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Rethinking Teaching Experience in Digital Reform: The Role of Technology-Related Learning Recency in Technology Integration

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Abstract

Educational systems are investing heavily in digital reform, yet teachers' technology integration remains uneven and theoretically underexplained. Although teaching experience is frequently examined as a predictor of technology adoption, prior research has produced inconsistent findings, partly because experience is often treated as a static demographic variable. This study reconceptualizes teaching experience as a historically situated construct shaped by teachers' technological trajectories and examines classroom technology integration from a temporal perspective. Drawing on a multiple case study of three primary schools in China, it analyzes lesson plans, classroom observations, and interviews through reflexive thematic analysis, using the Unified Theory of Acceptance and Use of Technology (UTAUT) as a sensitizing lens. Findings suggest that teaching experience did not in itself constrain or enable technology integration. Instead, differences in integration were better explained by the recency of teachers' technology-related learning opportunities, while teachers' technological trajectories shaped how they relied on, used, and benefited from such opportunities. Teachers whose careers were marked by technological discontinuity were more dependent on institutional training and more vulnerable to anxiety and avoidance when support was lacking, whereas those with sustained digital exposure demonstrated greater confidence and self-directed learning capacity. The study offers a temporally informed perspective that helps explain contradictory findings on the relationship between teaching experience and technology integration in the literature. It also contributes to research on teachers' technology use by moving beyond static understandings of teaching experience and highlights the value of differentiated, timely professional development in rapidly digitalizing educational contexts.

Plain Language Summary

Many schools are investing in digital technology to improve teaching and learning. However, teachers do not all use technology in the same way or to the same extent. Some teachers use digital tools confidently in their lessons, while others use them less often or feel unsure about how to integrate them into teaching. Previous research has often tried to explain this difference by looking at teachers' years of teaching experience, but the results have been inconsistent. This study explores why teaching experience does not always predict whether teachers use technology in their classrooms. Instead of viewing experience simply as the number of years a teacher has worked, the study looks at teachers' professional histories and the timing of the technology training they received. The research was conducted in three primary schools in China. Data were collected through interviews with teachers, classroom observations, and analysis of lesson plans. The study focused on how teachers learned to use digital tools and how their past training influenced their current teaching practices. The findings show that teaching experience alone does not determine whether teachers use technology effectively. What matters more is whether teachers have received recent and relevant technology training. Teachers who had more recent exposure to digital

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tools or ongoing professional learning felt more confident and were more willing to experiment with technology in their lessons. In contrast, teachers whose training was outdated or who experienced long gaps in technology learning were more likely to feel uncertain or avoid using digital tools. The study suggests that schools should provide continuous and updated technology training rather than relying only on teachers' years of experience. Supporting teachers with regular professional development can help them feel more confident and make better use of digital technology in the classroom.

Keywords
technology integration, teaching experience, technology-related learning recency, UTAUT, primary school EFL teachers, professional development

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1. Introduction

1.1. Digital reform and uneven technology integration

Across education systems worldwide, sustained investment in digital reform has positioned technology integration as a central strategy for improving teaching quality, learner engagement, and instructional equity (Scherer & Teo, 2019; Yu et al., 2022; Zheng & Warschauer, 2017). Governments have expanded infrastructure, introduced learning management systems, and promoted teacher professional development (PD) to support the routine use of information and communication technology (ICT) in classrooms. Yet despite favorable policy environments and improved material conditions, teacher-level technology integration remains uneven. Even within similarly resourced schools, some teachers experiment actively with digital tools while others demonstrate minimal, selective, or reluctant adoption (Erdin & Uzun, 2022; Peng et al., 2023). These persistent disparities suggest that infrastructure provision and policy mandates alone are insufficient to ensure sustained pedagogical change.

China provides a particularly salient context for examining the gap between policy ambition and classroom reality. National initiatives such as the *Education Informatization 2.0 Action Plan* have emphasized the deep integration of digital technologies into everyday teaching practice and framed teachers' digital competence as a core dimension of educational modernization (Ministry of Education, 2018). Substantial investments in interactive whiteboards (IWB), online platforms, and school-based training have transformed the material landscape of compulsory education. In language education, recent curriculum reforms further encourage the integration of digital resources to support multimodal input, interactive learning, and formative assessment (Ministry of Education, 2022). As a result, many primary schools are now technologically equipped, and digital tools are increasingly positioned as routine components of instructional practice.

However, empirical studies continue to document heterogeneous patterns of classroom integration, even under comparable institutional conditions (Zhou et al., 2022). This inconsistency points toward teacher-related factors that are frequently invoked but insufficiently theorized. Among these, teaching experience has received sustained attention.

1.2. The contested role of teaching experience

Teaching experience is commonly assumed to influence teachers' openness to technological innovation, instructional confidence, and adaptive capacity (Baek et al., 2008). Some studies report positive associations between experience and self-efficacy or pedagogical flexibility in integrating technology (Kartchava & Chung, 2015; Saudelli & Ciampa, 2016). Others identify negative relationships, suggesting that more experienced teachers may exhibit greater resistance or lower adoption rates (Ekşi & Aydın, 2013; Inan & Lowther, 2010; Thanaittipath & Boonmoh, 2024). Still others find weak, null, or non-linear relationships between experience and technology integration (Erdin & Uzun, 2022; Zhou et al., 2022).

Rather than reflecting empirical instability, these contradictions may signal a conceptual limitation in how teaching experience is operationalized. In much of the literature, experience is often proxied by years of service and sometimes conflated with age (Scherer et al., 2019; Scherer & Teo, 2019). Such measures treat experience as a static demographic attribute, detached from the technological conditions under which teachers were trained and socialized. This reduction obscures the possibility that teachers with equivalent years of service may have encountered markedly different technological environments throughout their professional trajectories.

Technology acceptance frameworks further illustrate this limitation. UTAUT treats experience as a moderating variable that shapes the effects of effort expectancy and social influence on behavioral intention, as well as the effect of facilitating conditions on use behavior (Venkatesh et al., 2003). However, within UTAUT, experience refers to prior interaction with a specific technological system rather than to teachers' broader professional histories. While useful for predicting relatively

short-term adoption, this system-specific framing provides limited insight into how historically situated technological trajectories shape teachers' responses to ongoing digital reform.

