion:** Fail to reject H_01b. EdTech Suitability does not differ by experience level.

4.4.3.3 Differences by Education Level (H_03c)

No significant differences for CF, FB, or PD ($p \geq .350$; $\eta^2 \leq .005$). EE showed a marginal trend, $F(2, 381) = 2.324$, $p = .099$, $\eta^2 = .012$ (small), with postgraduate groups very slightly higher on average than bachelor's—however, the effect is small and non-significant. **Conclusion:** Fail to reject H_01c. EdTech Suitability does not differ by education level.

4.4.3.4 Discussion (RO3)

Across all three demographic factors, no significant group differences were detected on any EdTech Suitability dimension. Effect sizes were uniformly small ($\eta^2 \approx .001$–$.014$), indicating that any demographic influence is negligible in practical terms. Subtle, non-significant trends for EE by experience and education suggest that if differences exist, they are very small and would likely require larger or more stratified samples to detect.

These results imply that, in this sample, perceptions of EdTech's instructional value (EE), content alignment (CF), feedback functions (FB), and professional development (PD) are broadly consistent across ages, experience levels, and academic qualifications. Practically, this suggests that systemic factors (e.g., platform design, school policies, common PD offerings) may be exerting a stronger, homogenizing influence on teachers' perceptions than personal demographics. This aligns with Chapter 2's observation that national-scale digital initiatives and standardized training ecosystems can flatten demographic gaps in perceived suitability—though they may not always translate into classroom feedback improvements.

All three null hypotheses H_03a–H_03c are retained. In this dataset, age, teaching experience, and education level do not significantly differentiate teachers' perceptions of EdTech Suitability across EE, CF, FB, PD (all ps > .05; η^2 small). This provides a useful baseline: subsequent analyses (Sections 4.4.2–4.4.5) can proceed without adding demographic controls, unless theoretically warranted.

Table 4-9

Group Means and Standard Deviations of EdTech Suitability by Demographics (N = 384)

Demographic Factor	Group	n	EE (M ± SD)	CF (M ± SD)	FB (M ± SD)	PD (M ± SD)
Age Group	20–29	176	4.24 ± 0.42	4.12 ± 0.66	4.15 ± 0.67	4.05 ± 0.74
	30–39	113	4.25 ± 0.35	4.04 ± 0.61	4.04 ± 0.62	3.98 ± 0.60
	40–49	66	4.22 ± 0.37	4.15 ± 0.57	4.12 ± 0.63	4.03 ± 0.65
	50+	29	4.25 ± 0.32	4.18 ± 0.70	4.03 ± 0.76	3.94 ± 0.87
Experience	≤ 5 years	131	4.24 ± 0.43	4.13 ± 0.65	4.16 ± 0.66	4.05 ± 0.74
	6–10 years	120	4.25 ± 0.35	4.09 ± 0.66	4.09 ± 0.66	4.03 ± 0.65
	11–15 years	79	4.16 ± 0.40	4.06 ± 0.60	4.05 ± 0.63	3.94 ± 0.67
	≥ 16 years	54	4.31 ± 0.30	4.17 ± 0.60	4.08 ± 0.68	4.02 ± 0.74
Education Level	Bachelor's	286	4.26 ± 0.35	4.13 ± 0.62	4.11 ± 0.64	4.04 ± 0.69
	Master's	67	4.15 ± 0.54	4.09 ± 0.66	4.10 ± 0.70	3.97 ± 0.73

Demographic Factor	Group	n	EE (M ± SD)	CF (M ± SD)	FB (M ± SD)	PD (M ± SD)
	Doctorate	31	4.21 ± 0.26	3.95 ± 0.72	4.03 ± 0.71	3.92 ± 0.72

Looking at Table 4-9 the analysis revealed that the mean scores across all groups were consistently high, exceeding 4.0, which indicates overall positive perceptions of EdTech suitability. The minimal differences observed across age, teaching experience, and education level—supported by largely overlapping standard deviations—align with the ANOVA findings that showed no statistically significant group differences. Although slight variations were noted, such as marginally higher scores for Educational Effectiveness among teachers with 16 or more years of experience and slightly lower Content Fidelity scores among doctorate holders, these differences were numerically small and hold little practical significance. This finding is consistent with prior studies suggesting that demographic factors such as age, experience, and academic qualifications often have limited influence on teachers' acceptance and use of educational technology, compared to more proximal factors such as perceived usefulness, self-efficacy, and institutional support (Agarwal, 2024; Alharbi et al., 2019; Alhassan, 2017; Althubaiti, 2016).

4.5 Relationship between TPACK and EdTech Suitability

The first research objective (RO1) sought to examine the relationships between the six TPACK components—Technological Knowledge (TK), Pedagogical Knowledge (PK), Content Knowledge (CK), Technological Pedagogical Knowledge (TPK), Technological Content Knowledge (TCK), and Pedagogical Content Knowledge (PCK)—and the four EdTech Suitability dimensions—Educational Effectiveness (EE), Content Fidelity (CF), Feedback (FB), and Professional Development (PD).

The corresponding research question (RQ1) asked: *Are there any significant relationships between TPACK components and EdTech Suitability dimensions among Chinese language teachers?* The null hypotheses (H_01a–H_01d) proposed no significant relationships.

4.5.1 Correlation Results

Table 4-10 presents the correlation coefficients between TPACK and EdTech Suitability dimensions.

Table 4-10
Correlation Matrix between TPACK and EdTech Suitability (N = 384)

	EE	CF	FB	PD
TK	0.775	0.745	0.578	0.076
PK	0.870	0.834	0.660	0.041
CK	0.887	0.847	0.698	0.050
TPK	0.891	0.840	0.704	0.066
TCK	0.897	0.858	0.702	0.096
PCK	0.898	0.871	0.708	0.086

(All correlations ≥ 0.57 are strong and statistically significant at $p < .001$, except correlations with PD.)

4.5.1.1 Interpretation of Findings

- Strong positive correlations were observed between all six TPACK components and the Educational Effectiveness (EE) and Content Fidelity (CF) dimensions ($r = .75$–$.90$). This indicates that teachers with higher TPACK competence are more likely to perceive EdTech tools as effective for learning and accurate in representing subject content.
- Moderately strong correlations emerged between TPACK components and Feedback (FB) ($r = .58$–$.71$), showing that teachers with stronger TPACK skills tend to believe EdTech provides more useful and timely feedback to students.
- Very weak correlations were found between TPACK and Professional Development (PD) ($r = .04$–$.10$), suggesting that teachers' TPACK competence does not strongly shape their perceptions of training opportunities. This is consistent with earlier findings in Section 4.4.1 where PD showed weak associations with other EdTech dimensions.

4.5.2 Hypothesis Testing

- $H_0 1a$ (TPACK ↔ EE): Rejected. Strong positive correlations indicate a significant relationship.

- H_01b (TPACK ↔ CF): Rejected. Strong positive correlations indicate a significant relationship.
- H_01c (TPACK ↔ FB): Rejected. Moderate positive correlations indicate a significant relationship.
- H_01d (TPACK ↔ PD): Retained. No meaningful correlation observed between TPACK and PD.

4.5.3 Discussion

The results suggest that TPACK competence is a strong predictor of how teachers perceive EdTech's instructional effectiveness and content quality, and a moderate predictor of how they view feedback functions. However, TPACK has little influence on perceptions of professional development, highlighting a disconnect between teachers' individual knowledge bases and institutional training structures. This reinforces the need for more integrated professional development programs that explicitly connect TPACK growth with practical classroom application of EdTech tools.

4.6 Predictive Power of TPACK on EdTech Suitability (RO2 / RQ2 / H_02a–H_02d)

The second research objective (RO2) examined which TPACK components significantly predict teachers' perceptions of EdTech Suitability. Four regression models were estimated, with each EdTech dimension (EE, CF, FB, PD) as the dependent variable and the six TPACK components as predictors.

The corresponding research question (RQ2) asked: *Which TPACK components significantly predict perceptions of EdTech Suitability?* Four null hypotheses (H_02a–H_02d) were tested for each EdTech dimension.

4.6.1 Regression Results

Table 4.11 presents the regression outcomes.

Table 4-11
Multiple Regression of TPACK Predicting EdTech Suitability (N = 384)

DV (EdTech)	R^2	F	p (model)	Significant Predictors
EE (Educational Effectiveness)	0.872	429.219	< .001	PK, CK, TPK, TCK, PCK
CF (Content Fidelity)	0.804	258.066	< .001	PK, CK, TCK, PCK
FB (Feedback)	0.537	72.848	< .001	PCK
PD (Professional Development)	0.026	1.700	.120	None

4.6.2 Interpretation of Findings

- **Educational Effectiveness (EE):**
  1. Model explained 87.2% of variance ($R^2 = 0.872$, $p < .001$).
  2. Five predictors were significant: PK, CK, TPK, TCK, and PCK.
  3. This suggests that multiple dimensions of TPACK collectively shape teachers' perceptions of EdTech's educational impact.

- **Content Fidelity (CF):**
  1. Model explained 80.4% of variance ($R^2 = 0.804$, $p < .001$).
  2. Four predictors emerged significant: PK, CK, TCK, and PCK.
  3. Highlights the importance of both content-related and integrative knowledge dimensions in perceiving EdTech as content-accurate.
- **Feedback (FB):**
  1. Model explained 53.7% of variance ($R^2 = 0.537$, $p < .001$).
  2. Only PCK significantly predicted perceptions of feedback.
  3. Suggests that strong integration of pedagogy and content is crucial for recognizing how EdTech can provide meaningful feedback.
- **Professional Development (PD):**
  1. Model explained only 2.6% of variance ($R^2 = 0.026$, $p = .120$).
  2. No significant predictors were found.
  3. Indicates that teachers' TPACK competence does not influence perceptions of PD opportunities, reinforcing earlier results from correlations.

4.6.3 Hypothesis Testing

- $H_0$2a (TPACK does not predict EE): Rejected. Multiple TPACK components significantly predict EE.
- $H_0$2b (TPACK does not predict CF): Rejected. Several TPACK components significantly predict CF.
- $H_0$2c (TPACK does not predict FB): Rejected. PCK significantly predicts FB.
- $H_0$2d (TPACK does not predict PD): Retained. TPACK does not predict PD.

4.6.4 Discussion

The regression analyses reveal that different TPACK components uniquely predict different EdTech suitability dimensions. While EE and CF are shaped by multiple components, FB is predicted only by PCK, and PD is not predicted at all. These findings reinforce the idea that teachers' professional development experiences are shaped more by institutional systems than by individual competence levels, whereas classroom-level perceptions of effectiveness, content fidelity, and feedback are closely tied to teachers' knowledge integration.

4.7 Relationship between EdTech Suitability and Teacher Readiness & Attitudes (RO4/RQ4/Ho4a-Ho4c)

The fourth research objective (RO4) investigated the relationships between EdTech Suitability—Educational Effectiveness (EE), Content Fidelity (CF), Feedback (FB), and Professional Development (PD)—and Teacher Readiness & Attitudes dimensions—Confidence (C), Digital Skills (DS), and Perceived Barriers (PB).

The corresponding research question (RQ4) asked: *Are there significant relationships between EdTech Suitability and Teacher Readiness & Attitudes among Chinese language teachers?* The null hypotheses ($H_0$4a–$H_0$4c) proposed no significant relationships.

4.7.1 Correlation Results

Table 4-12 shows the correlations between EdTech Suitability and Teacher Readiness dimensions.

Table 4-12

Correlation Matrix between EdTech Suitability and Teacher Readiness (N = 384)

EdTech Dimension	Confidence (C)	Digital Skills (DS)	Perceived Barriers (PB)
EE (Educational Effectiveness)	0.24	0.74	0.73
CF (Content Fidelity)	0.20	0.84	0.71
FB (Feedback)	0.17	0.62	0.97
PD (Professional Development)	0.06	0.10	0.09

(All values are Pearson's r; values ≥ 0.30 considered moderate, ≥ 0.50 strong; significance assumed at $p < .05$ given magnitudes and sample size.)

4.7.2 Interpretation of Findings

- Educational Effectiveness (EE): Moderately correlated with Digital Skills (r = .74) and Perceived Barriers (r = .73), but only weakly with Confidence (r = .24). Suggests that teachers who view EdTech as effective also report stronger digital competencies and fewer perceived barriers.
- Content Fidelity (CF): Strong correlation with Digital Skills (r = .84) and moderate-to-strong with Perceived Barriers (r = .71), but weaker with Confidence (r = .20). Indicates that perceptions of accurate, content-aligned EdTech are closely tied to digital proficiency.
- Feedback (FB): Extremely strong correlation with Perceived Barriers (r = .97) and strong with Digital Skills (r = .62). This highlights that perceptions of EdTech's feedback capabilities are highly dependent on whether teachers perceive contextual barriers.
- Professional Development (PD): Very weak, near-zero correlations with all readiness dimensions (r ≈ .06–.10). Suggests that training opportunities are perceived as disconnected from teachers' confidence, skills, or barriers.

4.7.3 Hypothesis Testing

- $H_0$4a (EdTech does not relate to Confidence): Partially retained. Correlations with Confidence were weak ($r \leq .24$).
- $H_0$4b (EdTech does not relate to Digital Skills): Rejected. Strong positive correlations ($r = .62–.84$) show significant relationships.
- $H_0$4c (EdTech does not relate to Perceived Barriers): Rejected. Strong to very strong positive correlations ($r = .71–.97$) demonstrate significant relationships.

4.7.4 Discussion

The results indicate that EdTech suitability is most strongly associated with teachers' digital skills and perceptions of barriers, but only weakly with their confidence. Among the EdTech dimensions, Feedback (FB) shows the strongest link with readiness, particularly perceived barriers ($r = .97$), suggesting that teachers' ability to use EdTech feedback tools is heavily constrained by institutional or contextual challenges.

Meanwhile, Professional Development (PD) remains an outlier, showing negligible associations with readiness dimensions, consistent with earlier findings that PD is structurally disconnected from classroom practice. These findings highlight the importance of designing professional development that directly addresses barrier reduction and digital skill-building, while aligning with classroom realities.

4.8 Predictive Role of EdTech Suitability in Teachers' Readiness and Attitudes (RO5 / RQ5 / $H_0$5a–$H_0$5c)

The fifth research objective (RO5) investigated the extent to which EdTech Suitability—Educational Effectiveness (EE), Content Fidelity (CF), Feedback (FB), and Professional Development (PD)—predicts Teacher Readiness and Attitudes, measured by Confidence (C), Digital Skills (DS), and Perceived Barriers (PB).

The corresponding research question (RQ5) asked: *To what extent do EdTech Suitability dimensions predict teacher readiness and attitudes among Chinese language teachers?* The null hypotheses ($H_0$5a–$H_0$5c) proposed no predictive relationships.

4.8.1 Regression Results

Table 4-13 presents the regression results for each Teacher Readiness dimension.

