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Predicting EFL Teacher' Digital Integration through TPACK, Facilitating Conditions, and Institutional Culture

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Despite years of policy investment in educational technology, Chinese EFL teachers' digital integration remains uneven; most use technology for content delivery, not pedagogical transformation. This explanatory sequential mixed-methods study examined how TPACK, facilitating conditions, and institutional culture shape enrichment-oriented versus transformation-oriented technology use among 271 EFL teachers in Jiangsu Province, followed by interviews with eight teachers. Quantitative analysis using PLS-SEM showed TPACK as the strongest predictor of both integration types, with institutional culture exerting modest positive effects. More striking was the paradoxical role of facilitating conditions: they predicted transformation positively but enrichment negatively. This suggests that once infrastructure reaches a baseline level, teachers may bypass simpler uses in favour of more ambitious innovation. Interviews revealed persistent TPACK deficits, stark institutional disparities, and the powerful influence of peer networks and student feedback. The study offers an integrated framework that distinguishes enrichment from transformation and challenges the assumption that infrastructure linearly drives integration quality. Implications point to the need for policies that distinguish enrichment from transformation, institutional professional development that addresses pedagogical reasoning rather than tool training, and teacher education that fosters integrated TPACK alongside technical proficiency.

Keywords: digital integration, EFL teachers, TPACK, facilitating conditions, institutional culture

INTRODUCTION

Digital technologies have become woven into the fabric of education, and their presence alone no longer suffices; what matters is how they are used to enhance learning (Firmin & Genesi, 2013; Hossain, 2026; Livingstone, 2019). In China, this principle has shaped national policy from the *Education Informatization 2.0 Action Plan* to *Education*

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Modernization 2035, creating an official vision of technology-rich, student-centred learning. Tertiary English as a Foreign Language (EFL) reforms have followed suit, with documents such as *The College English Teaching Guide* (2020) endorsing blended learning and digital resources. Yet the gap between policy and practice is stubborn and well-documented. Chinese EFL teachers' use of technology continues to fall short of expectations, and integration often remains superficial even when mandates are clear (Li, 2014; Liang, 2021).

Jiangsu Province, a region known for its economic strength and educational investment, illustrates this tension vividly. The province has poured resources into digital infrastructure, smart classrooms, and AI-driven language tools. Nonetheless, the depth and pedagogical quality of technology use among EFL instructors remains uneven. A provincial policy issued in 2023 reaffirms the urgency of digital transformation, yet the core puzzle endures: given top-down directives and tangible resources, why does meaningful integration at the teacher level remain so elusive?

To understand this puzzle, one may look both at what teachers know and what their institutions provide. Among internal factors, Technological Pedagogical Content Knowledge (TPACK) stands as the most comprehensive framework for understanding the specialised knowledge teachers need to integrate technology with purpose (Mishra & Koehler, 2006). Without TPACK, resources go underused. Among external factors, two matter particularly for Chinese EFL teachers. Facilitating conditions, which are infrastructure, access, and technical support, determine whether teachers can actually put their knowledge to work (Venkatesh et al., 2003; Teo, 2009). In China's higher education landscape, this is no minor point: the digital divide between well-funded "key" universities and under-resourced "non-key" institutions is stark (Huang et al., 2020). Institutional culture, which is the shared values, leadership behaviours, and collegial norms that signal what is encouraged and rewarded, shapes whether teachers feel empowered to innovate (Huang et al., 2022; Li, 2014). In a hierarchical, exam-oriented system influenced by Confucian traditions, these cultural signals carry particular weight (Cheng, 2014; Liu et al., 2020).

These three factors that are TPACK (internal), facilitating conditions (external-material), and institutional culture (external-social), are among the most consistently cited determinants of technology integration. Yet most studies treat them in isolation. Few ask how they interact, and fewer still distinguish between integration levels: whether a teacher uses technology to enrich existing practice or to transform it entirely (Uslu & Usluel, 2019; Cheng & Parker, 2023). This distinction is not merely academic. The conditions that support enrichment may not be the same ones that enable transformation. And the relationship between facilitating conditions and integration quality may not be as straightforward as policymakers assume. Infrastructure could well be a threshold factor once it reaches a basic level; it may cease to differentiate teachers' practices, perhaps even allowing them to skip over simpler uses in pursuit of more ambitious goals.

This study set out to investigate these dynamics through an explanatory sequential mixed-methods design. Three research questions guided the inquiry:

(1) To what extent do TPACK, facilitating conditions, and institutional culture predict digital integration for enrichment and transformation among Chinese EFL teachers?

(2) How do teachers themselves perceive and navigate these factors in their daily practice?

In answering these questions, the study develops an integrated framework that captures the interplay between internal knowledge and external conditions, challenges, and offers practical directions for policy, institutional development, and teacher education.