These patterns suggest that teaching experience alone may not adequately explain differences in technology integration. Instead, its influence may depend on teachers' professional histories and the temporal conditions under which technology-related learning occurs.

1.3. A temporal perspective on experience

What remains underexplored is the temporal dimension of teachers' professional histories with technology. In rapidly digitalizing contexts, teachers' careers may span periods of substantial technological transformation. Those who entered the profession during predominantly analog eras may encounter digital technologies as discontinuous additions to established pedagogical routines. In contrast, teachers whose preservice or early-career training incorporated digital tools may experience technology as integral to professional formation. These differing technological trajectories may shape teachers' confidence, affective responses, and reliance on institutional support.

Building on this temporal perspective, this study introduces the concept of technology-related learning recency to capture an important temporal aspect of teaching experience. It refers to how recently teachers have engaged in technology-related learning relevant to their classroom practice, whether through formal PD or self-directed learning. In this sense, technology-related learning recency may help explain why teaching experience relates to classroom technology integration in different ways, depending on the timing of learning opportunities within teachers' broader professional histories with technology.

Examining this temporal aspect is particularly important in primary English as a Foreign Language (EFL) education, where digital tools are often promoted to support multimodal input and communicative pedagogy. At the same time, this setting illustrates a broader theoretical question of how teachers' professional histories with technology and the timing of technology-related learning shape technology integration in contexts of systemic digital reform.

To address this gap, the present study investigates how the recency of technology-related learning helps explain differences in technology integration among primary EFL teachers in China. Adopting a multiple case study design across three primary schools, the study draws on lesson plans, classroom observations, and semi-structured interviews to examine teachers' technological trajectories, recent learning opportunities, and responses to digital tools. UTAUT is employed as a sensitizing framework to interpret teachers' perceptions of facilitating conditions and effort expectancy.

By foregrounding the recency of technology-related learning, this study offers a temporally informed perspective that may help explain contradictory findings on the relationship between teaching experience and technology integration. In doing so, it offers both theoretical clarification and practical implications for designing differentiated and timely PD in rapidly evolving educational contexts.

2. Literature review

2.1. The inconsistent role of teaching experience

Teaching experience has long been positioned as a central explanatory variable in research on teachers' technology integration (Baek et al., 2008). Yet accumulated evidence presents a fragmented and often contradictory pattern. Empirical studies variously report positive, negative, null, and even non-linear relationships between teaching experience and technology integration. For example, Peng et al. (2023) found that less experienced teachers demonstrated stronger self-efficacy and more favorable attitudes toward ICT use than their senior counterparts. In language education specifically, systematic reviews suggest that teaching experience alone fails to consistently predict technology acceptance, as teachers' attitudes do not always align with observable implementation practices (Nopis & Hashim, 2024). Longitudinal investigations further complicate the picture, showing that teachers' integration trajectories evolve over time and are shaped by contextual and personal variables that extend beyond mere length of service (Fütterer et al., 2024). Methodological differences, contextual diversity, and varied operationalizations of technology use are frequently cited as explanations for these inconsistencies (Scherer et al., 2019; Scherer & Teo, 2019).

A substantial strand of research suggests that extensive teaching experience may, under certain conditions, constrain technology integration. Inan and Lowther (2010) reported that K–12 teachers with more years of service demonstrated lower levels of classroom technology integration, attributing this pattern partly to comparatively weaker technological proficiency. Similar findings have been observed in EFL contexts, where experienced teachers sometimes report lower perceived technological needs or reduced confidence in adopting new digital tools, potentially reflecting deeply established pedagogical routines (Ekşi & Aydın, 2013; Thanaittipath & Boonmoh, 2024). From this perspective, experience may solidify instructional habits that render technological change more cognitively or professionally demanding.

Conversely, numerous studies indicate that novice or early-career teachers frequently exhibit higher levels of technology adoption (Al Musawi et al., 2016; Kovalenko & Skvortsova, 2022). This pattern has often been explained through the "digital native" thesis (Prensky, 2001), which posits that younger generations possess innate digital fluency. However, this generational framing has been widely critiqued for oversimplification and limited empirical grounding (Bennett et al., 2008). More recent work suggests that self-perceived digital familiarity may contribute to technology acceptance but does not operate deterministically. For instance, Milutinović (2022) found that Serbian pre-service teachers who identified with digital native characteristics reported higher perceived ease of use and stronger behavioral intentions to integrate technology. Although focused on pre-service populations, such findings point to the relevance of prior digital exposure rather than age per se. Alternative explanations, including access to structured training, pedagogical orientations, and professional adaptability, appear to offer more robust explanatory power than generational labels alone.

At the same time, experience can function as a professional asset. Kartchava and Chung (2015) reported that experienced Canadian EFL teachers perceived technology as engaging and pedagogically enriching, attributing this perception to accumulated instructional expertise. Similarly, Kovalenko and Skvortsova (2022) and Saudelli and Ciampa (2016) suggest that experienced teachers may employ technology in more strategically integrated ways when pedagogical knowledge compensates for initial technological limitations. Rather than inhibiting innovation, experience in these cases enables deeper alignment between digital tools and instructional objectives.

Other studies report null or non-linear relationships, underscoring the contingent nature of experience. Erdin and Uzun (2022) identified no association between years of teaching and perceived technological proficiency among Turkish EFL teachers, suggesting that systemic training initiatives may offset experiential differences. In a Chinese primary EFL context, Zhou et al. (2022) documented an inverted U-shaped pattern, with mid-career teachers demonstrating stronger technological pedagogical knowledge than both novices and highly experienced teachers. Collectively, these findings indicate that the relationship between teaching experience and technology integration is neither linear nor uniform but appears to depend on additional contextual and developmental factors.

These divergent outcomes reveal a deeper conceptual issue in how teaching experience is defined. In many studies, experience is conflated with chronological age or total years of service (Kumala et al., 2022; Li, 2023), obscuring differences in teachers' exposure to technological change across professional lifespans. Such operationalizations treat experience as a static demographic attribute rather than as a historically situated construct embedded within shifting technological environments.