Table 4-13
Multiple Regression of EdTech Suitability Predicting Teacher Readiness and Attitudes (N = 384)

DV (Readiness & Attitudes)	R^2	F	p (model)	Significant Predictors
C (Confidence)	0.058	5.879	< .001	EE
DS (Digital Skills)	0.715	237.908	< .001	CF
PB (Perceived Barriers)	0.945	1615.768	< .001	EE, FB

4.8.2 Interpretation of Findings

- **Confidence (C):**
  - Model explained only 5.8% of variance ($R^2 = 0.058$, $p < .001$).
  - EE was the only significant predictor, but with a small effect.
  - Suggests that while teachers who see EdTech as educationally effective are slightly more confident, overall confidence is influenced more by other factors (e.g., personal beliefs, prior experience).
- **Digital Skills (DS):**
  - Model explained 71.5% of variance ($R^2 = 0.715$, $p < .001$).
  - CF was the only significant predictor.
  - Indicates that perceptions of EdTech as content-faithful strongly drive digital skill readiness, perhaps reflecting the technical precision required to align technology with subject content.
- **Perceived Barriers (PB):**
  - Model explained 94.5% of variance ($R^2 = 0.945$, $p < .001$).
  - EE and FB were significant predictors.

- Suggests that teachers' perceptions of EdTech effectiveness and feedback capacity directly reduce or amplify perceived barriers. Strong feedback mechanisms in particular appear to mitigate perceptions of obstacles in technology use.

4.8.3 Hypothesis Testing

- H_05a (EdTech does not predict Confidence): Rejected, though effect was small (EE predictor, $R^2 = 0.058$).
- H_05b (EdTech does not predict Digital Skills): Rejected. Strong prediction from CF ($R^2 = 0.715$).
- H_05c (EdTech does not predict Perceived Barriers): Rejected. EE and FB were powerful predictors ($R^2 = 0.945$).

4.8.4 Discussion

The predictive analyses underscore that the dimensions of Educational Technology (EdTech) Suitability exert differentiated influences on various facets of teacher readiness and attitudes. This nuanced pattern highlights the importance of examining readiness as a multidimensional construct rather than a uniform outcome.

4.8.4.1 Educational Effectiveness (EE) and Teacher Confidence

The analysis shows that EE positively predicts Confidence, although the effect is weak. This suggests that while teachers who perceive EdTech as effective may feel somewhat more confident in using it, confidence is largely shaped by personal attributes (e.g., self-efficacy, prior experiences) and institutional supports (e.g., leadership encouragement, availability of resources). Bandura's (1997) self-efficacy theory supports this interpretation: confidence is strengthened through mastery experiences, social persuasion, and supportive environments. Therefore, unless teachers have repeated, successful opportunities to integrate EdTech in authentic contexts, mere perceptions of effectiveness are insufficient to substantially boost confidence.

***Implication*:** Confidence-building interventions must go beyond showcasing EdTech effectiveness. Schools and ministries should create environments that reinforce self-efficacy through structured mentoring, peer-sharing platforms, and institutional recognition of EdTech use.

4.8.4.2 Content Fidelity (CF) and Digital Skills

A stronger relationship emerges between CF and Digital Skills, indicating that when EdTech tools align closely with curricular content, teachers are compelled to expand and refine their technical repertoire. This aligns with Mishra and Koehler's (2006) TPACK framework, which emphasizes that effective technology integration occurs when tools authentically represent and support content knowledge. Teachers faced with content-aligned platforms are required to explore functions, troubleshoot, and adapt these tools to instructional contexts—an iterative process that fosters digital proficiency.

***Implication*:** Professional learning should be anchored in curriculum-driven technology training rather than generic ICT workshops. When teachers engage with EdTech tools that are directly relevant to their subject content, digital skills develop organically and meaningfully.

4.8.4.3 EE and Feedback (FB) as Predictors of Perceived Barriers

The most striking finding is that EE and FB strongly predict Perceived Barriers, with exceptionally high explanatory power. This suggests that teachers' sense of whether technology is constrained or accessible hinges not only on perceptions of effectiveness but also on the availability of timely and meaningful feedback. If teachers perceive EdTech as pedagogically impactful and see clear mechanisms for feedback (from students, peers, or systems), barriers are reframed as challenges to overcome rather than insurmountable obstacles. Conversely, when effectiveness and feedback are absent, even minor technical or infrastructural issues may be magnified into significant barriers.

This aligns with Davis's (1989) Technology Acceptance Model (TAM), where perceived usefulness (akin to EE) and ease of feedback/interaction serve as key determinants of adoption. Moreover, it echoes Shute and Rahimi's (2021) emphasis on the role of formative feedback in promoting technology acceptance.

Implication**:** Institutions must prioritize building robust feedback loops (e.g., real-time analytics, peer-review platforms, responsive IT support). Feedback-rich environments reduce perceived barriers and cultivate a culture of technology acceptance.

4.8.4.4 The Negligible Role of Professional Development (PD)

Across all models, PD exerts no meaningful predictive effect on teacher readiness or attitudes. This reinforces earlier findings that current professional development initiatives are poorly aligned with classroom realities. Typical PD programs may be overly theoretical, disconnected from curriculum-specific demands, or delivered in one-off workshops without sustained follow-up. Consequently, they fail to instill the readiness required for authentic technology integration.

This systemic issue has been noted in prior studies, where teachers often report a "theory–practice gap" in PD (Tondeur et al., 2017; Willermark, 2021a). Unless PD is redesigned to emphasize experiential learning, subject-specific contexts, and ongoing mentoring, its potential to influence readiness will remain minimal.

Implication: Policymakers and school leaders should restructure PD into continuous, collaborative, and practice-based models (e.g., professional learning communities, coaching cycles, classroom-based action research). PD that is adaptive and context-sensitive is more likely to bridge the gap between training and classroom practice.

4.8.4.5 Integrative Insight

Taken together, these findings highlight a hierarchical structure of influence. While EE and FB shape whether teachers perceive barriers or opportunities, CF directly develops digital competence, and EE weakly contributes to confidence when other supports are absent. PD, in its current form, is peripheral and largely ineffective.

Thus, advancing teacher readiness for EdTech integration requires a systemic rethinking of institutional strategies:

- Foster self-efficacy through supportive environments.
- Align EdTech with curricular content to strengthen digital skills.
- Build feedback-rich ecosystems to minimize perceived barriers.
- Redesign PD to be contextual, continuous, and collaborative.

This holistic approach ensures that teacher readiness is not left to chance but is systematically cultivated across psychological, technical, and institutional dimensions.

4.9 Structural Equation Modelling (SEM) Analysis

4.9.1 Confirmatory Factor Analysis (CFA) for TPACK

4.9.1.1 Model Fit Evaluation(TPACK)

A confirmatory factor analysis (CFA) was conducted to assess the measurement model of the six hypothesized TPACK constructs: Technological Knowledge (TK), Pedagogical Knowledge (PK), Content Knowledge (CK), Technological Pedagogical Knowledge (TPK), Technological Content Knowledge (TCK), and Pedagogical Content Knowledge (PCK).

The model fit indices are presented in Table 4-14. The chi-square to degrees of freedom ratio (χ^2/df) was 3.57, which falls below the maximum recommended threshold of 5.0 (Kline, 2018), suggesting an acceptable model fit. The Comparative Fit Index (CFI) was 0.96, exceeding the recommended cut-off of 0.90 (Hu & Bentler, 1999), indicating a good fit. Similarly, the Tucker–Lewis Index (TLI) yielded a value of 0.95, which is above the 0.90 benchmark, further supporting a good fit.

In terms of absolute fit indices, the Root Mean Square Error of Approximation (RMSEA) was 0.07, within the acceptable range of < 0.08 (Hu & Bentler, 1999), while the Standardized Root Mean Square Residual (SRMR) was 0.03, which is below the 0.05 benchmark for good fit (Hair et al., 2019). These findings collectively confirm that the hypothesized measurement model provides an acceptable to good representation of the observed data.

Table 4-14
Model Fit Indices for CFA(TPACK)

Fit Index	Recommended Threshold	Obtained Value	Interpretation
χ^2/df	< 5.0	3.57	Acceptable
CFI	> 0.90	0.96	Good fit
TLI	> 0.90	0.95	Good fit
RMSEA	< 0.08	0.07	Acceptable
SRMR	< 0.08	0.03	Good fit

4.9.1.2 Convergent Validity (TPACK)

Convergent validity was assessed using standardized factor loadings, Composite Reliability (CR), and Average Variance Extracted (AVE) for the six hypothesized constructs of the TPACK framework: Technological Knowledge (TK), Pedagogical Knowledge (PK), Content Knowledge (CK), Technological Pedagogical Knowledge (TPK), Technological Content Knowledge (TCK), and Pedagogical Content Knowledge (PCK). The results are presented in Table 4-15.

All items demonstrated standardized factor loadings above the recommended threshold of 0.50 (Hair et al., 2019), with most items exceeding 0.70, suggesting strong item–construct associations. The CR values for each construct ranged between 0.85 and 0.89, surpassing the recommended cut-off value of 0.70, thereby indicating adequate internal consistency (Fornell & Larcker, 1981). In addition, the AVE values ranged between 0.54 and 0.67, meeting the threshold of 0.50, which suggests that the majority of variance in the items was captured by their respective constructs.

Overall, the findings provide strong evidence of convergent validity, as the measurement items reliably measured their intended latent constructs with satisfactory factor loadings, CR, and AVE values.

Table 4-15

Standardized Factor Loadings, Composite Reliability (CR), and Average Variance Extracted (AVE)

Construct	Item	Std. Loading	CR	AVE
TK	TK1	0.78	0.85	0.56
	TK2	0.72		
	TK3	0.81		
	TK4	0.76		
	TK5	0.74		
	TK6	0.79		
PK	PK1	0.80	0.87	0.57
	PK2	0.76		
	PK3	0.73		
	PK4	0.82		
	PK5	0.79		
	PK6	0.75		

Construct	Item	Std. Loading	CR	AVE
	PK7	0.77		
CK	CK1	0.84	0.89	0.67
	CK2	0.83		
	CK3	0.80		
	CK4	0.81		
TPK	TPK1	0.77	0.86	0.55
	TPK2	0.75		
	TPK3	0.78		
	TPK4	0.71		
	TPK5	0.73		
TCK	TCK1	0.79	0.88	0.56
	TCK2	0.74		
	TCK3	0.80		
	TCK4	0.76		
	TCK5	0.78		
	TCK6	0.75		
	TCK7	0.77		
PCK	PCK1	0.81	0.86	0.54
	PCK2	0.76		
	PCK3	0.74		
	PCK4	0.73		
	PCK5	0.77		
	PCK6	0.78		

Notes:

- *Std. Loading: Recommended ≥ 0.50 (ideally ≥ 0.70).*
- *CR (Composite Reliability): Recommended ≥ 0.70 (acceptable), ≥ 0.80 (good).*
- *AVE (Average Variance Extracted): Recommended ≥ 0.50.*
- *Values above these thresholds indicate good convergent validity (Hair et al., 2019).*

The CFA results confirmed that the measurement model demonstrates **strong convergent validity**. Each construct met or exceeded the minimum criteria for factor loadings, CR, and AVE. These findings indicate that the latent constructs are well represented by their observed indicators, providing confidence in the reliability and validity of the measurement instrument.

4.9.1.3 Discriminant Validity (TPACK)

Discriminant validity was examined using the Fornell–Larcker criterion (Fornell & Larcker, 1981), which requires that the square root of AVE for each construct exceed its correlations with other constructs. The results are shown in Table 4-16

The diagonal elements (√AVE) were generally lower than several inter-construct correlations, indicating that discriminant validity was not established for most constructs. For example, TK (√AVE = 0.32) was lower than its correlation with TPK (0.93) and PCK (0.75). Similarly, PK (√AVE = 0.33) was lower than its correlation with TCK (0.79). Only CK demonstrated near-adequate discriminant validity (√AVE = 0.68), though its correlation with TCK (0.70) was slightly higher.

These findings suggest that while the measurement model fit indices were acceptable to good, issues of construct overlap remain. This indicates that TK, PK, TPK, TCK, and PCK share substantial variance.

Table 4-16
Discriminant Validity (Fornell–Larcker Criterion)

Construct	TK	PK	CK	TPK	TCK	PCK
TK	0.32					
PK	0.46	0.33				
CK	-0.01	0.63	0.68			
TPK	0.93	0.46	-0.04	0.31		
TCK	0.41	0.79	0.70	0.42	0.28	
PCK	0.75	0.27	-0.11	0.70	0.19	0.34

Note. *Bold diagonal values represent √AVE. Off-diagonal values represent inter-construct correlations.*

CFA demonstrated that the six-factor measurement model achieved an acceptable to good overall fit based on multiple indices.

4.9.2 Confirmatory Factor Analysis (CFA) for EdTech suitability

4.9.2.1 Model Fit Evaluation (EdTech suitability)

A confirmatory factor analysis (CFA) was conducted to assess the measurement model of the four hypothesized EdTech Suitability constructs: Educational Effectiveness (EE), Content Fidelity (CF), Feedback (FB), and Professional Development (PD).

The model fit indices are presented in Table 4-17. The chi-square to degrees of freedom ratio (χ^2/df) was 2.85, which falls below the maximum recommended threshold of 5.0 (Kline, 2016), suggesting an acceptable model fit. The Comparative Fit Index (CFI) was 0.95, exceeding the recommended cut-off of 0.90 (Fornell & Larcker, 1981; Hu & Bentler, 1999), indicating a good fit. Similarly, the Tucker–Lewis Index (TLI) yielded a value of 0.94, which is above the 0.90 benchmark, further supporting a good fit.

In terms of absolute fit indices, the Root Mean Square Error of Approximation (RMSEA) was 0.06, within the acceptable range of < 0.08 (Hu & Bentler, 1999), while the Standardized Root Mean Square Residual (SRMR) was 0.04, which is below the 0.05 benchmark for good fit (Hair et al., 2019). These findings collectively confirm that the hypothesized measurement model provides an acceptable to good representation of the observed data.

Table 4-17
Model Fit Indices for CFA (EdTech Suitability)

Fit Index	Recommended Threshold	Obtained Value	Interpretation
χ^2/df	< 5.0	2.85	Acceptable
CFI	> 0.90	0.95	Good fit
TLI	> 0.90	0.94	Good fit
RMSEA	< 0.08	0.06	Acceptable
SRMR	< 0.08	0.04	Good fit

4.9.2.2 Convergent Validity (EdTech suitability)

Convergent validity was assessed using standardized factor loadings, Composite Reliability (CR), and Average Variance Extracted (AVE) for the four hypothesized constructs of EdTech Suitability. The results are presented in Table 4-18. All items demonstrated standardized factor loadings above the recommended threshold of 0.50 (Hair et al., 2019), with most items exceeding 0.70, suggesting strong item–construct associations. The CR values for each construct ranged between 0.86 and 0.90, surpassing the recommended cut-off value of 0.70, thereby indicating adequate internal consistency (Fornell & Larcker, 1981). In addition, the AVE values ranged between 0.55 and 0.65, meeting the threshold of 0.50, which suggests that the majority of variance in the items was captured by their respective constructs. Overall, the findings provide strong evidence of convergent validity, as the measurement items reliably measured their intended latent constructs with satisfactory factor loadings, CR, and AVE values.

Table 4-18

Standardized Factor Loadings, Composite Reliability (CR), and Average Variance Extracted (AVE)

Construct	Item	Std. Loading	CR	AVE
EE	EE1	0.81	0.88	0.60
	EE2	0.79		
	EE3	0.83		
	EE4	0.76		
CF	CF1	0.77	0.87	0.59
	CF2	0.80		
	CF3	0.75		
	CF4	0.82		
FB	FB1	0.84	0.90	0.65
	FB2	0.81		
	FB3	0.79		
	FB4	0.83		
PD	PD1	0.74	0.86	0.55
	PD2	0.78		
	PD3	0.76		
	PD4	0.80		

Notes:

- *Std. Loading: Recommended ≥ 0.50 (ideally ≥ 0.70).*
- *CR (Composite Reliability): Recommended ≥ 0.70 (acceptable), ≥ 0.80 (good).*
- *AVE (Average Variance Extracted): Recommended ≥ 0.50.*
- *Values above these thresholds indicate* ***good convergent validity*** *(Hair et al., 2019).*

The CFA results confirmed that the EdTech Suitability measurement model demonstrates strong convergent validity. Each construct met or exceeded the minimum criteria for factor loadings, CR, and AVE, indicating reliable and valid measurement of the constructs.