LITERATURE REVIEW

Digital Integration

Digital integration is not about the mere presence of technology but about its strategic, pedagogically-grounded use (Reigeluth & Joseph, 2002). The concept has shifted over time: early definitions focused on using technology to improve what already existed; more recent accounts emphasise transformation, where technology enables educational goals that were previously out of reach (Ertmer, 2005; Kimmons, 2015). For students, meaningful integration means moving beyond passive consumption to active knowledge creation, but through research, ideation, and presentation (Yu et al., 2013).

Ertmer and colleagues (2012) proposed a useful tripartite framework. Content delivery refers to using technology to present instructional materials. Learning enrichment involves using it to introduce more interactive and engaging methods. Teaching and learning transformation occurs when technology enables student-centred, innovative approaches that fundamentally reshape the classroom. The framework draws on Constructivist theory and Piaget's cognitive processes: assimilation maps to content delivery, accommodation to enrichment, and equilibrium to transformation (Doolittle & Hicks, 2003; Kumar & Gupta, 2009). Empirical work has validated this typology (Lai & Jin, 2021; Lai et al., 2022), and it is especially pertinent in Chinese EFL contexts, where most integration still sits at the basic level, reinforcing teacher-centred instruction rather than challenging it (Li, 2014; Liang, 2021). For this reason, the present study focuses on enrichment and transformation, the two more advanced levels.

TPACK

Shulman's (1987) pedagogical content knowledge (PCK) laid the groundwork for understanding what teachers need to know to teach effectively. Mishra and Koehler (2006) extended this insight into the technological domain, proposing the TPACK framework. The core idea is that effective technology integration requires more than technological skill, pedagogical knowledge, or content expertise in isolation. What matters is how these three domains intersect and interact, producing integrated forms such as Technological Pedagogical Knowledge (TPK) and Technological Content Knowledge (TCK), with TPACK representing their synthesis (Koehler et al., 2013).

TPACK has been widely validated as a predictor of digital adoption among EFL teachers (Elas et al., 2019; Zhang & Chen, 2022). But the literature has limitations. Much of it relies on self-report, which invites social desirability bias. Many studies focus narrowly on internal factors, leaving external barriers, such as institutional

support and infrastructure, out of the picture (Zhang & Chen, 2022). Some have omitted core TPACK components in their final models (Hsu, 2017), while others have used self-efficacy measures that may not reflect actual classroom practice (Albuloushi, 2019; Bui et al., 2022). There are also conceptual debates. Seufert and colleagues (2021) point to definitional ambiguities, particularly around overlap between TK, TPK, and TCK. Petko (2020) questions whether TPACK is best understood as integrative, where TK, PK, and CK combine directly, or transformative, where intermediary forms like TPK and TCK are necessary precursors. These debates complicate empirical application.

Moreover, real-world TPACK enactment is always mediated by first- and second-order barriers. Given these complications, the present study treats TPACK as a holistic construct, positioning it alongside facilitating conditions and institutional culture in a broader explanatory framework (Uslu & Usluel, 2019; Cheng & Parker, 2023).

Facilitating Conditions

Facilitating conditions refer to the infrastructural and resource support that makes technology adoption feasible (Venkatesh et al., 2003; Teo, 2009). They encompass two dimensions: availability, whether modern instructional devices are present, and accessibility, whether those resources are up-to-date, conveniently located, and backed by timely technical assistance (Alghasab et al., 2020; Cheng & Parker, 2023). Without such support, even well-planned lessons can be derailed by network outages or hardware failures (Mei et al., 2017).

Studies have consistently affirmed the importance of facilitating conditions. Teo (2011), in a survey of 592 teachers, found they directly influenced adoption intentions. Ma et al. (2019) and Mei et al. (2017) reported similar patterns among Chinese and pre-service EFL teachers. But there is a blind spot: most studies treat resource distribution as uniform, ignoring the stark inequalities between well-funded and under-resourced schools (Huang et al., 2020). In China, this means overlooking the divide between "key" universities with advanced facilities and dedicated IT staff and "non-key" institutions, where outdated equipment and inconsistent support are the norm (Huang et al., 2022).

Institutional Culture

Institutional culture encompasses collective support, expectations, and shared values that encourage technology use for instructional purposes (Huang et al., 2022; Li, 2014). A supportive school environment enhances teachers' willingness to adopt technology (Cheng & Parker, 2023; Xie et al., 2021). Shared vision helps align goals during technological change and reduces resistance (Huang & Teo, 2020; Staples et al., 2005). Leadership and colleague support are critical dimensions: proactive leadership motivates teachers, while passive leadership results in minimal engagement (Lawrence et al., 2020; Cheung, 2023); collegial recognition fosters collaborative adoption (Durff & Carter, 2019; Li, 2014).