In response, the present study approaches teaching experience as temporally embedded and shaped by teachers' professional trajectories across evolving technological and pedagogical landscapes. This framing shifts attention from static demographic categories to the temporal conditions under which teachers encounter technology-related learning. From this perspective, teaching experience can be understood as a dynamic construct reflecting accumulated encounters with institutional reforms, digital infrastructures, and professional learning opportunities.

A related conceptual clarification concerns the distinction between "technology use" and "technology integration." Technology use often denotes the functional adoption of digital tools, typically measured through frequency indicators. Technology integration, in contrast, emphasizes the pedagogically purposeful embedding of digital tools within instructional design aligned with learning objectives (Tondeur et al., 2021). Prior research demonstrates that frequency does not necessarily equate to meaningful integration; rather, integration depends on teachers' capacity to align technological affordances with pedagogical intent (Hsu, 2010; Pierson, 2001). While the terms are sometimes used interchangeably, this study adopts technology integration as its primary analytic focus, treating technology use as subsumed within broader pedagogical integration processes.

2.2. Age as a related factor

Chronological age is frequently examined alongside and sometimes conflated with teaching experience in technology integration literature, yielding similarly divergent and inconclusive findings (Scherer et al., 2019; Scherer & Teo, 2019). The literature indicates that chronological age does not exert a uniform influence on teachers' technology integration, instead reflecting context-dependent patterns similar to those observed for teaching experience in EFL settings.

Many studies indicate that younger teachers demonstrate greater enthusiasm for and more frequent use of digital tools. For example, Vungthong et al. (2017) found that younger EFL teachers in Thai primary schools utilized tablet applications more frequently than colleagues aged 40 and over. Similarly, Huang et al. (2019) identified a generational divide among Chinese university EFL teachers: younger teachers tended to view technology as essential for student engagement and contemporary pedagogy, whereas older teachers more often emphasized their roles as language experts, relying on accumulated content and pedagogical knowledge rather than extensive technology integration.

At the same time, evidence suggests that chronological age alone does not reliably predict technology use when broader contextual conditions intervene. For instance, Erdin and Uzun (2022) found no association between age and perceived technological proficiency among Turkish EFL teachers across educational levels, indicating that systemic factors such as institutional training initiatives or large-scale technological upskilling can mitigate age-related differences. These findings reinforce the view that age effects are contingent rather than deterministic and should be interpreted in relation to contextual and experiential variables.

2.3. Pre-service training and in-service professional development

Professional learning, encompassing both pre-service training and in-service PD, is widely recognized as a critical factor supporting teachers' technology integration (Tondeur et al., 2017). In EFL contexts, professional learning is generally associated with enhanced technological competence, confidence, and pedagogically meaningful application of digital tools. However, its effectiveness varies depending on training design, duration, continuity, and institutional conditions.

The literature on pre-service teacher education highlights its role in preparing language teachers for technology integration. University-based coursework has been shown to support the development of technological competence and confidence among future teachers. For instance, Aşık et al. (2018) found that senior-year pre-service EFL teachers who participated in a practice-oriented "learning technology by design" course demonstrated improvements in technological pedagogical content knowledge, alongside increased confidence in technology integration. Similarly, Thanaittipath and Boonmoh (2024) observed Thai pre-service teachers using accessible tools such as videos and PowerPoint (PPT) to engage students and support instruction, with a more diverse repertoire of digital tool use than that exhibited by in-service teachers in the same study.

In-service PD can also have positive effects when it is carefully designed and pedagogically grounded. Yang et al. (2024) found that a PD program incorporating AI-based tools for speaking instruction enhanced teachers' self-efficacy related to classroom management, student engagement, and instructional strategies. By engaging teachers in lesson planning and classroom enactment, the program supported transitions from traditional approaches to AI-assisted instruction. Similarly, Nguyen and Sit (2024) reported that structured blended-learning PD programs in Vietnamese K-12 EFL contexts promoted positive perceptions and teacher engagement while helping participants overcome initial barriers such as uneven ICT competence.

Despite these documented benefits, research consistently highlights structural and contextual barriers that constrain the impact of PD on technology integration. Inadequate infrastructural support, limited access to reliable technology, and persistent time constraints have been identified as obstacles that restrict teachers' ability to translate professional learning into classroom practice, even when training is pedagogically sound (Chin et al., 2022; Tondeur et al., 2017; Uzorka et al., 2023). These findings indicate that PD outcomes remain contingent on institutional conditions rather than guaranteed by training participation alone.

2.4. Technology-Related Learning Recency

Building on this broader literature on professional learning and technology integration, this study introduces the concept of technology-related learning recency. It refers to how close in time teachers' relevant technology-related learning is to the point at which they are expected to use digital tools in classroom practice. The concept captures a temporal issue that is related to, but not fully addressed by, existing literature on professional learning and technology integration.

First, technology-related learning recency differs from sustained and continuity-oriented approaches to PD. Research on sustained PD has emphasized duration, repeated engagement, feedback, and opportunities for implementation over time rather than one-off workshops (Cirkony et al., 2024; Desimone, 2023; Sancar et al., 2021). Continuity-oriented perspectives similarly foreground coherence, alignment, and the iterative embedding of learning across activities and contexts (Ehrenfeld, 2022; Lindvall & Ryve, 2019; Sims & Fletcher-Wood, 2021). Related process-oriented accounts of PD further emphasize how professional learning moves from insight to use and eventually becomes embedded in routine practice through continued support over time (Sims et al., 2023). These perspectives are highly relevant, but their primary concern is not the temporal proximity between relevant learning and classroom enactment. Technology-related learning recency makes this narrower temporal question more explicit.

Second, the construct is distinct from technology socialization and from temporal accounts of TPACK. Technology socialization frames teachers' uptake of digital tools as a socially situated process shaped by workplace participation, identity, and relations with local tools and conditions (Kalman & Guerrero, 2013; Phillips, 2017; Rice, 2021). Temporal work on TPACK, by contrast, emphasizes that teachers' technology-related pedagogical knowledge develops, stabilizes, and is recalibrated over time through practice and professional learning (Chen et al., 2022; Pareto & Willermark, 2018; Schmid

et al., 2024). These lines of work show how teachers' learning is socially and developmentally patterned, but they do not isolate how close relevant learning is to classroom enactment.