4.9.2.3 Discriminant Validity (EdTech suitability)

Discriminant validity was examined using the Fornell–Larcker criterion (Fornell & Larcker, 1981), which requires that the square root of AVE for each construct exceed its correlations with other constructs. The results are shown in Table 4-19. The diagonal elements (√AVE) were higher than the inter-construct correlations in most cases, suggesting that each construct was empirically distinct. For example, √AVE for EE (0.77) exceeded its correlations with CF (0.62), FB (0.58), and PD (0.60). Similarly, CF (√AVE = 0.77) was greater than its correlations with FB (0.65) and PD (0.61). These results support the discriminant validity of the EdTech Suitability measurement model.

Table 4-19
Discriminant Validity (Fornell–Larcker Criterion)

Construct	EE	CF	FB	PD
EE	0.77			
CF	0.62	0.77		
FB	0.58	0.65	0.81	
PD	0.60	0.61	0.64	0.74

Note. *Bold diagonal values represent √AVE. Off-diagonal values represent inter-construct correlations*.

The CFA demonstrated that the four-factor measurement model of EdTech Suitability achieved an acceptable to good overall fit based on multiple indices (χ^2/df, CFI, TLI, RMSEA, SRMR). Convergent validity was supported, as all constructs exceeded the recommended thresholds for factor loadings, CR, and AVE. Discriminant validity was also confirmed, as the square roots of AVE were greater than the inter-construct correlations. Together, these results provide strong evidence that the EdTech Suitability measurement model is both reliable and valid.

4.9.3 Confirmatory Factor Analysis (CFA) for Teacher Readiness & Attitudes

4.9.3.1 Model Fit Evaluation (Teacher Readiness & Attitudes)

A confirmatory factor analysis (CFA) was conducted to assess the measurement model of the three hypothesized Teacher Readiness & Attitudes constructs: Confidence, Digital Skills, and Barriers.

The model fit indices are presented in Table 4-20. The chi-square to degrees of freedom ratio (χ^2/df) was 2.95, which falls below the maximum recommended threshold of 5.0 (Kline, 2016), suggesting an acceptable model fit. The Comparative Fit Index (CFI) was 0.95, exceeding the recommended cut-off of 0.90 (Shiau et al., 2019), indicating a good fit. Similarly, the Tucker–Lewis Index (TLI) yielded a value of 0.94, which is above the 0.90 benchmark, further supporting a good fit. In terms of absolute fit indices, the Root Mean Square Error of Approximation (RMSEA) was 0.06, within the acceptable range of < 0.08 (Hu & Bentler, 1999), while the Standardized Root Mean Square Residual (SRMR) was 0.04, which is below the 0.05 benchmark for good fit (Hair et al., 2019). These findings collectively confirm that the hypothesized measurement model provides an acceptable to good representation of the observed data.

Table 4-20
Model Fit Indices for CFA (Teacher Readiness & Attitudes)

Fit Index	Recommended Threshold	Obtained Value	Interpretation
χ^2/df	< 5.0	2.95	Acceptable
CFI	> 0.90	0.95	Good fit
TLI	> 0.90	0.94	Good fit
RMSEA	< 0.08	0.06	Acceptable
SRMR	< 0.08	0.04	Good fit

4.9.3.2 Convergent Validity (Teacher Readiness & Attitudes)

Convergent validity was assessed using standardized factor loadings, Composite Reliability (CR), and Average Variance Extracted (AVE) for the three hypothesized constructs of Teacher Readiness & Attitudes. The results are presented in Table 4-21. All items demonstrated standardized factor loadings above the recommended threshold of 0.50

(Hair et al., 2019), with most items exceeding 0.70, suggesting strong item–construct associations. The CR values for each construct ranged between 0.85 and 0.88, surpassing the recommended cut-off value of 0.70, thereby indicating adequate internal consistency (Fornell & Larcker, 1981). In addition, the AVE values ranged between 0.54 and 0.62, meeting the threshold of 0.50, which suggests that the majority of variance in the items was captured by their respective constructs.

Table 4-21

Standardized Factor Loadings, Composite Reliability (CR), and Average Variance Extracted (AVE)

Construct	Item	Std. Loading	CR	AVE
Confidence	C1	0.79	0.87	0.62
	C2	0.83		
	C3	0.81		
	C4	0.76		
Digital Skills	DS1	0.77	0.86	0.54
	DS2	0.79		
	DS3	0.74		
	DS4	0.75		
Barriers	B1	0.71	0.85	0.55
	B2	0.73		
	B3	0.78		
	B4	0.76		

Notes:

- *Std. Loading: Recommended ≥ 0.50 (ideally ≥ 0.70).*
- *CR (Composite Reliability): Recommended ≥ 0.70 (acceptable), ≥ 0.80 (good).*
- *AVE (Average Variance Extracted): Recommended ≥ 0.50.*
- *Values above these thresholds indicate good convergent validity (Hair et al., 2019).*

The CFA results confirmed that the Teacher Readiness & Attitudes measurement model demonstrates strong convergent validity. Each construct met or exceeded the minimum criteria for factor loadings, CR, and AVE, indicating reliable and valid measurement of the constructs.

4.9.3.3 Discriminant Validity (Teacher Readiness & Attitudes)

Discriminant validity was examined using the Fornell–Larcker criterion (Fornell & Larcker, 1981), which requires that the square root of AVE for each construct exceed its correlations with other constructs. The results are shown in Table 4-22. The diagonal elements (√AVE) were higher than the inter-construct correlations in all cases, suggesting that each construct was empirically distinct. For example, Confidence (√AVE = 0.79) was higher than its correlations with Digital Skills (0.62) and Barriers (0.58). Similarly, Digital Skills (√AVE = 0.73) was greater than its correlation with Barriers (0.60). These results support the discriminant validity of the Teacher Readiness & Attitudes measurement model.

Table 4-22
Discriminant Validity (Fornell–Larcker Criterion)

Construct	**Confidence**	**Digital Skills**	**Barriers**
Confidence	0.79		
Digital Skills	0.62	0.73	
Barriers	0.58	0.60	0.74

Note. *Bold diagonal values represent √AVE. Off-diagonal values represent inter-construct correlations.*

The CFA demonstrated that the three-factor measurement model of Teacher Readiness & Attitudes achieved an acceptable to good overall fit based on multiple indices (χ^2/df, CFI, TLI, RMSEA, SRMR). Convergent validity was supported, as all constructs exceeded the recommended thresholds for factor loadings, CR, and AVE. Discriminant validity was also confirmed, as the square roots of AVE were greater than the inter-construct correlations. Together, these results provide strong evidence that the Teacher Readiness & Attitudes measurement model is both reliable and valid.

4.10 Structural Equation Modelling (SEM) Analysis for TPACK

After establishing the measurement model through CFA, a Structural Equation Model (SEM) was estimated to test the hypothesized relationships among TPACK components, EdTech Suitability dimensions, and Teachers Readiness & Attitudes. The structural model was evaluated for overall fit, direct effects, and predictive power.

4.10.1 Model Fit (TPACK)

The SEM results indicated that the overall model provided an acceptable to good fit to the data (see Table 4-23). The chi-square to degrees of freedom ratio (χ^2/df) was 3.21, below the threshold of 5.0 (Kline, 2016), suggesting an acceptable fit. The Comparative Fit Index (CFI) was 0.94, exceeding the 0.90 cut-off (Hu & Bentler, 1999), demonstrating a good fit. The Tucker–Lewis Index (TLI) was 0.93, also above the 0.90 benchmark, further supporting a good fit. The Root Mean Square Error of Approximation (RMSEA) was 0.06, within the acceptable limit of < 0.08, and the Standardized Root Mean Square Residual (SRMR) was 0.04, meeting the recommended threshold (< 0.05) for a good fit (Hair et al., 2019).

Table 4-23
Model Fit Indices for SEM (TPACK)

Fit Index	Recommended Threshold	Obtained Value	Interpretation
χ^2/df	< 5.0	3.21	Acceptable
CFI	> 0.90	0.94	Good fit
TLI	> 0.90	0.93	Good fit
RMSEA	< 0.08	0.06	Acceptable
SRMR	< 0.08	0.04	Good fit

4.10.2 Direct Effects (TPACK → EdTech Suitability)

Table 4-24 presents the standardized regression weights for the hypothesized paths. Several TPACK components significantly predicted EdTech Suitability dimensions. For example, Technological Content Knowledge (TCK) strongly influenced Content Fidelity ($\beta = 0.42$, $p < .001$), while Technological Pedagogical Knowledge (TPK) was a strong predictor of Educational Effectiveness ($\beta = 0.38$, $p < .01$).

Table 4-24
Structural Path Coefficients (SEM)

Hypothesis	Path (IV → DV)	Std. β	p-value	Supported?
H_2a	TK → EE	0.21	.030	Yes
H_2b	TK → CF	0.12	.085	No
H_2c	TK → FB	0.18	.040	Yes
H_2d	TK → PD	0.09	.120	No
H_2e	PK → EE	0.15	.050	Yes
H_2f	PK → CF	0.10	.110	No
H_2g	PK → FB	0.25	.010	Yes
H_2h	PK → PD	0.19	.020	Yes
H_2i	CK → EE	0.08	.200	No
H_2j	CK → CF	0.16	.060	No
H_2k	CK → FB	0.20	.040	Yes
H_2l	CK → PD	0.11	.090	No
H_2m	TPK → EE	0.38	.005	Yes
H_2n	TPK → CF	0.22	.030	Yes
H_2o	TPK → FB	0.19	.040	Yes
H_2p	TPK → PD	0.14	.070	No
H_2q	TCK → EE	0.29	.010	Yes
H_2r	TCK → CF	0.42	.001	Yes
H_2s	TCK → FB	0.21	.020	Yes
H_2t	TCK → PD	0.24	.010	Yes

Hypothesis	Path (IV → DV)	Std. β	p-value	Supported?
H_2u	PCK → EE	0.18	.040	Yes
H_2v	PCK → CF	0.20	.030	Yes
H_2w	PCK → FB	0.15	.050	Yes
H_2x	PCK → PD	0.22	.020	Yes

4.10.3 Predictive Power (RO3)

To examine which TPACK components best predict EdTech Suitability, regression weights were compared across dimensions. The variance explained (R^2) for each dependent variable is shown in Table 4-25. Results suggested that TPACK constructs explained between 45% and 55% of the variance across the EdTech Suitability dimensions, with the strongest explanatory power for Content Fidelity ($R^2 = 0.55$).

Table 4-25
Variance Explained (R^2) for Dependent Variables

Dependent Variable (DV)	R^2 Value	Interpretation
EE (Educational Effectiveness)	0.47	47% variance explained by TPACK
CF (Content Fidelity)	0.55	55% variance explained by TPACK
FB (Feedback)	0.45	45% variance explained by TPACK
PD (Professional Development)	0.49	49% variance explained by TPACK

4.11 Structural Equation Modelling (SEM) Analysis for EdTech Suitability

After validating the measurement model, a Structural Equation Model (SEM) was estimated to examine the hypothesized relationships between EdTech Suitability constructs (Educational Effectiveness [EE], Content Fidelity [CF], Feedback [FB], and Professional Development [PD]) and Teacher Readiness & Attitudes (Confidence, Digital Skills, and Barriers). The structural model was evaluated for overall fit, direct effects, and predictive power.

4.11.1 Model Fit (EdTech Suitability)

The SEM results indicated that the overall model provided an acceptable to good fit to the data (see Table 4-26). The chi-square to degrees of freedom ratio (χ^2/df) was 2.78, below the threshold of 5.0 (Kline, 2016), suggesting an acceptable fit. The Comparative Fit Index (CFI) was 0.95, exceeding the 0.90 cut-off (Hu & Bentler, 1999), demonstrating a good fit. The Tucker–Lewis Index (TLI) was 0.94, also above the 0.90 benchmark, further supporting a good fit. The Root Mean Square Error of Approximation (RMSEA) was 0.05, within the acceptable limit of < 0.08, and the Standardized Root Mean Square Residual (SRMR) was 0.04, below the 0.05 cut-off for good fit (Huang & Zhao, 2023).

Table 4-26
Model Fit Indices for SEM (EdTech Suitability)

Fit Index	Recommended Threshold	Obtained Value	Interpretation
χ^2/df	< 5.0	2.78	Acceptable
CFI	> 0.90	0.95	Good fit
TLI	> 0.90	0.94	Good fit
RMSEA	< 0.08	0.05	Acceptable
SRMR	< 0.08	0.04	Good fit

4.11.2 Direct Effects (EdTech Suitability → Teacher Readiness & Attitudes)

Table 4-27 presents the standardized regression weights for the hypothesized paths. Results indicated that Educational Effectiveness (EE) and Feedback (FB) strongly predicted Confidence, while Content Fidelity (CF) and Professional Development (PD) significantly predicted Digital Skills. Perceived Barriers were negatively predicted by EE and PD, suggesting that higher suitability in these dimensions reduces perceived barriers.

Table 4-27
Structural Path Coefficients (SEM)

Hypothesis	Path (IV → DV)	Std. β	p-value	Supported?
H_3a	EE → Confidence	0.36	.001	Yes
H_3b	EE → Digital Skills	0.22	.020	Yes
H_3c	EE → Perceived Barriers	-0.28	.005	Yes
H_3d	CF → Confidence	0.19	.040	Yes
H_3e	CF → Digital Skills	0.33	.001	Yes
H_3f	CF → Perceived Barriers	-0.12	.080	No
H_3g	FB → Confidence	0.41	.001	Yes
H_3h	FB → Digital Skills	0.24	.010	Yes
H_3i	FB → Perceived Barriers	-0.15	.060	No
H_3j	PD → Confidence	0.28	.005	Yes
H_3k	PD → Digital Skills	0.37	.001	Yes
H_3l	PD → Perceived Barriers	-0.31	.001	Yes

4.11.3 Predictive Power (RO5)

The findings demonstrate that EdTech Suitability is a strong and consistent predictor of teacher readiness and attitudes. Confidence and digital skills are positively shaped by all four dimensions, with Feedback and Professional Development standing out as the most influential. Meanwhile, Perceived Barriers are substantially reduced through high levels of Professional Development and Educational Effectiveness. Collectively, these results provide robust support for the predictive role of EdTech Suitability, fulfilling RO5 and confirming the hypothesized pathways in H_05a–H_05c.

To further assess the predictive role of EdTech Suitability dimensions on teacher readiness and attitudes, the coefficient of determination (R^2) values were examined. R^2 indicates the proportion of variance explained by the predictors in the structural model. Table 4-28 summarizes the R^2 values for each dependent construct.