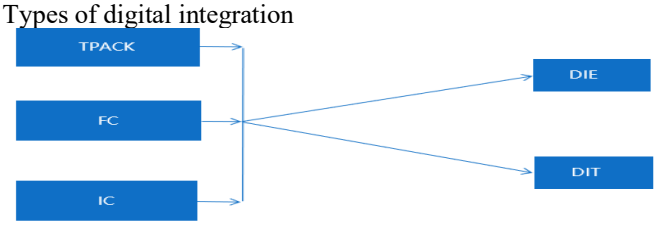
In the Chinese context, institutional culture is shaped by socio-cultural factors such as Confucian values emphasising hierarchy, conformity, and examination-oriented instruction (Cheng, 2014). These values may inhibit student-centred, technology-

enhanced pedagogy, as teachers fear diverging from traditional methods or facing criticism (Liu et al., 2020). Implementation of national initiatives like *Education Informatization 2.0* remains uneven: key universities benefit from strong leadership and resources, while non-key and rural schools lack comparable support (Huang et al., 2020; Li, 2014). Some research challenges the predominant emphasis on institutional culture; Raygan and Moradkhani (2020), for instance, found no significant link between school climate and technology adoption among Iranian EFL teachers, suggesting that individual agency and broader socio-political factors may play more decisive roles. This underscores the need for a nuanced understanding of how institutional culture functions within specific contexts.

Conceptual Framework

This study brings together TPACK, facilitating conditions, and institutional culture, three of the most frequently cited determinants of technology integration within a single framework. Drawing on Ertmer's (2012) framework, and mindful that Chinese EFL teachers mostly operate at basic levels (Lai et al., 2022; Li, 2014), this framework focuses on enrichment and transformation as the two advanced integration types. The guiding proposition is that all three factors positively predict both digital integration for enrichment (DIE) and digital integration for transformation (DIT) (see Figure 1). Accordingly, this study examined the two integration levels and investigated how the three factors interacted in shaping teachers' practices.

Figure 1
Types of digital integration



Note: TPACK = technological pedagogical content knowledge; FC = Facilitating Condition; IC = Institutional Culture; DIE = Digital integration for enrichment; DIT = Digital integration for transformation.

According to the previous discussed literature, we propose the following hypothesis.

Hypothesis One (H1): TPACK has a positive influence on digital integration for enrichment.

Hypothesis Two (H2): Facilitating conditions have a positive influence on digital integration for enrichment.

Hypothesis Three (H3): Institutional culture has a positive influence on digital integration for enrichment.

Hypothesis Four (H4): TPACK has a positive influence on digital integration for transformation.

Hypothesis Five (H5): Facilitating conditions have a positive influence on digital integration for transformation.

Hypothesis Six (H6): Institutional culture has a positive influence on digital integration for transformation

METHOD

This study used an explanatory sequential mixed-methods design (Creswell & Plano Clark, 2018). The quantitative phase came first, providing a broad overview of the relationships among the key variables. The qualitative phase followed, using interviews to interpret and deepen the quantitative findings.

Context and Sampling

The study took place in Jiangsu Province, one of China's most economically developed and educationally advanced regions. Jiangsu offers a particularly instructive context because it has made substantial investments in educational technology yet still faces uneven integration outcomes.

Quantitative sampling

A random sampling strategy ensured representation across key and non-key university types. Questionnaires were distributed through the WENJUANXING platform via social media groups, discussion forums, and professional development networks. Power analysis for PLS-SEM indicated that 200 responses would suffice to detect medium effect sizes with 80% power at $\alpha = 0.05$ (Hair et al., 2022). An oversampling strategy was employed to mitigate the effects of potential attrition. Of 280 responses received, 271 were valid (96.8% response rate). The effective sample of 271 exceeded the minimum requirement. The sample was predominantly over 45 years old (53.87%); 75.65% came from non-key public universities; 65.68% held Master's degrees; 82.66% had more than 15 years of teaching experience; 69.74% self-identified as intermediate technology users; and 80.81% had received some form of technology training.

Qualitative sampling

Purposeful random sampling selected eight interview participants from 22 volunteers who had indicated willingness in the questionnaire. Selection was based on technology proficiency and age to ensure maximum variation (Patton, 2015). Since the qualitative phase was designed to illuminate, not generalise quantitative findings, depth of analysis mattered more than breadth (Campbell et al., 2020). Eight interviews allowed us to explore each participant's experience in detail while keeping the analysis manageable and rigorous. The final sample consisted of five women and three men; four were over 45, three were between 30 and 45, and one was under 30; all held Master's degrees; six taught at non-key universities; and their self-assessed proficiency levels were two high, three medium, and three low (see Table 1).

Ethical Consideration

The study received approval from the institutional ethical committee before data collection began. All participants received information about the study's purpose, the

voluntary nature of their participation, and their right to withdraw at any time without penalty. Written informed consent was obtained from interview participants. Identifying information was removed from all data files; pseudonyms were assigned in transcripts and reports. Data were stored on password-protected devices accessible only to the research team.