Existing research nevertheless suggests that this temporal proximity may matter. Studies of formal PD associate recent or repeated technology-related learning with greater confidence and readiness for digital demands, although such learning is more commonly operationalized through participation, frequency, or dosage than through direct measures of proximity to classroom enactment (Annemann et al., 2025; Pongsakdi et al., 2021; Rodríguez-Muñiz et al., 2021). Research in language education also shows that teachers often turn to self-directed or informal learning when formal provision lags behind immediate instructional needs or newly introduced tools (Gautam, 2020; Ito, 2024; Çapan, 2023). Taken together, these studies point to the possible importance of when relevant learning occurs in relation to classroom enactment, even if that issue has not been clearly named as a distinct analytic concern.

In this study, technology-related learning recency is conceptualized in terms of two analytically separable dimensions: the recency of formal technology-related PD and the recency of self-directed technology-related learning. Here, self-directed technology-related learning refers to relevant self-initiated learning connected to classroom technology use, rather than incidental digital exposure in general. This separation is deliberate. Formal and self-directed learning are qualitatively different pathways and should not be simply collapsed into a single undifferentiated value. A teacher may therefore have high recency on the self-directed dimension while having low recency on the formal PD dimension; the construct is not intended to yield a single overall recency score. At the same time, considering both dimensions under a broader temporal lens makes it possible to examine whether recent learning is available at the point of classroom enactment, whether institutionally provided or self-initiated. These pathways may interact in complementary or compensatory ways (Abedi et al., 2023; Huang & Lai, 2020).

2.5. The UTAUT framework

Research on technology acceptance and integration has produced a wide range of theoretical models, reflecting variations in technological affordances, user populations, and contextual settings (Venkatesh et al., 2003). Many of these frameworks originate from distinct disciplinary traditions, including psychology and information systems, and consequently foreground different explanatory constructs. As a result, reliance on any single model may yield a partial account of technology adoption by privileging certain dimensions while omitting others (e.g., San Martín & Herrero, 2012). In response to this fragmentation, Venkatesh et al. (2003) developed UTAUT, which synthesizes key components from eight influential models into a single, integrative framework designed to explain technology acceptance and integration more comprehensively.

UTAUT proposes four core constructs that shape an individual's intention to integrate a technological system: performance expectancy, effort expectancy, social influence, and facilitating conditions. Performance expectancy refers to the degree to which users believe that technology will enhance task performance, while effort expectancy captures perceptions of ease of use. Social influence denotes perceived expectations from significant others, such as colleagues or supervisors, and facilitating conditions refer to beliefs about the availability of organizational and technical support that enable system use.

Within the UTAUT framework, behavioral intention is primarily influenced by performance expectancy, effort expectancy, and social influence, whereas actual system use is shaped by behavioral intention in conjunction with facilitating conditions. These relationships are moderated by individual and contextual variables, including age, gender, experience, and voluntariness of use, which condition how strongly the core constructs influence intention and behavior (Venkatesh et al., 2003), as depicted in Figure 1.

UTAUT has made a substantial contribution to the technology acceptance literature and has demonstrated strong explanatory power relative to its antecedent models (Venkatesh et al., 2003). The inclusion of moderating variables further enhances the framework's ability to capture how demographic and experiential factors shape technology integration processes, offering a more differentiated account of user behavior.

In educational research, UTAUT has been widely applied and validated. Prior studies have employed the model to examine technology integration among teachers (e.g., Abd Rahman et al., 2021; Nwibe & Ogbuanya, 2025) and students (e.g., Chen et al., 2025; Du & Lv, 2024), consistently highlighting the combined influence of individual perceptions and contextual enabling conditions in shaping integration decisions in educational settings.

Although UTAUT was originally developed as a quantitative model for predicting technology usage intentions (Venkatesh et al., 2003), its application has expanded to include qualitative and mixed-methods research (e.g., Killian et al., 2021; Zaim et al., 2024). In this body of work, UTAUT functions as a sensitizing framework for interpreting contextual and experiential factors shaping technology integration. In line with this approach, the present study uses UTAUT as a sensitizing lens to guide analysis of teachers' perceptions of effort expectancy and facilitating conditions within the focal educational context.

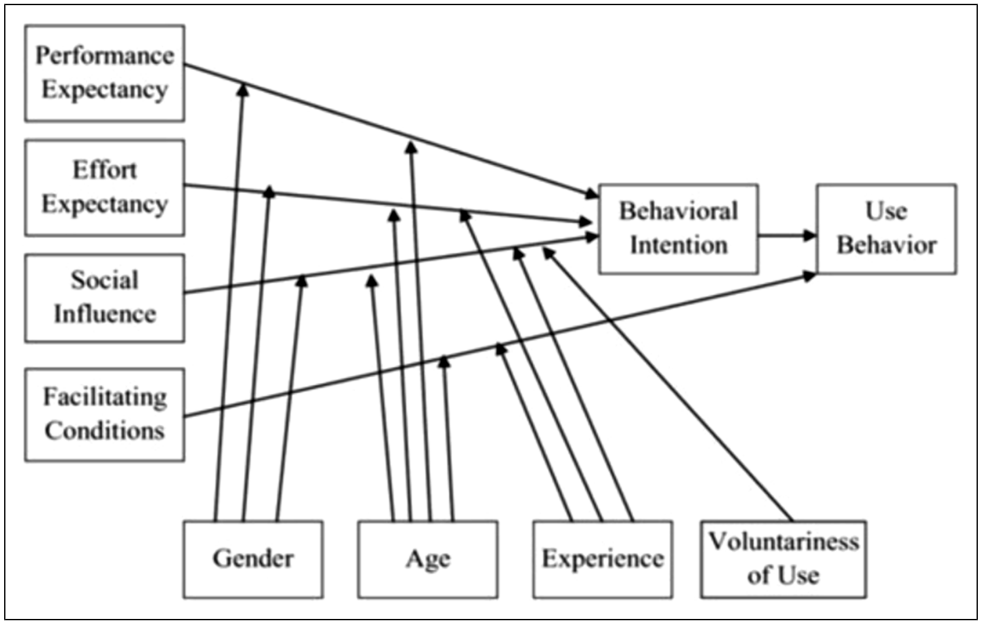

Figure 1. The UTAUT model (Adapted from Venkatesh et al., 2003)