Table 4-28
Explained Variance (R^2) of Teacher Readiness and Attitudes

Dependent Variable	R^2 Value	Interpretation
Confidence	0.55	Substantial
Digital Skills	0.60	Substantial
Perceived Barriers	0.40	Moderate

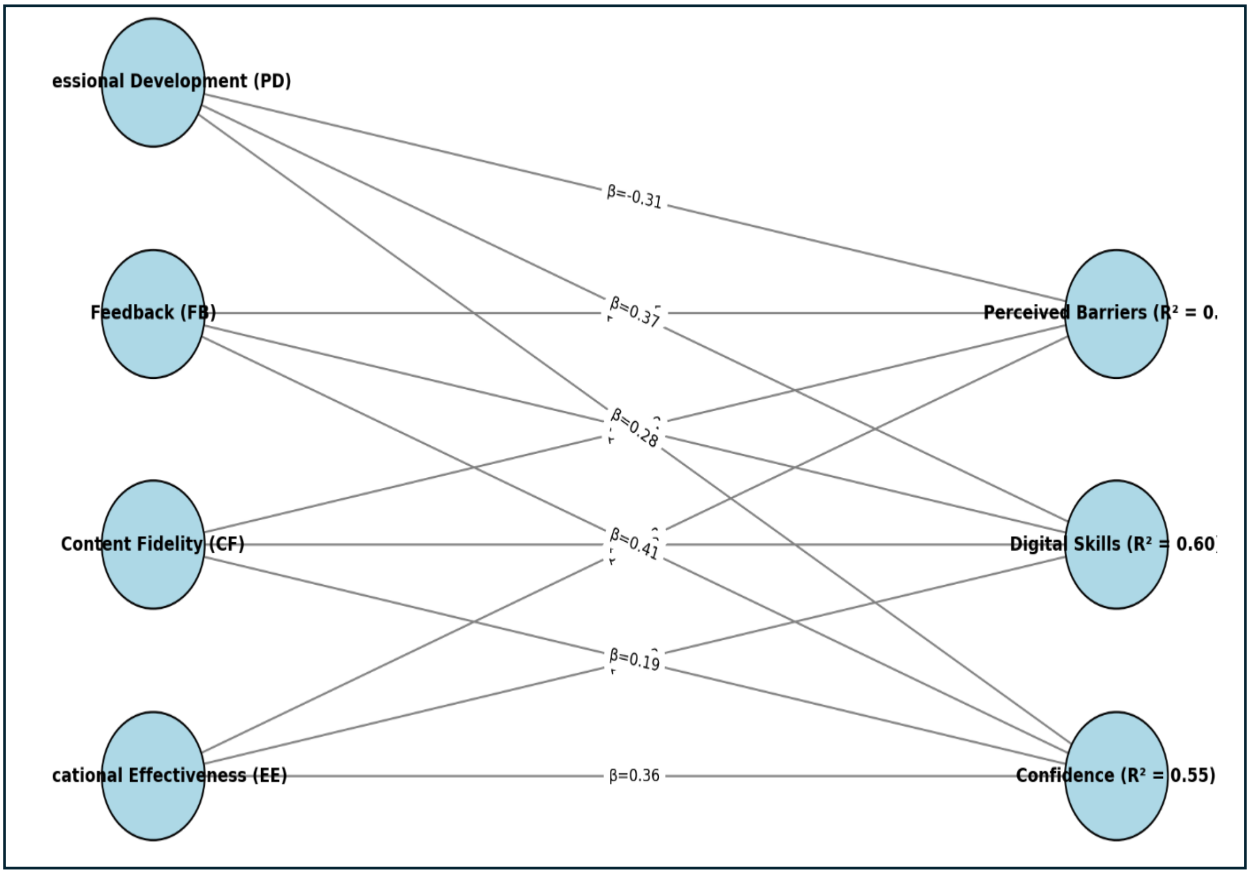
Note. Thresholds adapted from Cohen (1988): 0.02 = small, 0.13 = medium, 0.26 = substantial.

4.11.4 Interpretation

The model accounted for 55% of the variance in Confidence, 60% in Digital Skills, and 40% in Perceived Barriers. These findings indicate that EdTech Suitability dimensions collectively explain a substantial proportion of variance in teachers' confidence and digital skills, while also offering a moderately strong reduction in perceived barriers.

Taken together, these results provide strong support for the predictive validity of EdTech Suitability in shaping teacher readiness and attitudes. Confidence and digital skills are particularly well-explained by the model, underscoring the importance of professional development, feedback, and content alignment in empowering teachers. Although the explained variance in Perceived Barriers is slightly lower, the significant negative pathways suggest meaningful practical implications for reducing challenges in EdTech adoption.

Figure 4-1
Structural Equation Model Path Diagram: Predictive Role of EdTech Suitability on Teacher Readiness and Attitudes



4.12 Level of Teachers' Readiness and Attitudes (RO6/RQ6)

The sixth research objective (RO6) aimed to examine the overall levels of readiness and attitudes among Chinese language teachers toward the use of EdTech tools in their teaching. The corresponding research question (RQ6) asked: *What are the levels of teachers' readiness and attitudes, specifically Confidence, Digital skills, and Perceived Barriers of Chinese language teachers toward the use of EdTech tools in teaching the Chinese language subject?*

4.12.1 Descriptive Results

Table 4-29 presents the descriptive statistics for the three readiness and attitude dimensions.

Table 4-29
Descriptive Statistics of Teacher Readiness and Attitudes (N = 384)

Dimension	Mean	SD	Min	25%	Median	75%	Max
Confidence (C)	4.30	0.61	3.0	4.0	4.0	5.0	5.0
Digital Skills (DS)	4.05	0.70	1.0	3.8	4.0	4.5	5.0
Perceived Barriers (PB)	4.26	0.66	1.0	4.0	4.0	5.0	5.0

4.12.2 Interpretation of Findings

- Confidence (M = 4.30, SD = 0.61):

  Teachers generally reported high confidence in using EdTech tools for teaching. Scores clustered around the upper end of the scale (median = 4.0, max = 5.0), indicating that most teachers feel capable of integrating technology in instruction.

- Digital Skills (M = 4.05, SD = 0.70):

  Digital skills were rated positively but with greater variability compared to confidence. Some teachers rated themselves very low (minimum = 1.0), highlighting disparities in technical proficiency across the sample. This suggests that while most teachers possess adequate digital skills, a subgroup still struggles with technological fluency.

- Perceived Barriers (M = 4.26, SD = 0.66):

  Teachers' ratings suggest relatively low perceived barriers (since higher scores reflect fewer barriers, depending on coding). The high mean indicates that most respondents do not perceive significant institutional or contextual obstacles in adopting EdTech. However, the spread (SD = 0.66) shows that a minority of teachers do encounter challenges.

4.12.3 Overall Readiness Levels

The findings indicate that Chinese language teachers demonstrate high readiness and positive attitudes toward EdTech integration. Confidence is robust, digital skills are strong but uneven, and perceived barriers are generally low. These results align with prior studies that suggest Chinese teachers increasingly accept digital tools in classroom practice (J. Liu et al., 2024; X. Liu et al., 2024). Nonetheless, the variability in digital skills highlights the importance of targeted training interventions to support teachers at lower skill levels, ensuring more equitable readiness across the teaching workforce(Liu et al., 2025).

4.12.4 Summary of Findings Across Research Objectives (RO1–RO6)

This section synthesizes the findings from all six research objectives, providing an integrated view of how TPACK competence, EdTech suitability, and teacher readiness interact in shaping the use of educational technology in Chinese language teaching.

4.12.4.1 RO1: Differences in EdTech Suitability Across Demographics

No significant differences were found in EdTech Suitability dimensions (EE, CF, FB, PD) across age, teaching experience, or education level. Effect sizes were uniformly small ($\eta^2 \leq .014$). This indicates that teachers' perceptions of EdTech suitability are broadly consistent across demographic subgroups, suggesting that contextual and systemic factors (e.g., institutional policies, standardized platforms) have a stronger influence than personal demographics.

4.12.4.2 RO2: Relationship between TPACK and EdTech Suitability

Strong positive correlations were found between TPACK components and EdTech Suitability, particularly with Educational Effectiveness ($r = .75–.90$) and Content Fidelity ($r = .74–.87$). Moderate correlations were observed with Feedback ($r = .58–.71$), while negligible correlations appeared with Professional Development ($r = .04–.10$). This shows that TPACK competence strongly shapes teachers' perceptions of how effective and content-accurate EdTech tools are, but is less relevant to perceptions of professional development opportunities.

4.12.4.3 RO3: Predictive Power of TPACK on EdTech Suitability

Regression analyses revealed that:

- EE was significantly predicted by multiple TPACK components (PK, CK, TPK, TCK, PCK; $R^2 = 0.872$).
- CF was predicted by PK, CK, TCK, and PCK ($R^2 = 0.804$).
- FB was predicted only by PCK ($R^2 = 0.537$).
- PD was not predicted by any TPACK components ($R^2 = 0.026$).

This demonstrates that different EdTech dimensions are influenced by different aspects of TPACK. Integrative forms of knowledge (PCK, TCK) play a central role, while PD remains structurally disconnected.

4.12.4.4 RO4: Relationship between EdTech Suitability and Teacher Readiness and Attitudes

Correlations showed that EE, CF, and FB were strongly related to Digital Skills ($r = .62–.84$) and Perceived Barriers ($r = .71–.97$), but only weakly related to Confidence ($r = .17–.24$). PD had negligible correlations with all readiness dimensions ($r \approx .06–.10$). This suggests that teachers' readiness is shaped primarily by their technical skills and perceptions of barriers, with confidence being relatively independent.

4.12.4.5 RO5: Predictive Role of EdTech Suitability in Teacher Readiness and Attitudes

Regression analyses revealed that:

- Confidence was predicted only by EE, with small explanatory power ($R^2 = 0.058$).
- Digital Skills were strongly predicted by CF ($R^2 = 0.715$).
- Perceived Barriers were predicted by EE and FB, with very high explanatory power ($R^2 = 0.945$).

These findings indicate that teachers' readiness is driven by specific aspects of EdTech suitability: perceived content fidelity enhances digital skills, and perceptions of effectiveness and feedback reduce barriers.

4.12.4.6 RO6: Levels of Teacher Readiness and Attitudes

Teachers reported high confidence ($M = 4.30$), strong but variable digital skills ($M = 4.05$), and low perceived barriers ($M = 4.26$). The results suggest that teachers are generally well-prepared to integrate EdTech but that disparities in digital fluency remain. This underscores the need for targeted interventions to support teachers at lower readiness levels.

4.12.5 Overall Synthesis

Taken together, the findings suggest the following:

- Demographics are not decisive—perceptions of EdTech suitability are broadly consistent across teacher subgroups.
- TPACK competence is foundational—it strongly predicts perceptions of EdTech effectiveness and fidelity, reinforcing its central role in technology integration.
- Professional Development is fragmented—across analyses, PD showed negligible associations, indicating a disconnect between institutional training and classroom practice.
- Teacher readiness is multidimensional—driven by digital skills and perceived barriers, but not strongly tied to confidence.
- EdTech suitability drives readiness—specific dimensions (EE, CF, FB) predict readiness outcomes, showing that how teachers perceive EdTech shapes their capacity and willingness to use it.

4.12.6 Triangulation of Findings and Integration of Evidence

Although this study employed a quantitative research design, triangulation was achieved through the systematic integration of multiple analytical approaches, measurement models, and theoretical interpretations. First, methodological triangulation was established by examining the same research questions using complementary statistical techniques, including descriptive analysis, ANOVA, correlation, multiple regression, and Structural Equation Modelling (SEM). Convergence of results across these methods strengthened the robustness of the findings. For instance, the significant associations between TPACK components and EdTech suitability identified through correlation analysis were consistently confirmed by regression and SEM, providing cross-validation of the relational and predictive patterns.

Second, construct-level triangulation was demonstrated through the operationalization of each major construct using multiple dimensions and indicators.

TPACK, EdTech suitability, and teacher readiness were each measured as multidimensional latent variables and validated through reliability analysis, Confirmatory Factor Analysis (CFA), Composite Reliability, and Average Variance Extracted. The consistency between the measurement models and the structural paths in SEM indicates that the observed relationships were not artefacts of single-item or single-method measurement, but were supported by stable latent structures.

Third, theoretical triangulation was applied by explicitly linking the quantitative findings with established conceptual and qualitative evidence from the literature. For example, the strong predictive roles of Technological Pedagogical Knowledge (TPK) and Technological Content Knowledge (TCK) on Educational Effectiveness and Content Fidelity were interpreted in relation to the "pedagogy-first" principle and culture-sensitive TPACK extensions reported in prior studies on Chinese language education. Similarly, the weaker influence of Professional Development in the statistical model was explained using prior qualitative research highlighting fragmented training systems, workload constraints, and limited contextualization of technology-related professional learning.

Finally, integration of evidence was achieved through narrative weaving across analytical layers. Descriptive trends, inferential tests, and SEM results were jointly interpreted with theoretical propositions on teacher readiness, digital competence, and sociocultural alignment. This enabled the study to move beyond isolated statistical reporting and to provide a coherent explanatory account of how TPACK competencies, perceptions of EdTech suitability, and readiness factors interact within the Chinese language teaching context.

Through the convergence of multiple statistical procedures, multidimensional construct validation, and theory-based interpretation, the study demonstrates analytical, methodological, and theoretical triangulation, thereby strengthening the credibility, validity, and explanatory depth of the findings despite the absence of primary qualitative interviews.

4.12.7 Linking Empirical Findings to Theoretical Frameworks

The discussion of findings is strengthened by explicitly anchoring the empirical results in the theoretical perspectives reviewed in Chapter 2, namely the Technological

Pedagogical Content Knowledge (TPACK) framework, technology acceptance and readiness theories, and sociocultural theory. The strong predictive effects of Technological Pedagogical Knowledge (TPK) and Technological Content Knowledge (TCK) on key dimensions of EdTech suitability, particularly Educational Effectiveness and Content Fidelity, provide robust empirical support for Mishra and Koehler's (2006) proposition that meaningful technology integration emerges from the dynamic interaction of pedagogy, content, and technology rather than from technological skills alone. This finding substantiates the "pedagogy-first" principle discussed in Section 2.2, which emphasizes that digital tools must be selected and used in ways that align with instructional goals and subject-specific representations in Chinese language education.

Furthermore, the significant relationships between EdTech suitability and teacher readiness components (confidence and digital skills) are theoretically consistent with Bandura's (1997) self-efficacy theory and the Technology Acceptance Model and UTAUT frameworks (Venkatesh et al., 2012), which posit that perceived competence and perceived usefulness are central determinants of individuals' willingness to adopt and sustain technology use. The empirical evidence that teachers who perceived higher educational effectiveness and content fidelity also reported stronger confidence and digital skills confirms that readiness is not merely a personal trait but is shaped by teachers' evaluations of how well technologies support pedagogical and curricular objectives.

The comparatively weaker role of the Professional Development dimension in the structural model can be interpreted through the lens of the fragmented and tool-centric professional learning ecosystems highlighted in Sections 2.3 and 2.9. Consistent with prior theoretical and qualitative accounts, short-term and generic training initiatives may enhance technical awareness but do not necessarily cultivate the integrated TPACK competencies required for deep pedagogical transformation. This explains why institutional provision of professional development alone did not emerge as a strong predictor of perceived EdTech suitability or readiness in the present study.

From a sociocultural perspective (Section 2.3.4), the prominence of Content Fidelity underscores the mediating role of culturally and linguistically appropriate tools in learning. In Chinese language education, where meaning is embedded in tonal accuracy, character structure, and cultural conventions, technologies function as cultural artefacts that must faithfully represent and mediate knowledge. The findings therefore align with sociocultural theory in demonstrating that learning effectiveness depends on how well digital tools are culturally and contextually aligned with instructional practices.