Table 1
Information of interviewees

Participant	Gender	Age	Years of Teaching	Academic Background	Type of Institute Working In	Self-Evaluation of Technology Proficiency
A	Female	<30	6	Master's degree	public non-key university	high
B	Female	30-45	20	Master's degree	public non-key university	low
C	Male	>45	23	Master's degree	public non-key university	high
D	Female	>45	29	Master's degree	public non-key university	medium
E	Female	30-45	10	PhD candidate	public non-key university	low
F	Male	>45	13	Master's degree	key university	medium
G	Male	30-45	9	PhD candidate	key university	medium
H	Female	>45	22	PhD candidate	public non-key university	low

Quantitative Phase: Data Collection and Analysis

Instrumentation

The questionnaire had three sections: demographics, digital integration types (adapted from Ertmer et al., 2012; Lai et al., 2022), and scales for TPACK, facilitating conditions, and institutional culture (adapted from Baş et al., 2016; Ma et al., 2019). To guarantee the content validity of questionnaires, all items were reviewed by experts prior to distribution. These experts specialize in TESL, educational technology, research methods, and education. A pilot test with more than 30 teachers yielded Cronbach's $\alpha > 0.80$ for all scales.

Quantitative Analysis

Descriptive statistics were generated using SPSS 26.0. The conceptual model was tested using Partial Least Squares Structural Equation Modeling (PLS-SEM) in SmartPLS 4.0. This approach was chosen for its suitability in exploratory research and its robustness with smaller samples (Hair et al., 2017). The measurement model was assessed for internal consistency (Cronbach's α, composite reliability), convergent validity (outer loadings, AVE), and discriminant validity (Fornell-Larcker, HTMT). The structural model was evaluated using path coefficients (β), coefficients of determination (R^2), predictive relevance (Q^2), and effect sizes (f^2). Multicollinearity was checked via the Variance Inflation Factor (VIF).

Connecting Phase

Between the quantitative and qualitative phases, the survey results are reviewed to pinpoint findings that need explanation. The most puzzling was the negative relationship between facilitating conditions and enrichment-oriented integration. This unexpected result, along with the stronger predictive power of TPACK for enrichment than for transformation, shaped the interview protocol. The connecting step ensured that

the qualitative phase was designed to illuminate the quantitative findings, not merely repeat them (Creswell & Plano Clark, 2018).

Qualitative Phase: Data Collection and Analysis

Data collection

Semi-structured interviews explored teachers' perceptions of barriers and enablers to digital integration. Interview protocols were developed from survey findings and validated by experts. All interviews were conducted in Mandarin, audio-recorded, and transcribed verbatim.

Qualitative Analysis

Thematic analysis using NVIVO followed a two-cycle coding process: first-cycle coding (open, in vivo, structural) and second-cycle coding (axial, selective) (Saldaña, 2016). In the first cycle, open coding, reading each transcript line by line, and labelling meaningful segments were conducted. In vivo coding preserved participants' own words where they captured significant meanings. Structural coding organised segments according to the interview themes. This cycle generated initial codes, which we grouped into broader categories through constant comparison. For example, "build a communication group," "easy to share materials with students." These codes were related to the category "convenience."

In the second cycle, axial coding is used to identify relationships among categories. For instance, how technical challenges related to limited integration and how both are connected to institutional support. Selective coding consolidated these into six themes: (a) value of technology, (b) types of integration, (c) demographics, (d) TPACK, (e) facilitating conditions, and (f) institutional culture. Table 2 shows the codes and themes. Through comparison and synthesis, five valuable themes related to the research questions were produced. Trustworthiness was established through member checking, peer debriefing, thick description, and triangulation of quantitative and qualitative data.

Table 2
Record of codes and themes

Category/Code	Record of occurrence	Theme
Convenience	12	The value of technology
Up-to-date rich resources	8	
Support English teaching and learning	40	
Enrichment	3	Types of digital integration
Transformation	14	
Age	7	Demographics of participants
Gender	5	
Teaching experience	7	
Personal interest	4	
Technology proficiency	14	
Difficulty in mastering technology	12	TPACK
Lack digital resources	4	
Technology itself	6	
Bad facilities	9	Facilitating conditions
Good facilities	3	
Service guarantee	1	
School	35	Institutional culture
Colleagues	6	
Students	12	
Self	7	

FINDINGS

Quantitative Findings

Measurement Model Assessment

The measurement model is first assessed. All factor loadings exceeded 0.7, and all Average Variance Extracted (AVE) values exceeded 0.5, confirming convergent validity (Hair et al., 2022). Cronbach's α and composite reliability surpassed 0.7 for all constructs (Table 3). The Fornell-Larcker criterion and HTMT were assessed to confirm discriminant validity. Based on the data shown in Table 4, the Square Root of each Construct's AVE presented more significance compared to the correlations with other constructs. As a consequence, Fornell-Larcker was reached. The HTMT values (displayed in Table 3) of all constructs were below the cut-off HTMT requirement of 0.9 (Hair et al., 2022). In addition, VIF values were below 5, indicating no multicollinearity (see Table 5).