2.6. Research questions

The literature indicates that teaching experience exerts a complex and context-dependent influence on technology integration. At the same time, PD research increasingly emphasizes the importance of design quality, continuity, and recency. Although frameworks such as UTAUT incorporate experience as a moderating variable, most studies treat experience, age, and training as discrete predictors rather than interacting dimensions. Consequently, limited attention has been devoted to how teaching experience and the temporal recency of technological preparation jointly shape integration practices, particularly in primary EFL contexts. To address these gaps, this study is guided by the following research questions:

RQ1. How do primary EFL teachers with different levels of teaching experience integrate digital technologies in Chinese primary classrooms?
RQ2. How does the recency of technology-related learning, as a temporal dimension of teaching experience, help explain differences in teachers' technology integration practices?
RQ3. How is technology-related learning recency associated with teachers' psychological and behavioral responses to digital technologies across different teaching experience backgrounds?

3. Method

3.1. Research design

This study adopts an interpretivist multiple-case study design (Duff, 2008) to examine how the recency of technology-related learning helps explain teachers' technology integration practices within institutional contexts. A multiple-case approach was selected to enable in-depth exploration of practices embedded within specific school environments while facilitating cross-case comparison to identify recurring patterns and develop a contextually grounded explanatory account. Rather than seeking statistical generalization, the study aims for analytic generalization by generating theoretically informed insights that may be transferable to comparable educational settings.

This methodological orientation reflects the strengths of qualitative inquiry for developing process-oriented explanations. Maxwell (2004) distinguishes between variance-oriented and process-oriented explanation, arguing that while quantitative designs estimate net relationships between variables, qualitative research is better suited to examining how patterns unfold in context. In this study, the focus is on how teachers' professional histories, technology-related learning opportunities, institutional conditions, and psychological responses help explain differences in technology integration, rather than on

testing statistical associations. Qualitative case study methodology is therefore an appropriate choice for examining these context-sensitive processes across multiple school settings.

The research was conducted in three primary schools in Hangzhou, a metropolitan region in eastern China characterized by strong policy emphasis on educational digitalization. Conducting the study within a shared national and provincial policy framework allowed institutional variation to be examined without introducing major policy inconsistencies.

The three schools represented distinct institutional profiles: an urban private school, an urban public school, and a rural public school. This configuration was designed to capture variation in governance structures, technological infrastructure, and professional development systems while maintaining comparability in curriculum standards and reform mandates. Such structured variation enabled systematic examination of how teacher-level factors operated within differing organizational environments.

Across the three cases, data were collected from teachers and school leaders to integrate classroom-level and institutional perspectives. The multiple-case framework therefore strengthens explanatory depth by situating individual technology integration practices within layered organizational and policy contexts.

3.2. Participants

Participants included 21 stakeholders across the three case schools: 15 primary EFL teachers, three EFL department heads, and three school principals. The 15 teachers represented a broad range of professional experience, from fewer than five years to more than twenty years of teaching. This distribution enabled analysis of how experience levels relate to technology integration practices. Teachers also differed in the recency of their technology-related learning, including both formal PD and self-directed learning.

Department heads and principals were included to provide institutional perspectives on technology-related policies, resource allocation, and professional learning structures. Their contributions contextualized teachers' classroom decisions within broader organizational expectations.

Participants were recruited in collaboration with school administrators, and all participation was voluntary. To ensure confidentiality, pseudonyms were assigned to schools and individuals, and identifying information was removed during transcription and analysis.

Table 1 presents demographic characteristics of the EFL teachers and EFL heads, including gender, academic qualifications, age range, teaching experience, and grade levels taught.

3.3. Data collection procedure

Data collection followed a structured sequence within each case, consisting of lesson plan reviews, non-participant classroom observations, and semi-structured interviews. This staged approach enabled insights from earlier phases to inform

Table 1. Profile information of case study participants

School	Teacher/EFL Head	Gender	Degree	Age Range	Teaching Experience	Grade Level
Apple	Yun	Female	BA	20-25	< 1 year	1, 2, 3
	Xue	Female	BA	25-30	1-5 years	5, 6
	Fei	Female	BA	30-35	5-10 years	4, 5
	Jing	Female	BA	25-30	5-10 years	4, 5
	Hong	Female	BA	45-50	20-25 years	3, 6
	Xing (EFL head)	Female	BA	25-30	5-10 years	4
Blueberry	Ann	Female	BA	20-25	< 1 year	3
	Bai	Female	BA	25-30	5-10 years	4, 6
	Lin	Female	MA	25-30	1-5 years	2, 5
	Dai	Female	BA	30-35	5-10 years	5
	Chen	Female	BA	40-45	20-25 years	4
	Feng (EFL head)	Female	MA	50-55	25-30 years	3
Cherry	Gong	Female	BA	25-30	5-10 years	4
	Han	Female	BA	25-30	1-5 years	2
	Jin	Female	BA	25-30	1-5 years	3
	Ke	Male	BA	25-30	1-5 years	5
	Ning	Male	BA	25-30	1-5 years	4
	Mei (EFL head)	Female	BA	30-35	5-10 years	3

subsequent data collection. Lesson plan reviews provided an overview of teachers' planned technology integration, while classroom observations captured enacted practices and interactional dynamics. These preliminary sources informed the refinement of interview questions, allowing deeper exploration of teachers' pedagogical reasoning and professional experiences.

Each participating teacher was observed during two class sessions. Observations focused on the types of digital tools employed, instructional strategies, patterns of teacher–student interaction, and student engagement. Detailed field notes were recorded during and immediately after each session. Observations were used primarily to contextualize and triangulate interview accounts rather than to construct exhaustive behavioral analyses.

The interview protocol was developed in alignment with the research questions, the UTAUT framework, and prior scholarship (e.g., Sultan Alshraideh, 2021). The protocol was piloted with three teachers and refined for clarity and sequencing. During the main data collection phase, EFL teachers participated in two interview rounds to capture both background experiences and reflective insights following classroom observations. Department heads and principals each participated in a single semi-structured interview focusing on institutional policies, resource allocation, and professional development structures. All interviews were conducted in Chinese, lasted between 40 and 60 minutes, and were audio-recorded and transcribed verbatim.