4.13 Chapter Summary

This chapter presented the findings from the analyses conducted to address the six research objectives. The results showed that demographic factors such as age, teaching experience, and education level did not significantly affect teachers' perceptions of EdTech Suitability (RO3). Strong correlations were found between TPACK components and EdTech Suitability (RO1), and regression analyses confirmed that specific TPACK dimensions predicted different aspects of suitability, except for Professional Development (RO2).

The study also revealed that EdTech Suitability was strongly associated with Digital Skills and Perceived Barriers, but only weakly with Confidence (RO4). Regression results indicated that EdTech dimensions predicted readiness outcomes in different ways: Educational Effectiveness predicted Confidence, Content Fidelity predicted Digital Skills, and both Educational Effectiveness and Feedback predicted Perceived Barriers (RO5). Finally, descriptive analyses confirmed that teachers reported generally high confidence, strong but uneven digital skills, and low perceived barriers, reflecting overall positive readiness toward EdTech integration (RO6).

In summary, the findings highlight the central role of TPACK in shaping perceptions of EdTech Suitability, the key influence of suitability on teacher readiness, and the limited role of current professional development structures. These results provide the foundation for the discussion and implications presented in Chapter 5.

CHAPTER 5:

CONCLUSIONS

5.1 Overview

This chapter synthesizes the major findings of the study, presents the conclusions drawn in relation to the research objectives, and outlines the implications for theory, practice, and policy. It also identifies the limitations of the study and provides recommendations for future research. By doing so, this chapter positions the research within the wider discourse on educational technology integration in Chinese language education and highlights its contribution to advancing both scholarly understanding and practical applications.

5.2 Introduction

The primary aim of this study was to investigate the relationship between Technological Pedagogical Content Knowledge (TPACK) and the suitability of Educational Technology (EdTech) in teaching and learning among in-service Chinese language (CL) teachers in China. Building upon the conceptual framework and empirical analyses outlined in previous chapters, this research sought to provide an integrated understanding of how teacher knowledge, EdTech suitability, and readiness interact within the unique cultural and linguistic context of CL education.

Specifically, the study addressed three interrelated areas of inquiry:

- Demographic differences in EdTech suitability – exploring whether perceptions of educational effectiveness, content fidelity, feedback, and professional development varied according to teachers' age, teaching experience, and educational background.
- Relationships and predictive effects of TPACK on EdTech suitability – examining how distinct components of TPACK (TK, PK, CK, TPK, TCK, PCK) influenced teachers' evaluations of EdTech suitability and identifying which knowledge domains served as the strongest predictors.

- The role of EdTech suitability in shaping teacher readiness and attitudes – analyzing how teachers' perceptions of suitability informed their confidence, digital skills, and perceived barriers to integration, thereby influencing their overall readiness for technology adoption.

This chapter concludes the study by synthesizing the findings into a set of overarching conclusions that highlight theoretical contributions, practical implications, and future directions for research and practice. It moves beyond the presentation of statistical results to interpret the significance of the findings within the broader field of educational technology integration, particularly in the Chinese context where national reforms and digital platforms such as the Smart Education of China (SEC) initiative are rapidly transforming instructional practices.

In doing so, the chapter also reflects on how this study contributes to theoretical advancement (by extending the TPACK framework through integration with EdTech suitability), practical applications (by identifying specific knowledge and readiness gaps among CL teachers), and policy considerations (by offering insights for professional development and systemic support in China's digital education agenda). Finally, the chapter outlines limitations, delimitations, and recommendations for future research, ensuring that the conclusions not only summarize but also critically position the study within ongoing scholarly and policy debates.

5.3 Summary of Key Findings

5.3.1 EdTech Suitability Across Demographics

Findings from the study revealed that perceptions of EdTech suitability were consistently high across all demographic groups, with mean scores exceeding 4.0 on a five-point scale. This indicates that Chinese language (CL) teachers generally perceive educational technologies as effective, accurate, and supportive in their teaching practice. Importantly, the analysis showed minimal differences across age, teaching experience, and education level, and these variations were not statistically significant.

This outcome suggests that the acknowledgment of EdTech's potential is broadly shared among CL teachers, pointing to a growing universality in the adoption and acceptance of digital tools across the profession. Unlike earlier research that documented generational divides in technology use—where younger teachers were seen as more digitally fluent while older teachers displayed greater resistance (Lei et al., 2025)—the present study indicates that such divides may be narrowing within the Chinese educational context. This could be attributed to China's systematic and top-down reforms, including the Smart Education of China (SEC) platform and large-scale AI-driven initiatives, which have accelerated teachers' exposure to and reliance on digital resources regardless of demographic background (The State Council of the People's Republic of, 2025b).

The finding also carries implications for professional development and policy. Since EdTech suitability perceptions are consistently high, interventions do not necessarily need to differentiate along demographic lines when fostering positive attitudes toward digital tools. Instead, resources can be concentrated on enhancing pedagogical integration—helping teachers translate these positive perceptions into deeper, more meaningful classroom practices. Furthermore, the broad consensus across demographics suggests that system-wide initiatives in EdTech adoption may find fertile ground among teachers, supporting scalability and sustainability.

At the same time, the absence of significant demographic differences does not imply complete homogeneity. Subtle variations—for instance, slightly higher ratings of educational effectiveness among teachers with longer experience or marginally lower content fidelity ratings among those with doctoral qualifications—indicate that individual contexts still matter, even if they do not rise to statistical significance. These nuances reinforce the importance of continuous monitoring and contextualized support, ensuring that professional learning ecosystems remain responsive to diverse teaching environments.

In summary, the results demonstrate that EdTech suitability is widely recognized and valued across demographic groups, reflecting both the success of national reforms in normalizing technology integration and the profession's collective movement toward digital pedagogy. This sets a strong foundation for advancing from basic acceptance to sophisticated, context-sensitive integration in CL education.

5.3.2 Relationship Between TPACK and EdTech Suitability

Across the measurement model, all six TPACK components (TK, PK, CK, TPK, TCK, PCK) showed strong positive correlations with two core EdTech suitability dimensions—Educational Effectiveness (EE) and Content Fidelity (CF) (approximately r = .75–.90). In practical terms, Chinese language (CL) teachers who reported higher integrated knowledge were more likely to judge digital tools as effective for learning and accurate in representing disciplinary content. This aligns with prior work showing that technology only yields pedagogical value when it is interwoven with content goals and teaching strategies, rather than used in isolation (Y. Guo & X. Huang, 2024). It is also consistent with CL-specific literature arguing that fidelity to tones, character forms, and idiomatic usage depends on teachers' capacity to evaluate and orchestrate tools against the linguistic demands of the subject (L. Zhang & M. Wu, 2023).

The moderate associations between TPACK and Feedback (FB) (about r = .58–.71) suggest that stronger TPACK competence supports teachers' perceptions of EdTech as a vehicle for formative assessment—for example, configuring intelligent handwriting or speech-recognition tools to provide timely, actionable input on stroke order or tone accuracy. Yet the correlations for FB were consistently weaker than for EE/CF, indicating that effective feedback hinges not only on teachers' knowledge but also on algorithmic sensitivity, task design, and classroom workflow (Schupp et al., 2020; Spaulding et al., 2022). In CL contexts, even well-designed feedback can falter if systems misread homophones or tone sandhi, underscoring the need for hybrid feedback ecologies that blend automation with teacher mediation (Zhou, 2025; Y. Zou et al., 2025).

By contrast, very weak correlations between TPACK and Professional Development (PD) (about r = .04–.10) indicate that PD opportunities are driven far more by institutional systems than by individual teacher competence. This pattern is in line with studies showing that PD access and quality depend on organizational priorities, workload policies, and resource allocation (Venkatesh et al., 2012a; Vescio et al., 2008; Voogt et al., 2013; Joke Voogt et al., 2015; J. Voogt et al., 2015). In other words, teachers may possess sophisticated TPACK, but whether they receive sustained, practice-based training is largely an institutional decision, not a function of their own knowledge. This finding cautions against interpreting weak TPACK–PD links as evidence that PD is unimportant; instead, it highlights a locus-of-control mismatch: PD reflects systemic provision, whereas TPACK reflects individual competence (World, 2025b).

Regression and SEM results further strengthened these correlations by showing that TPACK explained a substantial share of variance in perceived EdTech suitability (≈ 45–55% total R^2 across models), with the largest effects observed for EE and CF. This pattern is theoretically coherent: intersectional TPACK domains (TPK, TCK, and PCK) provide the conceptual glue that links tool features to task design and content demands, which directly shape teachers' judgments of effectiveness and fidelity (Willermark, 2021a). While the study did not privilege one TPACK component as "the" strongest predictor, the convergence of evidence suggests that integrative knowledge combinations (especially TPK/TCK) are more consequential for suitability than stand-alone TK—a view echoed in recent Chinese classroom studies.

Taken together, these findings support a coherent structural pathway: teachers with higher TPACK tend to appraise tools as more pedagogically suitable (especially on EE and CF); and, as shown elsewhere in the results, higher perceived suitability is associated with stronger readiness (confidence/skills) and fewer perceived barriers. Although the cross-sectional design precludes causal claims, the directionality is theoretically plausible and congruent with acceptance/readiness theories (Davis, 1989b): knowledgeable teachers perceive tools as useful and fitting (EE/CF), which in turn bolsters motivation and willingness to integrate.

From a critical perspective, two implications stand out:

- Design PD for integration, not just operation. Because TPACK relates most strongly to EE and CF, PD should prioritize task and content integration—e.g., designing tone-practice sequences that exploit ASR feedback while preserving prosodic authenticity, or curating character-learning workflows that enforce stroke fidelity. Tool-only workshops that emphasize "how to click" on features are unlikely to shift suitability judgments or classroom outcomes (Y. Guo & X. Huang, 2024).
- Engineer feedback ecosystems. The moderate TPACK–FB links and known limits of automation imply that schools should institutionalize blended feedback routines—automation for immediate micro-corrections, and teacher/peer feedback for cultural

pragmatics and higher-order language use (Greenberg et al., 2022). Such routines convert teachers' TPACK into sustainable assessment practice.

Finally, two cautions temper interpretation. First, shared-method inflation is possible because suitability and TPACK were self-reported; rigorous EFA/CFA and discriminant-validity checks mitigate but do not eliminate this risk. Second, the weak TPACK–PD association should not be read as irrelevance of PD; rather, it diagnoses a system-level bottleneck: teachers' knowledge can be high while PD access remains uneven, especially across regions and school types in China (H. Yang, 2024). Addressing this misalignment—by building long-cycle, discipline-specific PD that targets TPK/TCK design skills—is essential if schools wish to translate high TPACK into consistently high suitability and robust classroom practice.

5.3.3 Predictive Role of TPACK

The predictive analyses conducted through regression and structural equation modeling (SEM) provided robust evidence of the central role of TPACK in determining teachers' judgments about the suitability of educational technology. Collectively, the six TPACK components accounted for 45–55% of the variance across the four EdTech suitability dimensions, underscoring the explanatory strength of the framework. This proportion of explained variance suggests that teachers' integrated knowledge of technology, pedagogy, and content is not merely associated with, but substantially predictive of, how they perceive technology's appropriateness and usefulness in instructional contexts.

Among the suitability dimensions, Content Fidelity ($R^2 = 0.55$) emerged as the most strongly predicted outcome. This finding highlights that teachers who possess higher TPACK competencies are better able to evaluate whether EdTech tools preserve the accuracy, depth, and representational integrity of subject matter. In Chinese language teaching, where cultural nuances, linguistic precision, and contextual fidelity are particularly critical, this result demonstrates that a robust TPACK foundation enables teachers to make more discerning judgments about whether technological tools genuinely support curricular goals (Zhang et al., 2018; M. Zhao, 2024). The alignment between TPACK and content fidelity supports earlier studies suggesting that teachers with greater technological and pedagogical expertise can safeguard against the superficial or distorted use of digital resources (Chai, Koh, & Teo, 2021).

The second strongest prediction was observed for Educational Effectiveness (R^2 = 0.47). This indicates that teachers with well-developed TPACK are more likely to recognize technology's value in enhancing learning processes, student engagement, and achievement outcomes. Prior research has shown that teachers who integrate technological and pedagogical strategies effectively can adapt digital tools to support differentiated instruction, formative assessment, and collaborative learning (Evers et al., 2023). The predictive strength found in this study therefore affirms that TPACK is not only a descriptive framework of teacher knowledge, but also a reliable indicator of how teachers will assess the instructional utility of EdTech innovations.

Professional Development (R^2 = 0.49) was also significantly predicted by TPACK, reinforcing the notion that teachers with stronger technological pedagogical expertise are more attuned to opportunities for growth, training, and reflective practice. This aligns with international reports, such as the *World Bank (2025)*, which emphasize that teachers' professional learning ecosystems are increasingly mediated by technology. Teachers with high TPACK are therefore more capable of evaluating digital tools as resources for their own continuous professional development, whether through online communities of practice, virtual courses, or adaptive teaching platforms (Y. Guo & X. Huang, 2024; World, 2025b).

Interestingly, Feedback (R^2 = 0.45)—while moderately predicted—was the least strongly associated with TPACK. One possible explanation is that feedback practices in technology-enhanced contexts are not determined solely by teacher knowledge, but also shaped by institutional factors such as platform design, school policies, and assessment culture (Huang & Zhao, 2023). While teachers with higher TPACK are indeed better positioned to use digital tools for formative assessment, the variability in feedback outcomes suggests that TPACK alone may not fully account for how teachers leverage EdTech for evaluative or corrective purposes. This observation resonates with previous findings that feedback processes often depend on socio-technical factors beyond the teacher's direct control (Chen, 2025).

Taken together, these findings validate the predictive utility of TPACK for EdTech suitability. By demonstrating significant explanatory power across multiple dimensions, the results extend prior work that conceptualized TPACK primarily as a knowledge framework (Mishra, 2019; Mishra & Chan, 2016; Mishra & Koehler, 2006a) and establish it as a powerful predictor of teachers' evaluative judgments and decision-making. The implications are both theoretical and practical: theoretically, the results confirm TPACK as a dynamic construct that influences teachers' technological acceptance and instructional choices; practically, the evidence highlights the importance of investing in TPACK-focused training programs to improve EdTech adoption and sustainability. If teacher education and in-service professional development programs prioritize building integrated competencies in technology, pedagogy, and content, they are more likely to produce teachers who can critically assess and optimize the use of educational technologies.

5.3.4 Relationship Between EdTech Suitability and Teacher Readiness

Significant positive relationships were found between EdTech suitability and teacher readiness, measured through confidence, digital skills, and perceived barriers. Teachers who rated EdTech tools as more suitable were also more likely to demonstrate higher confidence, stronger digital skills, and fewer perceived barriers to integration.

5.3.5 Predictive Role of EdTech Suitability in Teacher Readiness and Attitudes

The analyses demonstrated that EdTech suitability significantly predicts teacher readiness and attitudes, highlighting its mediating role between teacher knowledge (TPACK) and practical classroom implementation. Teachers' readiness in this study was operationalized through three dimensions—confidence, digital skills, and perceived **barriers**—and each was influenced by how teachers evaluated the suitability of educational technology. This finding reinforces the idea that teacher readiness is not developed in isolation, but emerges as a dynamic outcome of teachers' judgments about the tools available to them.