Table 3
Reliability and validity

Construct	Item	Factor Loadings	VIF	Cronbach's α	AVE	CR (rho_a)	CR (rho_c)
TPACK	TPACK1	0.926	3.159	0925	0.701	0.925	0.921
	TPACK2	0.871	3.308				
	TPACK4	0.837	4.255				
	TPACK5	0.787	3.954				
	TPACK6	0.754	2.807				
FC	F1	0.939	2.748	0.898	0.748	0.905	0.899
	F2	0.866	4.42				
	F3	0.783	2.741				
IC	I1	0.837	1.826	0.848	0.646	0.849	0.845
	I2	0.739	2.741				
	I3	0.833	2.188				
DIE	E1	0.852	3.047	0.936	0.785	0.937	0.936
	E2	0.893	4.449				
	E3	0.869	4.535				
	E4	0.928	3.803				
DIT	T1	0.792	2.853	0.928	0.718	0.933	0.927
	T2	0.884	2.814				
	T3	0.88	4.375				
	T4	0.715	2.906				
	T5	0.947	3.377				

Table 4
Fornell-larcker criterion

	DIE	DIT	FC	SC	TPACK
DIE	0.886				
DIT	0.391	0.848			
FC	0.16	0.457	0.865		
IC	0.287	0.298	0.361	0.804	
TPACK	0.5	0.338	0.325	0.329	0.837

Note: Diagonals represent the Square Root of each construct; off-diagonal represents the Constraint's Correlation. TPACK = technological pedagogical content knowledge; FC = Facilitating Condition; IC = Institutional Culture; DIE = Digital integration for enrichment; DIT = Digital integration for transformation

Table 5
HTMT

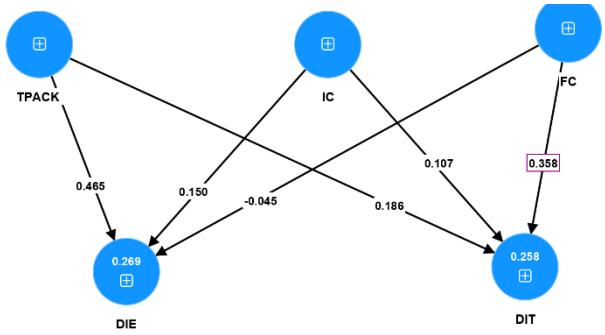
	DIE	DIT	FC	IC	TPACK
DIE					
DIT	0.392				
FC	0.158	0.455			
IC	0.287	0.294	0.365		
TPACK	0.497	0.337	0.333	0.331	

Note: TPACK = technological pedagogical content knowledge; FC = Facilitating Condition; IC = Institutional Culture; DIE = Digital integration for enrichment; DIT = Digital integration for transformation.

Structural Model Assessment

Regarding the R^2 values results provided in Figure 2, the combined effects of SC, FC, and TPACK together contribute to 25.8% of the variance in DIT (0.258) and 26.9% of the variance in DIE (0.269). According to Cohen (1988), R^2 values below 0.01 indicate a little influence, R^2 values around 0.09 as indicating a moderate effect, and R^2 values above 0.25 as indicating a large effect. Thus, the R^2 values in this study show a large effect. It suggests that Digital Integration for Enrichment has a strong effect in this model, while Digital integration for transformation has a moderate effect. Compared with the advance type, Digital Integration for Enrichment has a stronger effect.

Figure 2
R^2 values results



Based on the thresholds established by Gefen and Straub (2005), effect sizes were interpreted as small (0.02–0.15), medium (0.15–0.35), or large (>0.35). The results (Table 6) indicate small effects for H3 (f^2=0.025), H4 (f^2=0.039), and H5 (f^2=0.142), and a medium effect for H1 (f^2=0.249). In contrast, the effects for H2 and H6 were negligible.

Table 6
Hypothesis assessment

Hypothesis	Path	Path coefficient	P values	Result	f-square
H1	TPACK -> DIE	0.465	0.000	Accepted	0.249
H2	FC -> DIE	-0.045	0.000	Not Accepted	0.002
H3	IC -> DIE	0.150	0.000	Accepted	0.025
H4	TPACK -> DIT	0.358	0.000	Accepted	0.039
H5	FC -> DIT	0.186	0.000	Accepted	0.142
H6	IC -> DIT	0.107	0.000	Accepted	0.013

TPACK emerged as the dominant predictor for both integration types, though its effect on enrichment (β = 0.465) was considerably stronger than on transformation (β = 0.358). Institutional culture showed modest but significant positive effects on both. The most intriguing finding concerned facilitating conditions: they predicted transformation positively (β = 0.186) but enrichment negatively (β = -0.045)—a counterintuitive result that warrants closer examination.