3.4. Data analysis

Data analysis followed an iterative process consistent with the multiple-case design. Lesson plans were reviewed to identify intended forms of technology integration, and observation notes were consulted to contextualize practice and assess alignment between reported and enacted classroom practices. Selected observational excerpts were incorporated as illustrative evidence to enrich themes derived primarily from interview data.

Interview transcripts were analyzed using reflexive thematic analysis following Braun and Clarke's (2022b) six-phase framework. Analysis was conducted by the first author. Coding was predominantly inductive, allowing patterns to be identified from participants' narratives. The UTAUT framework was introduced during later interpretive stages as a sensitizing lens to support theme interpretation.

All interviews were transcribed verbatim in Chinese to preserve linguistic nuance. Translation into English was deferred until the reporting stage, with only finalized themes and selected excerpts translated for publication.

Phase 1 involved repeated reading of transcripts to achieve immersion in the dataset. In Phase 2, initial codes were generated to capture both descriptive content and interpretive dimensions. For instance, references to beginning teaching careers with pre-digital tools were coded as "technological discontinuity," while accounts of early exposure to digital tools during schooling or pre-service education were coded as "technological continuity." In Phase 3, related codes were clustered and visually mapped using XMind to identify candidate themes and relationships. Phases 4 and 5 involved reviewing and refining themes for coherence, internal consistency, and relevance to the research questions, with observational notes consulted where appropriate. In Phase 6, themes were clearly defined and named to construct an integrated analytical narrative. Cross-case comparisons were conducted to identify convergent and divergent patterns across schools.

To assess whether the thematic structure adequately represented the dataset, thematic saturation was not treated as a procedural endpoint for analysis. Instead, in line with reflexive thematic analysis, analytic adequacy was judged through sustained engagement with the full dataset, repeated movement between coded extracts and the broader dataset, and iterative review of candidate themes for coherence, distinctiveness, interpretive depth, and relevance to the research questions (Braun & Clarke, 2021; 2022a). The final thematic structure was considered analytically adequate when the three themes provided a sufficiently rich and integrated account of convergent and divergent patterns across the three school contexts.

Throughout analysis, reflexive memos were used to document interpretive decisions, analytic uncertainties, and the researcher's evolving assumptions and positioning in relation to the data. Peer debriefing with academic colleagues was used as a form of critical dialogue to question assumptions, consider alternative readings, and strengthen the clarity and coherence of theme development, rather than to seek coding consensus. Member checking was not used in this study. This decision was consistent with the reflexive thematic analytic design, which treated themes as researcher-generated interpretations rather than findings requiring participant verification. Trustworthiness was therefore supported through reflexive transparency, cross-case comparison, the use of multiple qualitative sources to deepen contextual understanding, and explicit attention to researcher positionality and reflexivity (Braun & Clarke, 2021; 2022a).

3.5. Researcher Positionality and Reflexivity

The first author occupied a dual insider-outsider position in this study. As a former Chinese primary school EFL teacher, she brought contextual familiarity with pedagogical routines and the practical constraints shaping technology use in local school

settings. This insider perspective facilitated rapport with participants and supported nuanced interpretation of their accounts. At the same time, as a doctoral researcher in educational technology, she approached the study with a degree of analytic distance and sensitivity to theoretical perspectives on technology integration. Reflexivity was maintained through memos documenting evolving assumptions, emotional responses, and the first author's shifting relationship to the field and the data during observations, interviews, and analysis. These memos were used to interrogate how her prior teaching experience and research interests might shape what was noticed, foregrounded, or interpreted as analytically significant, including a tendency to view recent technological training positively or to frame limited technology use as a deficit rather than a context-sensitive pedagogical choice. Consistent with reflexive thematic analysis, subjectivity was treated as a resource for interpretation, and themes were actively generated through sustained engagement with the data.

4. Result

This section presents the findings of the cross-case analysis, focusing on how the recency of technology-related learning helps explain differences in classroom technology integration. Drawing on interview data triangulated with lesson plans and classroom observations, the analysis demonstrates that teachers' technology integration practices were not determined by teaching experience alone.

Instead, differences in technology integration were more closely associated with the recency of learning, while their technological trajectories shaped how those opportunities were taken up and relied upon. Across the three cases, three themes are reported: (1) divergent technological trajectories across teaching careers; (2) the role of recent learning opportunities; and (3) psychological and behavioral outcomes associated with these trajectories and learning conditions.

4.1. Divergent technological trajectories across teaching careers

Interview data reveal marked differences in teachers' technological trajectories, closely linked to the historical moment at which they entered the profession. Teachers who began their careers prior to widespread classroom digitization described formative professional experiences grounded in analog and projection-based tools rather than computer-mediated systems. Their accounts suggest trajectories characterized by technological discontinuity, with successive waves of innovation requiring repeated adaptation. Feng (Blueberry School) recalled: "When we first started working, there were no computers, no PPTs. We first used pictures, and later hand-drawn slides. The plastic ones… using a big black machine to project the image, the most ancient form."

Similarly, Chen (Blueberry School) explained that she initially relied on "a tape recorder" before transitioning to "white screens and projectors," while Hong (Apple School) noted that digital tools became integrated into her teaching only mid-career: "When I first started teaching English… computers were not common… I didn't use them much. Around 2006, the whole school adopted PPT, and we started using it."

These accounts indicate that for long-serving teachers, technological change occurred in discrete phases rather than through gradual extension of existing digital competencies. Early professional expertise, developed around analog tools such as tape recorders or hand-drawn transparencies, offered limited transferability to contemporary software-based platforms. As a result, technological competence did not accumulate cumulatively over time, even as pedagogical expertise deepened.

In contrast, teachers who entered the profession after digital technologies had become embedded in schooling described trajectories marked by continuity. For some, familiarity with digital tools began during their own student experiences. Fei (Apple School) reflected: "I feel like I started using IWBs from my student days… I watched my teachers use the IWBs when I was a student, so I am quite familiar with them."