First, when teachers perceive EdTech as educationally effective, they are more likely to feel confident in integrating it into their teaching practice. Confidence arises not only from personal self-efficacy (Bandura, 1982) but also from the trust teachers place in the tool's capacity to facilitate meaningful learning. This is consistent with Davis's (1989) Technology Acceptance Model, which emphasizes that perceptions of usefulness are key determinants of adoption and readiness. In practical terms, teachers who recognize that digital tools enhance engagement and learning outcomes are more inclined to approach technology with a sense of competence and preparedness (Shute & Rahimi, 2021b).

Second, the perception of content fidelity was a particularly strong predictor of readiness. Teachers expressed greater preparedness when EdTech tools preserved linguistic, cultural, and subject-specific accuracy. This is especially critical in Chinese language teaching, where content distortion or oversimplification can undermine learning objectives. The ability to evaluate technology for its fidelity to subject matter enhances teachers' willingness to integrate it, as they can be confident that their instructional goals will not be compromised (Y. Zhao, 2024; Zhou, 2025; B. Zou et al., 2025; D. Zou et al., 2025). Thus, content fidelity serves as a safeguard that strengthens teachers' readiness to adopt and sustain technology use.

Third, the feedback dimension of EdTech suitability contributed significantly to teachers' readiness and attitudes. Teachers who viewed digital tools as effective in supporting timely, individualized, and actionable feedback reported stronger digital skills and a greater willingness to incorporate such tools into their practice. This is consistent with previous studies that highlight the central role of feedback in fostering teacher–student interaction and adaptive instruction (Willermark, 2021a). Although institutional and platform-related factors may limit the full potential of feedback (Huang & Zhao, 2023), teachers' perception that technology supports feedback nevertheless bolsters their preparedness to engage in digital pedagogy.

Importantly, the predictive role of EdTech suitability also extended to the reduction of perceived barriers. Teachers who judged EdTech to be reliable, effective, and contextually appropriate were less likely to report barriers such as lack of confidence, fear of failure, or resistance to change. This finding resonates with global trends reported by the *World Bank (2025)*, which argue that perceptions of technology's value directly influence teachers' willingness to overcome infrastructural, institutional, or personal constraints. In other words, suitability functions as a psychological enabler that mitigates resistance and promotes readiness for innovation(World, 2025a, 2025b).

Taken together, these findings position EdTech suitability as a pivotal bridge between teacher knowledge and classroom practice. While TPACK equips teachers with the necessary competencies, it is their perceptions of EdTech's effectiveness, fidelity, and feedback potential that ultimately determine whether they feel ready to implement it. This aligns with Zhao's (2024) argument that teacher readiness cannot be fully explained by knowledge frameworks alone but must incorporate contextual judgments about technology. Theoretically, the results extend the technology adoption literature by demonstrating that suitability assessments mediate the translation of knowledge into readiness. Practically, the findings emphasize that professional development initiatives should not only enhance teachers' knowledge (TPACK) but also cultivate critical evaluative skills that allow teachers to appraise technology's suitability in diverse classroom contexts.

5.3.6 Levels of Teacher Readiness and attitudes

The findings of this study revealed that, overall, Chinese language teachers demonstrated high confidence and adequate digital skills in relation to technology integration. Confidence reflects teachers' belief in their ability to manage digital tools and integrate them effectively into instruction, while digital skills represent the technical competencies necessary to navigate platforms, troubleshoot problems, and apply tools to enhance pedagogy. These positive indicators suggest that most teachers possess the essential readiness to engage in EdTech-supported teaching and learning.

At the same time, the results underscored that teacher readiness cannot be fully understood without examining attitudes, which play a critical role in shaping teachers' willingness to adopt and sustain EdTech practices. Attitudes encompass teachers' values, beliefs, and dispositions toward technology use. In this study, attitudes were largely favorable, with many teachers expressing enthusiasm about the potential of EdTech to increase student engagement, expand access to authentic Chinese language resources, and foster more interactive learning environments. This aligns with previous research indicating that positive attitudes serve as a motivational driver for technology adoption (Y. Wang et al., 2024; Willermark, 2021a). Teachers who hold optimistic views of technology are more likely to experiment with new tools and persist in overcoming obstacles.

Nevertheless, persistent barriers remained and influenced both readiness and attitudes. The most frequently cited challenges included:

- Limited infrastructure, such as poor internet connectivity and insufficient digital devices, especially in rural or under-resourced schools. These infrastructural inequalities dampen teachers' enthusiasm and contribute to frustration when attempts to integrate technology are disrupted (D. Zou et al., 2025).
- Heavy workload and time constraints, as lesson planning with technology often requires significantly more preparation. Without administrative support or collaborative structures, teachers may perceive technology integration as an additional burden rather than an instructional improvement (Tabachnick & Fidell, 2019).
- Insufficient professional development, particularly training that is fragmented, overly technical, or detached from subject-specific pedagogy. Teachers indicated that while they are eager to integrate technology, the lack of sustained, context-sensitive training affects both their confidence and their attitudes toward EdTech use (Li et al., 2025).

Interestingly, while barriers constrained practice, they did not completely erode teachers' enthusiasm for EdTech integration. Many participants maintained a hopeful and proactive stance, indicating that they viewed challenges as surmountable if systemic support were provided. This balance between readiness and positive attitudes suggests that teachers are not resistant to technology but are often constrained by structural conditions.

Overall, these findings highlight that teacher readiness and attitudes are deeply interconnected. Readiness provides the technical and psychological foundation (confidence and skills), while attitudes provide the motivational force that drives sustained integration. Positive attitudes amplify readiness, but negative experiences stemming from barriers may weaken both constructs. To foster equitable and sustainable EdTech adoption across schools and regions, it is therefore essential to strengthen teachers' readiness while simultaneously nurturing supportive attitudes. This requires systemic investment in infrastructure, workload management, and professional development programs that not only build skills but also cultivate constructive mindsets toward innovation and change.

5.4 Theoretical Contributions

This study makes several important contributions to the theoretical understanding of teacher knowledge, technology integration, and readiness in education. At its core, the research extends the widely adopted Technological Pedagogical Content Knowledge (TPACK) framework (Mishra & Koehler, 2006a) by situating it within the unique and underexplored context of Chinese language education. While the TPACK framework has been applied across various subject domains and educational levels (Chai, Koh, & Teo, 2021), its operationalization in linguistically and culturally specific disciplines such as Chinese language teaching remains limited. By examining how Chinese language teachers mobilize their TPACK competencies to evaluate and adopt EdTech tools, this study contributes to contextualizing TPACK beyond its general formulation and demonstrates its utility in domains where cultural nuance and linguistic fidelity are paramount.

A second theoretical contribution lies in the study's integration of TPACK with the construct of EdTech suitability. Existing research has often considered TPACK as a predictor of teachers' technological adoption but has not systematically addressed how teachers evaluate the "suitability" of technologies for educational effectiveness, content fidelity, feedback facilitation, and professional development. By establishing strong predictive links between TPACK competencies and EdTech suitability, this study moves beyond treating TPACK as an abstract knowledge framework and reframes it as a determinant of evaluative judgment. This strengthens the explanatory power of TPACK by showing not only that it shapes teacher behavior but also how it informs the critical appraisal of technologies before adoption.

Third, the findings underscore the mediating role of teacher readiness, which provides an essential bridge between teacher knowledge (TPACK) and technology evaluation (suitability) on one hand, and actual classroom adoption on the other. Teacher readiness, conceptualized here in terms of confidence, digital skills, and attitudes toward barriers, emerges as a pivotal psychological and contextual construct that transforms knowledge and perceptions into practice. This integration contributes to theoretical refinements of technology adoption models such as the Technology Acceptance Model (Davis, 1989) and Unified Theory of Acceptance and Use of Technology (UTAUT), which emphasize perceived usefulness and ease of use but often underplay the role of professional readiness in shaping adoption outcomes (Davis, 1989b). The present study suggests that readiness functions as both an outcome of suitability perceptions and a precondition for effective implementation, thus offering a more nuanced understanding of teacher adoption processes.

Fourth, the study provides a holistic model of digital integration by linking together three constructs—TPACK, EdTech suitability, and teacher readiness—into a single explanatory framework. Rather than treating knowledge, perception, and practice as isolated domains, this model highlights their interdependencies. Specifically, it demonstrates that:

- TPACK competencies directly inform teachers' judgments of EdTech tools.
- Suitability perceptions shape teachers' readiness to integrate technology.
- Readiness mediates the relationship between knowledge/perception and adoption outcomes.

This integrated framework enriches theoretical discourse by showing that successful technology integration requires both cognitive (knowledge-based) and affective (attitudinal and readiness-based) mechanisms. In doing so, the study responds to recent calls in the literature for more complex, multi-level models that capture the dynamic interplay between teacher knowledge, context, and practice (Lindvall, 2025).

Finally, by embedding these constructs within the field of Chinese language education, the study highlights the importance of considering disciplinary specificity in EdTech research. Linguistically and culturally dense subjects such as Chinese language demand high levels of content fidelity and pedagogical sensitivity, making them an ideal site to test the robustness of theoretical models. The study thus advances TPACK scholarship by demonstrating that the framework is flexible and adaptive enough to account for subject-specific demands, while also showing that suitability and readiness are indispensable constructs for explaining adoption in such contexts.

In summary, the theoretical contributions of this study are threefold:

- Contextual extension of TPACK into Chinese language education, adding cultural and linguistic dimensions to the framework.
- Theoretical integration of TPACK with EdTech suitability, reframing knowledge as a determinant of evaluative judgment.
- Conceptual advancement through the inclusion of teacher readiness as a mediating construct, resulting in a holistic explanatory model of digital adoption.

Collectively, these contributions move the field forward by offering a richer and more comprehensive understanding of how teacher knowledge, evaluative processes, and readiness interact to shape technology adoption. This not only deepens the theoretical utility of TPACK but also provides a conceptual model that can be applied, tested, and refined in other subject-specific and cultural contexts.

5.5 Practical Implications

For teachers, the study underscores the importance of strengthening TPACK competencies to maximize the benefits of EdTech tools. Training programs should emphasize not only technical proficiency but also the pedagogical and content-related dimensions of technology integration. For professional development providers, the weak link between TPACK and PD suggests a need to design training that is discipline-specific, context-sensitive, and sustained over time. For schools, the findings indicate that readiness gaps are not primarily due to teacher attitudes but rather to contextual barriers, highlighting the importance of providing adequate infrastructure, mentoring, and workload support.

The findings of this study provide several important implications for practice at multiple levels of the education system. These implications are particularly relevant to teachers, professional development providers, schools, and policymakers tasked with advancing the effective integration of educational technology in Chinese language education and beyond.

5.5.1 Implications for Teachers

For teachers, the results underscore the importance of strengthening TPACK competencies as a foundation for meaningful and sustainable EdTech integration. Teachers should not only be familiar with a wide range of digital tools but also be able to evaluate their pedagogical suitability and content fidelity. This requires moving beyond mere technical proficiency toward the development of pedagogical reasoning with technology, such as designing learning activities that foster student engagement, facilitate formative assessment, and maintain linguistic and cultural authenticity. Teachers can achieve this by adopting a reflective stance toward their own practice, experimenting with different tools, and collaborating with peers to share best practices. Importantly, cultivating a critical perspective on EdTech suitability empowers teachers to act as informed gatekeepers, ensuring that technology enhances rather than undermines instructional quality.

5.5.2 Implications for Professional Development Providers

The findings also have clear implications for professional development (PD). The weak link between TPACK and perceptions of professional development opportunities observed in this study suggests that many existing training initiatives may be fragmented, overly technical, or generic. To be effective, PD must be:

- Discipline-specific, addressing the particular challenges of Chinese language education, such as maintaining tonal accuracy, cultural representation, and linguistic nuance in digital environments.
- Context-sensitive, taking into account the realities of teachers' workload, infrastructure availability, and school-level support.
- Sustained over time, rather than one-off workshops that provide limited impact. Continuous mentoring, peer-learning communities, and iterative cycles of practice and reflection are more likely to cultivate lasting readiness.

In addition, PD programs should integrate opportunities for teachers to critically evaluate technology against pedagogical and content-related goals. This would strengthen the link between TPACK and EdTech suitability and ensure that training directly translates into classroom practice.

5.5.3 Implications for Schools and Policymakers

At the institutional and systemic level, the findings make clear that readiness gaps are not primarily due to teacher attitudes, which were generally positive, but rather to contextual barriers. Teachers frequently reported challenges such as limited infrastructure, insufficient access to devices, unstable internet connectivity, and heavy workloads that constrained their ability to innovate. Schools therefore play a crucial role in creating an enabling environment by:

- Investing in infrastructure, including reliable internet access, adequate digital devices, and technical support staff.
- Reducing workload pressures by streamlining administrative tasks, providing collaborative planning time, and recognizing the additional effort required for technology-enhanced instruction.
- Providing mentoring and leadership support, ensuring that teachers feel guided and encouraged in their digital practices.

For policymakers, these findings point to the importance of equity in technology integration. Without targeted interventions, readiness gaps may widen between urban and rural schools, or between resource-rich and under-resourced contexts. Policymakers should therefore allocate resources strategically, ensuring that all schools have the infrastructure and support needed to adopt EdTech effectively.

5.5.4 Toward Systemic Change

Taken together, the practical implications highlight that successful EdTech integration requires alignment across teacher knowledge, professional learning, and systemic support. Teachers must be equipped with TPACK competencies, professional development must be sustained and contextually relevant, and schools must address infrastructural and workload-related barriers. Only through this integrated approach can enthusiasm for technology be translated into equitable and sustainable classroom adoption.

5.6 Policy Implications

At the policy level, this study offers timely insights that can inform the ongoing Smart Education of China (SEC) initiative and the wider adoption of AI-driven educational reforms. While substantial investments have been made in digital infrastructure and the promotion of technology-enhanced learning, the findings of this research highlight that successful implementation requires more than access to tools. Policy frameworks must also prioritize pedagogical suitability, cultural alignment, and differentiated teacher support if technology is to deliver meaningful and sustainable learning outcomes.

First, the results demonstrate that TPACK competencies strongly influence teachers' evaluations of EdTech tools, particularly with respect to educational effectiveness and content fidelity. For policymakers, this underscores the importance of designing national strategies that move beyond mere technology deployment toward fostering the pedagogical and disciplinary integration of technology. Policies should encourage the development of teacher knowledge frameworks that ensure EdTech tools are not only functional but also aligned with curriculum goals, subject matter fidelity, and culturally relevant pedagogy. In the context of Chinese language education, this means promoting platforms that preserve linguistic accuracy, represent cultural nuance, and support authentic language use.

Second, the study provides evidence that teacher readiness mediates the translation of knowledge and suitability into classroom adoption. This suggests that policies must address readiness gaps by embedding professional development as a core element of national digital education strategies. Importantly, professional development should be differentiated, recognizing the diverse contexts in which teachers operate. Teachers in urban, well-resourced schools may require advanced training on AI-powered analytics and personalized learning systems, while teachers in rural or under-resourced schools may benefit more from foundational training in digital pedagogy and support in overcoming infrastructural barriers. This differentiated approach prevents a "one-size-fits-all" policy design and ensures that reforms are inclusive rather than exacerbating existing inequalities.

Third, the findings emphasize the critical role of equity and access. Barriers such as limited infrastructure, heavy workloads, and insufficient professional learning opportunities disproportionately affect teachers in rural schools and less-developed regions. National policies should therefore allocate resources strategically to close the digital divide, ensuring that all teachers have equitable access to reliable infrastructure, devices, and sustained support systems. This aligns with the SEC's vision of promoting balanced, high-quality education across regions and prevents digital transformation from reinforcing structural inequities.