The independent constructs demonstrate significant predictive relevance for the dependent constructs, as all Q^2 values are statistically greater than zero. In terms of predictive power, the constructs TPACK, FC, and IC show moderate effectiveness in predicting DIE, with the PLS-SEM model outperforming the LM model in three out of four predictive error metrics. In contrast, the predictive power for DIT is high, with the PLS-SEM model surpassing the LM model across all four error measures.

Qualitative Findings

Thematic analysis of the interview data yielded four interconnected themes. These themes are presented as an integrated system in which patterns of variation across participants illuminate the quantitative findings. A synthesis across themes theorises relationships among the factors examined.

All eight participants acknowledged technology's pedagogical benefits, citing convenience (12 references), access to resources (8), and support for teaching and learning (40). This recognition, however, did not translate into uniform practice. Two patterns are noteworthy. First, descriptions of technology's value tended to be generic rather than specific; few articulated how technology served particular pedagogical goals. Second, a gap between espoused beliefs and enacted practices was evident. Participant E acknowledged the importance of ChatGPT but had not incorporated it: "I have attended lectures on its application, but I do not have time to explore its real use." This gap suggests perceived value, while necessary, is not sufficient for integration—consistent with Ertmer's (2005) distinction between first- and second-order barriers.

Technology use varied systematically with self-assessed proficiency. High-proficiency users (Participants A and C) pursued pedagogical transformation. Participant A used technology to foster student independence; Participant C implemented flipped classrooms for student-centred learning. For these participants, technology was a reorganising principle of teaching. Medium-proficiency users (F and G) expressed aspirational support for transformation but remained confined to classroom-based applications. Participant G captured this tension: "I have tried many kinds of software, but no software is completely tailored to my teaching." Low-proficiency users (B and E) confined themselves to content delivery and enrichment, emphasising efficiency over innovation. Participant H, the sole participant opposing technology integration, questioned student-centred approaches altogether. A temporal pattern also emerged: Participant D moved from basic delivery to transformative uses as institutional expectations rose, suggesting proficiency can evolve with external pressures.

Across proficiency levels, participants framed TPACK challenges in technical terms. Few discussed how technology might serve specific pedagogical goals or adapt to particular content areas. The dominant narrative was knowing how to operate the tool rather than knowing how to teach with it, a pattern that cut across the proficiency gradient. This narrow framing explains why TPACK predicted enrichment more strongly than transformation: enrichment requires less pedagogical rethinking, while transformation demands reconceptualizing roles and the nature of learning itself.

Accounts of facilitating conditions diverged sharply by institution type. Participants from key universities (C, G) described reliable infrastructure and responsive support. Participant G noted: "Our information centre provides guarantees. If we have questions, we can ask directly in the group." In contrast, non-key participants characterised their environment in terms of constraint: unstable networks, outdated equipment, and unresponsive help. Participant B's comment was typical: "Sometimes the network is broken easily." This institutional divide shaped the very possibility of integration. Non-key participants who expressed strong pedagogical beliefs nonetheless reported abandoning planned technology-enhanced lessons due to network failures, suggesting institutional constraints can override individual agency and TPACK.

Three mechanisms through which institutional culture operated were identified. Administrative mandates were powerful motivators, consistent with the Theory of Planned Behavior (Huang et al., 2020) and collectivist norms (Hofstede, 2001). Peer influence worked through modelling and social pressure, with younger teachers often mentoring older colleagues (Chiu, 2022). Student feedback shaped decisions, as participants expressed greater willingness to adopt technologies that students valued. Yet culture's influence was not uniform. Participants from polytechnic universities reported that English teaching was marginalised in institutions privileging science and engineering, where career advancement was tied to research output (Burgess et al., 2017). Individual agency also moderated cultural influence: some teachers innovated despite institutional indifference; others adhered to tradition despite encouragement. Institutional culture thus operated as a contingent force, mediated by disciplinary context, career stage, and personal conviction.

Across these themes, a consistent structure emerges. The narrow conceptualization of TPACK as technical skill explains why proficiency shaped practice along a gradient. This relationship was moderated by facilitating conditions: teachers with stronger TPACK leveraged resources more effectively; those with weaker TPACK remained constrained even when resources existed. Institutional culture operated as both an enabler (through mandates and peer influence) and a constraint (through disciplinary hierarchies). Perceived value, while present across participants, was insufficient to overcome these structural and knowledge-based barriers. This synthesis suggests a mediation structure: TPACK mediates the influence of facilitating conditions on integration, while institutional culture moderates this relationship. These dynamics illuminate the quantitative paradox: in well-resourced environments, teachers may bypass enrichment for transformation; in under-resourced settings, even basic enrichment remains difficult. The qualitative data thus offer a processual account that complements and deepens the statistical patterns.