Others attributed their preparedness to structured pre-service training. Ann (Blueberry School) noted that during her university studies, "mastering basic technological skills, such as Word, Excel, and PPT, was a compulsory subject." Lin (Blueberry School) further explained that creating digital animations during her undergraduate program "has been of great help to my current use of technology."

These contrasting narratives highlight not only differences in exposure, but also in the transferability and cumulative development of technological expertise. Teachers with sustained engagement in digital environments experienced smoother skill transfer, as competencies developed during schooling or pre-service education aligned with current classroom technologies.

From a UTAUT-informed perspective, these divergent trajectories help illuminate differences in effort expectancy. Teachers experiencing technological discontinuity were more likely to perceive digital tools as effort-intensive, given the need to reconstruct foundational skills. By contrast, teachers whose professional histories reflected technological continuity tended to perceive lower integration effort, as prior digital experience provided an adaptive base. This divergence in

perceived effort forms a critical analytic foundation for understanding subsequent differences in training engagement, confidence, and technology-related instructional decision-making.

4.2. The role of recent learning opportunities

This theme examines how recent technology-related learning opportunities helped shape teachers' classroom technology integration and how such opportunities were unevenly available across institutional contexts. The analysis suggests that technology integration was influenced less by teaching experience alone than by how recent learning opportunities were accessed and taken up. Teachers whose careers began prior to widespread classroom digitization were more likely to depend on formal PD as a primary pathway for skill acquisition. In contrast, those with more recent exposure to digital environments were often able to compensate for limited institutional support through self-directed learning.

For teachers whose professional entry predated large-scale educational digitization, access to structured and up-to-date training was described as essential. Hong (Apple School), for example, identified a widening gap between her existing technological repertoire and the increasingly sophisticated systems introduced at her school. Reflecting on a recent PD session, she stated:

> Currently, I am only able to use the most conventional and standard tools. Those are within my capability. However, as society progresses, I find myself unable to handle the more advanced technologies. Without proper training, what am I supposed to do? … I genuinely need training.

Hong's account illustrates how technological discontinuity positioned formal training as her principal means of developing new competencies. As discussed in Theme 1, her early professional experience was rooted in analog and low-digital environments, offering limited transferable knowledge for contemporary, software-driven platforms. In this context, training was not supplementary but foundational.

Despite this reliance, participants consistently reported structural limitations in existing PD provision. Three interrelated constraints were evident across sites: limited continuity, misaligned focus, and restricted accessibility.

First, training was frequently described as episodic rather than sustained. Chen (Blueberry School) emphasized that isolated sessions were insufficient for durable learning, particularly given established teaching routines:

A single training session is inadequate; we are likely to forget what we learned. Moreover, the influence of long-established habits makes it difficult for us to change our practices.

Similarly, Jing (Apple School) observed that without opportunities for ongoing rehearsal and application, newly introduced features were "quickly forgotten." These accounts suggest that one-off workshops failed to support consolidation, leaving teachers unable to translate initial exposure into stable classroom practice.

Second, participants highlighted an imbalance in the substantive focus of PD. Chen reported that many sessions emphasized pedagogical frameworks rather than operational technological skills, particularly during the pandemic period when social distancing protocols reduced in-person training opportunities: "It's usually training about teaching methods." While pedagogical development was valued, the limited attention to technical functionality meant that teachers were encouraged to innovate instructionally without being adequately equipped to enact those innovations through specific digital tools. This misalignment constrained the practical impact of PD and heightened perceptions of effort.

Third, access to training opportunities was uneven. Xue (Apple School) described a cascade dissemination model in which only selected teachers attended formal sessions, subsequently relaying information informally to colleagues: "The selected teacher might just quickly show me, 'This is this, this is that.' Last time, the head teacher was trained, and then the head teacher just told us about it."

Such second-hand transmission reduced complex systems to fragmented demonstrations, lacking the depth, coherence, and hands-on engagement necessary for meaningful skill development. As a result, training became diluted, reinforcing rather than resolving competence gaps.

Institutional eligibility criteria further shaped participation. Feng (Blueberry School) explained that PD opportunities were often restricted by age-based thresholds: "Every time there's training, the age limit is always 'under 40' or 'under 45'… I've never been trained."

This account demonstrates how age was used as a proxy for technological readiness, overlooking individual trajectories and specific learning needs. Rather than targeting training based on demonstrated discontinuity or expressed demand, institutional policies risked reproducing inequalities in access.

Importantly, the consequences of these constraints were not uniform. Teachers whose professional histories involved more sustained digital exposure often drew on self-directed technology-related learning to compensate for limited institutional support. Several participants described using online resources and independent exploration to develop

technological skills. Dai (Blueberry School) stated, "I improved my technological skills from the internet," while Jin (Cherry School) remarked, "I use technology to learn about technology." For these teachers, prior familiarity reduced perceived effort and enabled autonomous skill acquisition, partially offsetting limited institutional support.

The data also demonstrate that when training was recent, contextually relevant, and directly aligned with classroom tools, it could effectively facilitate integration among teachers otherwise constrained by technological discontinuity. Hong's experience with the Seewo IWB illustrates this dynamic. Following targeted, hands-on training, she reported immediate implementation of functions such as highlighting, magnification, and annotation—features she had previously been unable to operate. The proximity between training and classroom use reduced perceived complexity and enabled rapid experimentation, thereby lowering barriers to initial engagement.

Viewed through a UTAUT-informed lens, recent and accessible technology-related learning opportunities functioned as facilitating conditions that shaped teachers' effort expectancy and willingness to implement new tools. These findings suggest that technology integration depended less on teaching experience alone than on whether relevant learning was timely, accessible, and aligned with teachers' technological trajectories.

4.3. Divergent psychological and behavioral responses in technology integration

This theme examines contrasting psychological and behavioral responses associated with teachers' technological trajectories and their access to recent learning opportunities. The analysis suggests that when recent formal PD was limited, teachers whose careers were marked by technological discontinuity frequently reported heightened anxiety and a tendency toward avoidance. By contrast, teachers with more sustained digital engagement across their professional histories reported greater confidence, even in the absence of comprehensive institutional support.