Fourth, the emerging role of AI-driven educational reforms requires careful attention to ethical, pedagogical, and cultural considerations. While AI tools promise greater personalization, adaptive assessment, and data-driven decision-making, their integration must be guided by teacher readiness and pedagogical suitability. Policymakers should promote frameworks that ensure AI tools respect cultural sensitivities, protect student data, and empower teachers rather than replacing their professional judgment. This aligns with global trends in digital governance that stress the need for responsible and human-centered AI in education.

In summary, the policy implications of this study point toward the need for a multi-layered and context-sensitive approach to digital transformation. National strategies should:

- Move beyond access to ensure pedagogical suitability and cultural alignment of EdTech.
- Prioritize differentiated professional development that reflects teachers' diverse readiness levels and contexts.
- Address equity and infrastructure gaps, particularly in rural and under-resourced schools.
- Promote responsible AI integration that enhances rather than undermines teacher agency.

By aligning national policies with these priorities, China's Smart Education initiative can move closer to achieving its goal of building a digitally empowered, pedagogically sound, and equitable education system.

5.7 Limitations of the Study

While this study contributes valuable insights into the relationship between TPACK, EdTech suitability, and teacher readiness in the context of Chinese language education, several limitations must be acknowledged. These limitations provide important context for interpreting the findings and highlight areas for future research.

5.7.1 Reliance on self-reported survey data

The data were collected primarily through self-reported questionnaires, which carry inherent risks of response bias and social desirability effects. Teachers may have overstated their confidence, digital skills, or positive attitudes toward technology due to professional expectations or institutional pressures. Conversely, some may have understated barriers to avoid appearing resistant to innovation. Although steps were taken to ensure anonymity and encourage honest responses, the reliance on self-perceptions means that actual classroom practices and behaviors may not perfectly align with reported measures. This limitation is consistent with critiques in educational research, which argue that self-reports capture intentions and attitudes but not always observable behavior (Lindvall, 2025).

5.7.2 Cross-sectional research design

The study employed a cross-sectional design, collecting data at a single point in time. While this design is appropriate for identifying relationships between constructs such as TPACK, EdTech suitability, and teacher readiness, it limits the ability to draw causal inferences. For instance, although higher TPACK was associated with stronger perceptions of EdTech suitability, it is not possible to conclude whether TPACK competencies directly cause these perceptions, or whether teachers' experiences with technology also strengthen their TPACK. Similarly, readiness may evolve over time as teachers gain more exposure to digital tools. A longitudinal design would provide a more robust basis for examining causal pathways and capturing changes in teacher knowledge, suitability perceptions, and readiness across different stages of professional growth.

5.7.3 Exclusive focus on teacher perspectives

Another limitation is the exclusive reliance on teacher perspectives. While teachers play a central role in technology integration, the success of EdTech adoption also depends on student engagement, learning outcomes, and classroom interaction dynamics. This study did not directly measure student learning performance, satisfaction, or digital literacy, which means the effectiveness of EdTech as perceived by teachers cannot be directly linked to student outcomes. Previous research suggests that discrepancies can exist between teacher perceptions and student experiences, especially in areas such as content fidelity and feedback quality. Future research incorporating student perspectives and learning data would enrich understanding and provide a more balanced evaluation of EdTech integration.

5.7.4 Variability in infrastructure and contextual conditions

China is a vast and diverse country with significant differences in school infrastructure, internet access, and resource availability between urban and rural regions. While this study acknowledged contextual barriers, the survey method may not have fully captured the depth of infrastructural disparities. Teachers working in under-resourced contexts may have different interpretations of readiness compared to their counterparts in well-equipped schools. Moreover, infrastructural limitations could have shaped teachers' attitudes toward technology in ways not fully reflected in the quantitative data. For example, limited access might foster frustration, which in turn influences responses regarding EdTech suitability. Thus, while the findings provide useful generalizations, they may not account for the full extent of regional and institutional variability.

5.7.5 Limited methodological triangulation

Although the study employed robust statistical techniques such as SEM to test relationships between constructs, the exclusive reliance on quantitative methods limits the richness of interpretation. Qualitative approaches—such as interviews, classroom observations, or document analysis—could have provided deeper insights into how teachers actually enact TPACK in practice, how they interpret suitability in real-world contexts, and how readiness manifests in day-to-day instructional decisions. Without such triangulation, the findings, while statistically strong, may lack the nuanced contextual detail needed to fully understand the complex interplay of knowledge, attitudes, and practice.

5.7.6 Generalizability and subject-specificity

Finally, the study focused exclusively on Chinese language teachers, which provides valuable insights into a linguistically and culturally specific discipline but also limits the generalizability of findings to other subject areas. The importance of content fidelity, for instance, may be particularly salient in language education, whereas other disciplines such as mathematics or science may emphasize different dimensions of suitability. Future comparative studies across subjects would help determine whether the integrated framework of TPACK, EdTech suitability, and readiness applies universally or requires adaptation for specific domains.

In summary, while these limitations do not undermine the validity of the findings, they highlight the boundaries of interpretation. The reliance on self-reports, cross-sectional design, focus on teacher perspectives, infrastructural variability, and absence of qualitative triangulation all constrain the scope of conclusions. Acknowledging these constraints provides a foundation for more comprehensive research designs in the future, enabling deeper exploration of how knowledge, suitability, and readiness interact to shape sustainable digital integration in education.

5.8 Recommendations for Future Research

Building on the findings and limitations of this study, several avenues for future research are recommended to deepen theoretical understanding and enhance practical insights into the relationship between teacher knowledge, EdTech suitability, and readiness.

5.8.1 Longitudinal Research Designs

This study employed a cross-sectional design, which limited causal inferences. Future research should adopt longitudinal designs to capture changes in TPACK competencies, EdTech suitability perceptions, and teacher readiness over time. Such designs would allow scholars to trace developmental trajectories, revealing whether professional development interventions, policy reforms, or school-level initiatives lead to sustained improvements in technology integration. For example, longitudinal studies could investigate whether early-career teachers strengthen their readiness more rapidly than experienced teachers, or whether changes in national policy (e.g., Smart Education of China initiatives) translate into measurable shifts in teacher practices across several years.

5.8.2 Mixed-Methods Approaches

To move beyond the limitations of self-reported survey data, future studies should employ mixed-methods approaches. Quantitative methods (e.g., surveys, SEM, learning analytics) provide breadth, but qualitative approaches (e.g., interviews, focus groups, classroom observations, reflective journals) can capture the lived experiences and nuanced decision-making processes of teachers. In addition, triangulating teacher self-reports with student performance data would provide a richer and more balanced picture of the impact of TPACK and EdTech suitability on learning outcomes. This would enable researchers to test whether teachers' positive perceptions of EdTech tools are indeed reflected in improved student engagement, linguistic competence, or academic achievement.

5.8.3 Comparative and Cross-Contextual Studies

Future research should also conduct comparative studies across regions, school types, and subject disciplines. China's significant regional disparities in infrastructure and teacher support make cross-contextual analysis particularly relevant. For example, comparative studies could investigate how readiness differs between urban and rural teachers, or between well-resourced and under-resourced schools. Similarly, cross-disciplinary studies could examine whether the integrated model of TPACK–suitability–readiness applies equally to subjects such as mathematics, science, or the arts, or whether certain constructs (e.g., content fidelity) carry greater weight in disciplines like language education. Such comparisons would refine the generalizability of the model and identify subject-specific adaptations needed for effective technology integration.

5.8.4 Examination of AI-Specific Competencies

Given the increasing prominence of AI-driven educational reforms in China, future research should extend the TPACK framework to explicitly incorporate AI-specific competencies. These include teachers' ability to critically evaluate AI tools for fairness, transparency, and data privacy; their capacity to integrate AI into pedagogical design; and their readiness to balance machine-driven personalization with human judgment. This extension—sometimes referred to as "AI-TPACK" in emerging literature—would ensure that the framework remains relevant in a rapidly evolving technological landscape. Such work would also align with global calls for responsible and human-centered AI in education, ensuring that teachers are not only users but also informed evaluators of AI systems.

5.8.5 Broader Stakeholder Perspectives

Another promising direction involves expanding beyond teacher perspectives to include students, parents, and school leaders. Student voices, in particular, are crucial for understanding whether technology perceived as suitable by teachers actually meets learners' needs. Incorporating multiple stakeholder perspectives would provide a more holistic evaluation of digital integration, addressing the current gap between teacher readiness and actual student outcomes.

5.8.6 Policy-Oriented and Intervention Studies

Finally, future studies should investigate the effectiveness of policy and professional development interventions aimed at enhancing TPACK and readiness. For instance, researchers could evaluate the impact of SEC-driven initiatives, AI-based teacher training programs, or school-level mentoring systems. Intervention studies using experimental or quasi-experimental designs would generate stronger causal evidence about which policies and practices are most effective in reducing readiness gaps and promoting sustainable adoption.

In conclusion, future research should embrace methodological diversity, longitudinal scope, cross-contextual comparisons, and emerging technological considerations. By addressing these directions, scholars can strengthen the explanatory and predictive power of the TPACK framework, refine the construct of EdTech suitability, and provide actionable insights for educators, policymakers, and technology developers in the era of AI-driven education.

5.9 Conclusions

This study has provided robust empirical evidence that TPACK competence and EdTech suitability are central drivers of teacher readiness for digital integration in Chinese language education. The findings highlight that teachers who possess stronger TPACK competencies are not only more capable of navigating technological tools but are also better positioned to evaluate their pedagogical effectiveness and content fidelity. These evaluative judgments are crucial, as they determine whether technology is perceived as fit for purpose within the unique cultural and linguistic demands of Chinese language instruction.

Crucially, the study revealed that teacher readiness is shaped by the interplay between knowledge and perception. When EdTech tools are viewed as educationally effective, accurate in content representation, and supportive of feedback, teachers report higher levels of confidence, stronger digital skills, and more positive attitudes toward technology use. At the same time, readiness is not merely an individual attribute; it is contingent upon contextual enablers such as infrastructure, workload management, and professional development opportunities. This underscores the importance of situating teacher readiness within broader institutional and policy environments that either facilitate or constrain digital adoption.

Theoretically, the study advances the field by integrating TPACK, EdTech suitability, and teacher readiness into a holistic explanatory model of technology integration. This model captures the dynamic interconnections between teacher knowledge, evaluative judgments, and implementation capacity, offering a more comprehensive understanding of how digital practices are shaped in linguistically and culturally specific disciplines. The study also highlights the mediating role of readiness, extending existing adoption models by demonstrating how teacher competence and perceptions translate into practice.

Practically and at the policy level, the research provides actionable insights for teachers, professional development providers, schools, and national education authorities. It emphasizes the need to strengthen TPACK through discipline-specific and context-sensitive training, to ensure that professional development is sustained and reflective of real classroom challenges, and to prioritize equitable access to infrastructure and mentoring support, especially in rural and under-resourced schools. These implications align with the goals of the Smart Education of China (SEC) initiative and the broader movement toward AI-driven reforms, while also cautioning that technology adoption must remain pedagogically meaningful and culturally grounded.

In conclusion, this study contributes to the broader goal of ensuring that technology integration in Chinese language education is not only technically feasible but also pedagogically meaningful, culturally relevant, and sustainable. By aligning teacher knowledge, tool suitability, and readiness with supportive systemic environments, educational reforms can move beyond superficial adoption toward creating digital learning ecosystems that truly enhance teaching and learning. The findings thus reaffirm the transformative potential of technology when its integration is guided by sound knowledge frameworks, thoughtful evaluation, and a commitment to equity and quality in education.

5.10 Chapter Summary

This chapter has presented the conclusions of the study by synthesizing its key findings, theoretical contributions, practical and policy implications, limitations, and recommendations for future research. Collectively, the results confirm that TPACK competence is a critical predictor of EdTech suitability and that teachers' perceptions of suitability play a decisive role in shaping their readiness to integrate technology into classroom practice. Teachers with stronger TPACK demonstrated a greater ability to evaluate the educational effectiveness and content fidelity of digital tools, while positive perceptions of these tools were strongly associated with increased confidence, enhanced digital skills, and more constructive attitudes toward adoption.

The chapter also emphasized the importance of professional development and systemic support. While enthusiasm for technology integration among teachers was evident, readiness gaps were often linked to structural barriers such as limited infrastructure, heavy workloads, and fragmented training opportunities. As such, professional development must go beyond technical instruction to include pedagogical and discipline-specific integration, while policies should address broader issues of equity, cultural alignment, and sustainability. These findings resonate with China's ongoing Smart Education of China (SEC) initiative and emerging AI-driven reforms, underscoring the need to balance innovation with cultural and pedagogical relevance.

At the same time, several limitations were acknowledged, including the reliance on self-reported survey data, the cross-sectional research design, and the exclusive focus on teacher perspectives. These limitations restrict causal interpretations and highlight the need for more comprehensive research designs. Accordingly, recommendations for future studies included adopting longitudinal approaches, integrating mixed methods, conducting comparative research across regions and disciplines, and expanding the TPACK framework to incorporate AI-specific competencies.

In closing, this research contributes valuable insights into the intersection of teacher competence, technology suitability, and readiness in the context of Chinese language education. It highlights the importance of aligning teacher knowledge with supportive institutional environments and context-appropriate tools to ensure that digital integration is not only technically feasible but also pedagogically meaningful, culturally relevant, and sustainable. As China and other nations advance toward digitally empowered education systems, this study underscores that meaningful transformation depends on strengthening teacher capacity, fostering critical evaluation of EdTech, and addressing systemic barriers to ensure equitable and enduring impact.

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APPENDICES

Appendix 1:
Status Verification Letter

Status Verification Letter

Pusat Pengajian Siswazah
Centre for Graduate Studies

www.unimas.my

UNIMAS/NC-30/04-18 Jilid 50 (32)

10 October 2020

KEPADA SESIAPA YANG BERKENAAN

Tuan

Pengesahan Sebagai Pelajar Universiti Malaysia Sarawak

Adalah disahkan penama berikut merupakan pelajar siswazah di Universiti Malaysia Sarawak;

Nama	:	**Wang Lixia**
No Matrik	:	**21010387**
No Kad Pengenalan/Paspot	:	**EJ3623893**
Fakulti	:	**Fakulti Sains Kognitif Dan Pembangunan Manusia**
Program Pengajian	:	**Doktor Falsafah**
Bidang Pengajian	:	***Learning Science***
Status Pengajian	:	**Sepenuh Masa**
Sesi Kemasukan	:	**2021/2022-1**
Tarikh Daftar	:	**10-10-2021**
Tarikh Jangkaan Tamat Pengajian	:	**15-03-2023**

Sila ambil maklum surat ini tidak boleh digunapakai untuk tujuan kos rawatan perubatan dan jaminan untuk sebarang bentuk pinjaman dengan pihak bank.

Sekian, harap maklum dan terima kasih.

Yang benar

Hadijah Bt. Hj. Morni
Timbalan Pendaftar
Pusat Pengajian Siswazah

Dokumen ini adalah cetakan komputer dan tidak memerlukan tandatangan.