DISCUSSION

TPACK and the Enrichment-Transformation Gap

The finding that TPACK predicted enrichment more strongly than transformation extends prior studies (Raygan & Moradkhani, 2020; Zhang & Chen, 2022) by quantifying the gap. The difference in effect sizes ($f^2 = 0.249$ vs. 0.039) is not trivial. It suggests that current TPACK among Chinese EFL teachers may be adequate for

enhancing what already exists but insufficient for fundamentally rethinking how teaching happens.

The qualitative data suggest a plausible explanation for this differential pattern. Across all proficiency levels, participants predominantly conceptualised TPACK in technical terms, equating it with the ability to operate devices and software rather than with integrated pedagogical-content knowledge. This finding is consistent with critiques that professional development programmes tend to prioritise tool training over pedagogical reasoning (Tovar Viera & Velasco Sánchez, 2020; Lawrence et al., 2020). If TPACK is understood primarily as technological competence, its stronger association with enrichment-oriented practices is unsurprising, given that such practices typically require less pedagogical reorientation than transformation-oriented ones.

This interpretation has implications for TPACK theory. The framework's value lies in its claim that effective integration requires the integration of technological, pedagogical, and content knowledge, not just technical skill. But if teachers do not conceptualise TPACK this way, and if researchers measure it in ways that reflect technical proficiency rather than integrated knowledge, then the framework's explanatory power for transformative practices may be compromised. Future research might usefully employ observational measures that capture whether self-reported TPACK corresponds to demonstrated pedagogical-content integration in actual classrooms.

The Paradox of Facilitating Conditions

The most striking finding was the divergent relationship of facilitating conditions with the two integration types. Better infrastructure and support were associated with less enrichment-oriented use, a counterintuitive result that warrants careful interpretation. Three explanations, not mutually exclusive, merit consideration.

First, infrastructure may operate as a threshold condition. When basic resources are widely available, their presence ceases to differentiate practices. Teachers may invest effort in enrichment only when infrastructure is perceived as inadequate; once it becomes adequate, they may redirect their efforts toward more ambitious goals. This pattern aligns with the satisficing principle, whereby effort is calibrated to perceived constraints (Simon, 1956).

Second, goal displacement may occur in well-resourced environments. Enrichment may be seen as insufficiently ambitious, even pedestrian, when institutional expectations explicitly encourage innovative and transformative uses. Teachers may strategically bypass enrichment to pursue what is institutionally valued and rewarded.

Third, resource quality may matter more than resource quantity. The qualitative data suggest that facilitating conditions vary not only in amount but also in reliability. Unstable networks, outdated software, and unresponsive support, common in non-key universities, may impede even basic enrichment. In key universities, by contrast, high-quality resources may enable transformation while rendering enrichment redundant. The negative relationship between facilitating conditions and digital integration for enrichment may therefore reflect qualitative differences in resources rather than a direct negative effect of resource availability.

What unites these explanations is a common insight: facilitating conditions do not function as a linear predictor of integration quality but rather as a threshold condition. Below a certain level, integration is severely constrained; above it, other factors such as TPACK, institutional culture, and individual agency become more decisive. This distinction has implications for how infrastructure is conceptualised in technology adoption models.

Institutional Culture: Mechanisms and Limits

Institutional culture showed modest but consistent positive effects on both integration types, a pattern that aligns with prior research (Bice & Tang, 2022). The small effect sizes, however, suggest that culture explains only a limited portion of the variance in integration practices.

The qualitative data identified three pathways through which institutional culture operated. First, administrative mandates were particularly influential in China's hierarchical system, a finding consistent with the Theory of Planned Behavior (Huang et al., 2020) and collectivist norms (Hofstede, 2001). Second, peer influence worked through modelling and social pressure, fostering informal learning networks (Chiu, 2022). Third, student feedback acted as a moderating force: teachers expressed greater willingness to adopt technologies when students responded positively.

Yet the influence of institutional culture was not uniform across contexts. Participants from polytechnic universities reported that English teaching was marginalised within institutions that privileged science and engineering. Where career advancement was tied to research output (Burgess et al., 2017), pedagogical innovation in humanities disciplines received less recognition. Individual agency also played a role: some teachers innovated despite institutional indifference, while others adhered to traditional methods despite institutional encouragement, consistent with Alghasab's study (2026). Institutional culture thus operates as a contingent force, mediated by disciplinary context, career stage, and personal conviction. This complexity calls for more differentiated accounts of how culture shapes practice.

An Integrated Framework

Synthesising the quantitative and qualitative findings, this study proposes an integrated framework (Figure 2) that distinguishes enrichment from transformation and posits distinct configurations of determinants for each.

For enrichment, TPACK emerges as the dominant driver. Institutional culture contributes modestly, while facilitating conditions show a counterintuitive negative relationship, likely attributable to suppression effects or goal displacement. This pattern suggests that enrichment-oriented integration depends primarily on teacher knowledge rather than institutional provision. If this interpretation holds, professional development that enhances pedagogical-content knowledge may prove more effective than infrastructure investment in promoting basic integration.