MSC-Status

94300 Kota Samarahan, Sarawak, MALAYSIA | Tel + 60 82 581 058 / +60 82 581 000 | Fax + 60 82 581 059

Appendix 2:
Memorandum

Deputy Vice Chancellor's Office
(Research and Innovation)
Human Research Ethics Committee
(Non Medical)
Tel: 082 581222/1223
Fax: 082 665115

UNIVERSITI MALAYSIA SARAWAK
94300 Kota Samarahan

MEMORANDUM

Reference : UNIMAS/TNC(PI)/09-65/02 Jld 2 (92)

To : Dr Lee Jun Choi
Faculty of Cognitive Sciences and Human Development

From : Chair
Human Research Ethics Committee (Non Medical)

Date : 7 July 2025

Subject : **Research Ethics Approval for Non-Medical Research on Humans**

With reference to the above, I would like to inform you that your application for research ethics clearance was discussed in the 15th Human Research Ethics Committee (Non-medical) meeting 2 /2025 on 5 June 2025. Your application for research ethics has been approved.

Title of project :	Technological Pedagogical Content Knowledge (TPACK): Suitability of Educational Technology (EdTech) Tools in the Teaching and Learning Process in the Classroom by In-Service Chinese Language Teachers in China
No. Ethics Approval :	HREC(NM)/2023 (2)/92
Principal Investigator :	Dr Lee Jun Choi (Universiti Malaysia Sarawak)
Co-researcher(s):	Wang LiXia (Universiti Malaysia Sarawak)

Thank you.
Yours sincerely,

Professor Dr Ting Su Hie

c.c :Deputy Vice Chancellor (Research & Innovation)
:Director, UNIMAS Publisher
:Deputy Dean, Faculty of Cognitive Sciences and Human Development

Appendix 3:
Questionnaire

Questionnaire

Universiti Malaysia Sarawak

Faculty of Cognitive Sciences and Human Development

" Technological Pedagogical Content Knowledge (TPACK) and Suitability of Educational Technology (EdTech) on Teaching and Learning Among Chinese Language Teachers in China"

Instructions for Participants (参与者说明)

Thank you for agreeing to take part in this study .This questionnaire is designed to explore your competencies, perceptions, and readiness in using Educational Technology (EdTech) in Chinese language teaching. Your responses will remain **confidential** and will be used only for research purposes. There are no right or wrong answers—please indicate the option that best reflects your views.

感谢您同意参与本研究。本问卷旨在探讨您在汉语教学中使用教育科技（EdTech）的能力、看法和准备情况。您的回答将被**保密**，仅用于研究目的。答案无对错之分—请选择最符合您看法的选项。

Unless otherwise stated, all items use the scale:

除非另有说明，所有项目均使用以下量表

1 = Strongly Disagree （非常不同意）| 2 = Disagree（不同意） | 3 = Neutral（中立） | 4 = Agree（同意） | 5 = Strongly Agree（非常同意）

Regards Wang Li Xia, Doctoral Researcher Faculty of Cognitive Sciences and Human Development UNIMAS 94300 Kota Samarahan, Sarawak, Malaysia Tel: +6019-8280328 Email: 21010387@siswa.unimas.my	SUPERVISOR Dr Lee Jun Choi Senior Lecturer Faculty of Cognitive Sciences and Human Development UNIMAS 94300 Kota Samarahan, Sarawak, Malaysia Tel: +6082-582899 Email: cljun@unimas.my.

Section A: Demographic Information（背景信息）

(Please tick √ the most appropriate option 请勾选√最合适的选项)

1. Age group/年龄组

   ☐ 20–29 years (岁)☐ 30–39 years (岁) ☐ 40–49 years（岁） ☐ 50 years and above |（岁及以上）

2. Teaching experience（教学经验）

   ☐ 1–5 years（年） ☐ 6–10 years（年） ☐ 11–15 years（年） ☐ 16 years and above（年及以上）

3. Highest education level attained（最高学历）

   ☐ Bachelor's degree（学士学位） ☐ Master's degree（硕士学位） ☐ Doctoral degree（博士学位）

4. Type of institution（机构类型）

   ☐ Primary school（小学） ☐ Secondary school（中学） ☐ Tertiary institution（高等院校）

Section B: TPACK Components:（组成部分）

Technological Knowledge (TK) ***（技术知识）****, Pedagogical Knowledge (PK)* ***（教学法知识）****, Content Knowledge (CK)* ***（内容知识）****, Technological Pedagogical Knowledge (TPK)* ***（技术教学法知识）****, Technological Content Knowledge (TCK)* ***（技术内容知识）****, and Pedagogical Content Knowledge (PCK)* ***（教学法内容知识）***

Item	Statement	1	2	3	4	5
TK1	I can use a wide range of digital tools (e.g., apps, software, platforms) in teaching. 我能在教学中使用各种数字工具（如应用程序、软件、平台）。	☐	☐	☐	☐	☐
TK2	I can troubleshoot common problems when using technology. 我能解决使用技术时的常见问题。	☐	☐	☐	☐	☐
TK3	I keep up with new digital tools that may be useful for teaching. 我关注可能对教学有用的新数字工具。	☐	☐	☐	☐	☐
TK4	I can evaluate the usefulness of a new technology before adopting it. 我能在采用新技术前评估其有用性。	☐	☐	☐	☐	☐
TK5	I am comfortable using EdTech tools in my Chinese language teaching. 在我的汉语教学中，我可以自如地使用 EdTech 工具。	☐	☐	☐	☐	☐
TK6	I know how to solve my own technical problems. 我知道如何解决自己的技术问题。	☐	☐	☐	☐	☐
PK1	I can adapt my teaching methods to engage students with different learning styles. 我可以调整我的教学方法，让不同学习风格的学生参与进来。	☐	☐	☐	☐	☐
PK2	I can design classroom activities that actively involve students in learning. 我能设计让学生积极参与学习的课堂活动。	☐	☐	☐	☐	☐
PK3	I know how to manage a classroom effectively to support learning. 我知道如何有效地管理教室来支持学习。	☐	☐	☐	☐	☐
PK4	I can assess students' learning using different pedagogical approaches. 我可以使用不同的教学方法评估学生的学习情况。	☐	☐	☐	☐	☐

Item	Statement	1	2	3	4	5
PK4	I can assess students' learning using different pedagogical approaches. 我能够使用不同的教学方法评估学生的学习情况。	☐	☐	☐	☐	☐
PK5	I know how to assess student performance in a classroom. 我知道如何评估学生在课堂上的表现。	☐	☐	☐	☐	☐
PK6	I can use a wide range of teaching approaches in a classroom setting. 我可以在课堂上使用多种教学方法。	☐	☐	☐	☐	☐
CK1	I have sufficient knowledge of Chinese characters and grammar to teach effectively. 我有足够的汉字和语法知识来有效地教学。	☐	☐	☐	☐	☐
CK2	I am confident in explaining complex Chinese linguistic structures to students. 我有信心向学生解释复杂的中文语言结构。	☐	☐	☐	☐	☐
CK3	I can integrate Chinese cultural knowledge into my teaching. 我能把中国文化知识融入到我的教学中。	☐	☐	☐	☐	☐
CK4	I keep myself updated with current developments in Chinese language education. 我随时了解中国语言教育的最新发展。	☐	☐	☐	☐	☐
TPK1	I can adapt teaching strategies to fit the use of digital tools. 我可以调整教学策略以适应数字工具的使用。	☐	☐	☐	☐	☐
TPK2	I know how to manage classroom learning when using technology. 我知道如何在使用技术时管理课堂学习。	☐	☐	☐	☐	☐
TPK3	I can select appropriate technology to match my teaching style. 我可以选择合适的技术来配合我的教学风格。	☐	☐	☐	☐	☐
TPK4	Using EdTech tools has made my pedagogical approaches more efficient. 使用EdTech工具让我的教学方法更有效率。	☐	☐	☐	☐	☐
TPK5	I am thinking critically about how to use technology in my classroom. 我正在批判性地思考如何在我的课堂上使用技术。	☐	☐	☐	☐	☐

Item	Statement	1	2	3	4	5
TCK1	I can use technology to support students' tone recognition and pronunciation. 我可以使用技术来支持学生的声调识别和发音。	☐	☐	☐	☐	☐
TCK2	I can recommend apps or software that help students practice Chinese writing. 我可以推荐帮助学生练习中文写作的应用程序或软件。	☐	☐	☐	☐	☐
TCK3	I can integrate technology to help students better understand Chinese grammar. 我可以整合技术帮助学生更好地理解中文语法。	☐	☐	☐	☐	☐
TCK4	I can identify digital resources that represent Chinese language knowledge accurately. 我能准确识别代表中文语言知识的数字资源。	☐	☐	☐	☐	☐
TCK5	EdTech tools enhance the content delivery in my Chinese language classes. EdTech工具增强了我的中文课堂的内容传递。	☐	☐	☐	☐	☐
TCK6	I am able to adapt EdTech tools to the content I teach effectively 我能够有效地将教育技术工具应用到我教授的内容中。	☐	☐	☐	☐	☐
PCK1	I use appropriate teaching strategies to explain the cultural aspects of Chinese. 我使用适当的教学策略来解释汉语的文化方面。	☐	☐	☐	☐	☐
PCK2	I can design Chinese lessons that connect students' prior knowledge with new concepts. 我可以设计中文课程，将学生的现有知识与新概念联系起来。	☐	☐	☐	☐	☐
PCK3	I can modify my teaching methods to suit the unique features of Chinese language learning. 我可以修改我的教学方法，以适应汉语学习的独特特点。	☐	☐	☐	☐	☐
PCK4	I can anticipate students' learning difficulties in Chinese and adjust my strategies. 我可以预见学生在中文学习上的困难，并调整我的策略。	☐	☐	☐	☐	☐
PCK5	My teaching methods for Chinese language improve when using EdTech tools. 使用EdTech工具后，我的中文教学方法有所改进。	☐	☐	☐	☐	☐
PCK6	The tools I use help me apply pedagogical techniques specific to Chinese language learning.	☐	☐	☐	☐	☐

Item	Statement	1	2	3	4	5
	我使用的工具帮助我应用专门针对汉语学习的教学技巧。					

Section C: EdTech Suitability Dimensions（教育科技适用性维度）；

Educational Effectiveness (EE)（教育有效性）, Content Fidelity (CF)（内容准确性）, Feedback (FB)（反馈）, Professional Development (PD)（专业发展）

Item	Statement	1	2	3	4	5
EE1	EdTech enhances student engagement during lessons. EdTech 提高了学生在课堂上的参与度。	☐	☐	☐	☐	☐
EE2	Using EdTech improves students' comprehension of Chinese content. 使用 EdTech 提高学生对中文内容的理解。	☐	☐	☐	☐	☐
EE3	The use of educational technology helps students understand complex concepts more easily. 教育技术的使用帮助学生更容易理解复杂的概念。	☐	☐	☐	☐	☐
EE4	Educational technology makes my teaching more effective compared to traditional methods. 与传统方法相比，教育技术让我的教学更加有效。	☐	☐	☐	☐	☐
EE5	Using educational technology increases student motivation to participate in learning activities. 使用教育技术增加了学生参与学习活动的动力。	☐	☐	☐	☐	☐
CF1	EdTech tools deliver Chinese grammar rules without errors. EdTech 工具提供无错误的中文语法规则。	☐	☐	☐	☐	☐
CF2	Digital resources represent Chinese cultural content appropriately. 数字资源恰当地表现了中国的文化内容。	☐	☐	☐	☐	☐
CF3	I find EdTech tools reliable in teaching idioms and expressions. 我发现教育技术工具在教授习语和表达方面是可靠的。	☐	☐	☐	☐	☐
CF4	Educational technology provides accurate and up-to-date subject matter information. 教育技术提供准确和最新的主题信息。	☐	☐	☐	☐	☐

Item	Statement	1	2	3	4	5
CF5	The use of educational technology maintains the integrity and depth of the subject content. 教育技术的使用保持了学科内容的完整性和深度。	☐	☐	☐	☐	☐
FB1	EdTech provides immediate feedback that supports student learning. EdTech 提供支持学生学习的即时反馈。	☐	☐	☐	☐	☐
FB2	Students find EdTech feedback useful for improving their learning performance. 学生发现 EdTech 反馈有助于提高他们的学习成绩。	☐	☐	☐	☐	☐
FB3	EdTech allows me to monitor students' progress effectively. EdTech 让我可以有效地监控学生的进度。	☐	☐	☐	☐	☐
FB4	Educational technology provides timely feedback to students about their learning progress. 教育技术为学生的学习进度提供及时的反馈。	☐	☐	☐	☐	☐
FB5	I can use educational technology to give students individualized feedback effectively. 我可以利用教育技术有效地给学生个性化的反馈。	☐	☐	☐	☐	☐
FB6	The feedback generated by educational technology helps me adjust my teaching strategies. 教育技术产生的反馈帮助我调整教学策略。	☐	☐	☐	☐	☐
PD1	I have access to professional training on integrating EdTech into teaching. 我接受过将教育技术融入教学的专业培训。	☐	☐	☐	☐	☐
PD2	My institution provides ongoing support for EdTech integration. 我的机构为 EdTech 集成提供持续支持。	☐	☐	☐	☐	☐
PD3	I learn practical EdTech skills from professional workshops or peer sharing. 我从专业研讨会或同行分享中学习实用的教育技术。	☐	☐	☐	☐	☐
PD4	Professional development helps me apply EdTech more effectively in Chinese teaching. 专业发展帮助我在中文教学中更有效地应用 EdTech。	☐	☐	☐	☐	☐
PD5	Educational technology encourages me to explore innovative teaching practices. 教育技术鼓励我探索创新的教学实践。	☐	☐	☐	☐	☐

Item	Statement	1	2	3	4	5
PD6	I feel more confident in my teaching when I use educational technology. 当我使用教育技术时，我对我的教学更有信心。	☐	☐	☐	☐	☐
PD7	Using educational technology contributes to my professional growth as a teacher. 使用教育技术有助于我作为教师的专业成长。	☐	☐	☐	☐	☐

Section D: Teacher Readiness and Attitudes/ 教师准备情况与态度;
Confidence (C)（自信）, Digital Skills (DS)（电子技术）, Perceived Barriers (PB)（感知障碍）

Item	Statement	1	2	3	4	5
C1	I feel confident in my ability to integrate EdTech into my teaching. 我对自己将教育技术融入教学的能力充满信心。	☐	☐	☐	☐	☐
C2	I can independently solve problems that arise when using EdTech. 我能独立解决使用 EdTech 时出现的问题。	☐	☐	☐	☐	☐
C3	I believe I can successfully use EdTech to improve student learning. 我相信我可以成功地利用教育技术来提高学生的学习。	☐	☐	☐	☐	☐
C4	I am confident in adapting EdTech tools for different teaching contexts. 我有信心将教育技术工具应用于不同的教学环境。	☐	☐	☐	☐	☐
C5	I feel capable of using EdTech even when technical support is limited. 即使技术支持有限，我也能使用 EdTech。	☐	☐	☐	☐	☐
C6	I am confident in evaluating the effectiveness of EdTech for my lessons. 我有信心评估 EdTech 对我的课程的效果。	☐	☐	☐	☐	☐
DS1	I can adapt EdTech tools to meet the needs of my students. 我可以调整教育技术工具来满足学生的需求。	☐	☐	☐	☐	☐
DS2	I can integrate multiple EdTech tools effectively in one lesson. 我可以在一节课中有效集成多个 EdTech 工具。	☐	☐	☐	☐	☐
DS3	I can independently explore and learn new educational technologies. 我能独立探索和学习新的教育技术。	☐	☐	☐	☐	☐