For transformation, all three factors contribute, with TPACK exerting the strongest influence, followed by facilitating conditions and then institutional culture. This

configuration implies that transformation requires a convergence of knowledge, resources, and a supportive culture, which may explain why transformative practices remain relatively rare. Interventions targeting transformation must address all three domains; single-factor approaches are unlikely to succeed.

The qualitative data further suggest interactive dynamics. TPACK appears to mediate the relationship between facilitating conditions and integration: teachers with stronger TPACK leverage available resources more effectively, whereas those with weaker TPACK remain constrained even when resources exist. Institutional culture may moderate this relationship: supportive cultures amplify the benefits of TPACK and resources, while unsupportive cultures attenuate them. These interactions, though suggested by the qualitative data, await quantitative testing.

Theoretical Contributions

This study advances theory in four ways. First, it shows empirically that enrichment and transformation are shaped by different configurations of factors, challenging the treatment of technology integration as a unitary construct. This has implications for measurement and modelling. Second, it complicates the role of facilitating conditions, suggesting that infrastructure operates as a threshold rather than a linear predictor. Third, it extends TPACK theory by showing that knowledge is more strongly associated with enrichment than transformation, implying that transformation requires additional factors beyond knowledge. Fourth, it offers an integrated framework that captures the interplay between internal and external determinants, responding to calls for more holistic accounts of technology adoption (Uslu & Usluel, 2019; Cheng & Parker, 2023).

CONCLUSION

This mixed-methods study examined how TPACK, facilitating conditions, and institutional culture predict enrichment-oriented versus transformation-oriented digital integration among Chinese EFL teachers. TPACK proved the strongest predictor for both integration types, with a substantially larger effect on enrichment. Institutional culture showed modest positive effects on both. Facilitating conditions presented a paradox: they predicted transformation positively but enrichment negatively, suggesting that infrastructure may function as a threshold that enables teachers to bypass simpler uses in pursuit of more ambitious innovation. The study contributes an integrated model that distinguishes enrichment from transformation and shows that their determinants differ in kind, not just degree. Practically, findings suggest professional development should address pedagogical reasoning alongside technical skills, institutional support should be responsive and reliable, and policies should explicitly distinguish between integration levels.

IMPLICATION

The findings carry practical implications for three levels of action: policy, institutions, and teachers. For policymakers, the priority is sustained and equitable infrastructure investment, particularly for non-key universities, where unreliable networks and outdated equipment remain persistent barriers. Policy should also explicitly distinguish between enrichment and transformation, as treating integration as a single

undifferentiated goal risks encouraging superficial adoption while neglecting deeper pedagogical change.

For institutions, professional development must move beyond tool training to address pedagogical reasoning. The central question is not simply how a tool operates but what it makes possible pedagogically and for whom. Institutions should also create structured collaborative platforms that leverage peer influence, which emerged as a powerful mechanism in the qualitative data. Responsive, just-in-time technical support is essential, as is rebalancing incentive structures to reward teaching innovation alongside research, particularly in humanities disciplines where pedagogical work often carries less institutional weight.

For teachers, cultivating a student-centred, constructivist orientation frames technology as a means of enabling learning rather than delivering content. Ongoing TPACK development should attend not only to technical proficiency but also to the pedagogical and content dimensions of technology use, addressing why, when, and for whom a particular tool matters. Advancing digital integration ultimately requires alignment across three levels. No single level is sufficient on its own, but coordinated action across all three may be.

LIMITATIONS

Several limitations should be considered when interpreting these findings. The data came from a single province, and the sample skewed toward older, experienced teachers (53.87% over 45) and non-key university staff (75.65%), which limits generalizability to younger teachers, key institutions, or other regions. Future studies should test these patterns with larger, more balanced samples across multiple provinces. Self-report data carry risks of social desirability and selective recall (Mertler, 2019); while the qualitative interviews helped mitigate this, classroom observations or teaching artefacts would strengthen future work, and the interview sample (n = 8), though adequate for qualitative inquiry, also limits generalizability. The counterintuitive negative relationship between facilitating conditions and enrichment warrants experimental or quasi-experimental investigation to establish causal direction, and the proposed integrated model requires further testing across contexts. Three factors do not exhaust the full range of influences on technology integration; such as motivation, self-efficacy, time constraints, and institutional incentive mechanisms all deserve attention, and the model offered here is a starting point, not a final account. Future research might pursue five directions: longitudinal studies tracking how these relationships evolve over time; cross-regional comparisons to reveal cultural and policy contingencies; observational research to capture actual classroom practice; intervention studies testing whether professional development designed around pedagogical reasoning changes practice; and deeper qualitative investigation of the paradoxical relationship between facilitating conditions and digital integration, perhaps through stimulated recall interviews that capture teachers' in-the-moment decisions about technology use.

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