Hong (Apple School), whose professional trajectory involved substantial discontinuity, described how insufficient training undermined her confidence and shaped her classroom decisions:

> I lack confidence because I feel I may not be able to handle it [new technology] effectively. If issues arise during class, I am certain I would not be able to resolve them. If I had received training, I would certainly feel more assured. I would rather choose not to use the new technology at all and stick with my original methods.

Her account illustrates how the absence of recent, hands-on training was associated with anticipatory anxiety, particularly concerning potential technical failures during instruction. Rather than functioning as a resource, her accumulated pedagogical experience reinforced reliance on established routines, which were perceived as more controllable and less risky. In this context, experience amplified perceived performance costs, contributing to behavioral avoidance.

Similar concerns were expressed by Chen (Blueberry School), who noted that "long-established habits" made it difficult to move beyond familiar practices without sufficient technological support. Together, these accounts indicate that under conditions of limited training recency, professional experience may intensify caution rather than facilitate innovation. The possibility of visible classroom disruption heightened emotional costs and constrained experimentation.

However, the psychological impact of limited formal support was not uniform. Teachers whose professional histories involved more sustained digital engagement tended to report greater confidence despite comparable institutional constraints. Yun (Apple School) reported having "a certain level of confidence" when using new tools, while Jing estimated her confidence at "70%–80%." At Blueberry School, Lin described independently learning to create micro-lessons, framing skill development as an ongoing process rather than a source of stress. For these teachers, technological engagement appeared to be more normalized within their professional identities, reducing the perceived threat of potential setbacks.

These contrasting responses suggest that recent formal and self-directed learning opportunities were related to teachers' affective responses to risk. From a UTAUT-informed perspective, the accounts highlight the relevance of facilitating conditions and effort expectancy, as well as related differences in confidence in integrating technology. When anticipated emotional and cognitive costs were high, avoidance was more commonly described. Conversely, when teachers perceived manageable risks and retained confidence in their capacity to learn, experimentation and persistence were more evident. Psychological readiness is therefore better understood not as a matter of skill possession alone, but as part of a broader process through which teachers interpreted and responded to technological demands in practice.

5. Discussion

This discussion interprets the findings in relation to scholarship on teachers' technology integration and technology acceptance. The study suggests that inconsistent findings concerning teaching experience may be better understood by considering the recency of teachers' technology-related learning. By conceptualizing teaching experience as a historically

situated pattern of digital engagement rather than a static demographic variable, the findings highlight how technological trajectories, recent learning opportunities, institutional conditions, and psychological responses help explain differences in classroom technology integration.

5.1. Reinterpreting the role of teaching experience in technology integration

This study contributes to debates on teaching experience and technology integration by suggesting that experience does not exert a direct or uniform influence on teachers' technology integration. Instead, its effects are contingent upon how teachers' technological trajectories align with access to recent technology-related learning. From this perspective, teaching experience matters not as a simple measure of years in service, but in relation to how teachers' careers unfold within changing technological infrastructures and learning conditions. This temporally informed account may help explain contradictory findings reported across empirical contexts.

Previous research has frequently treated teaching experience as a stable background characteristic, resulting in inconsistent conclusions (e.g., Peng et al., 2023; Scherer & Teo, 2019). The present findings suggest that such inconsistencies stem from insufficient attention to teachers' cumulative technological exposure. Teachers who entered the profession prior to widespread classroom digitization often encountered technological change as episodic and externally driven, requiring later adaptation through in-service professional development. In contrast, teachers who began their careers more recently were more likely to experience sustained engagement with digital tools during pre-service preparation and early professional practice. Professional longevity, therefore, does not in itself predict integration; rather, the historical alignment between career stage and technological transformation becomes decisive. This interpretation is consistent with large-scale evidence indicating that demographic characteristics influence technology use indirectly through psychological and contextual mechanisms (Luo et al., 2025).

5.2. Recent learning opportunities and technology integration

A central contribution of this study is to highlight the importance of the recency of technology-related learning in understanding teachers' technology integration practices. Although PD has long been recognized as important for technology integration, the findings indicate that its impact depends critically on timing and relevance to classroom practice, rather than mere availability.

Consistent with recent research, teachers expressed a strong need for hands-on, context-specific training aligned with the technologies required in their classrooms (Mekheimer, 2025; Siyam et al., 2025). However, teachers whose careers were marked by technological discontinuity were more dependent on formal training due to limited transferable digital skills. When training was infrequent, misaligned, or inaccessible, this reliance resulted in delayed or stalled integration. In contrast, teachers whose professional histories involved more sustained digital engagement were better positioned to compensate through self-directed learning grounded in prior digital familiarity.

These patterns support recent work showing that facilitating conditions interact with teachers' internal technological knowledge rather than operating as external enablers alone (Mafa & Govender, 2025). These findings also refine a UTAUT-informed understanding of facilitating conditions by showing that support matters not only in terms of availability, but also in terms of recency, accessibility, and alignment with classroom demands. The present findings further demonstrate that when training was recent and targeted, it could effectively reduce perceived effort and support integration among teachers otherwise constrained by discontinuous technological trajectories. This highlights PD as a temporally sensitive process that needs to be understood in relation to teachers' prior technological histories rather than as a one-off intervention.

Additionally, the findings suggest that the relationship between formal PD and self-directed learning is best understood here as conditional rather than uniform. Although prior research suggests formal and informal learning can relate in different ways, including complementary, compensatory, and at times competitive patterns (Abedi et al., 2023; Huang & Lai, 2020), the present study most clearly points to a compensatory dynamic. More specifically, self-directed learning appeared to function more readily as a compensatory resource for teachers with more sustained digital exposure, rather than as a broadly available substitute for limited formal PD. This matters because it suggests that self-directed learning cannot be assumed to offset gaps in formal provision in the same way for all teachers. In practice, treating informal learning as a general substitute for formal PD may risk reinforcing existing differences in teachers' capacity for technology integration.

5.3. Psychological readiness and behavioral responses

Beyond skill acquisition, this study highlights the importance of psychological readiness in understanding teachers' technology integration. Teachers whose technological trajectories involved discontinuity and who lacked recent support

frequently reported anxiety, diminished confidence, and avoidance of new tools. Conversely, teachers with more sustained digital exposure across their professional histories demonstrated greater confidence and resilience, enabling them to persist in experimenting with technology despite institutional constraints.

These findings align with research emphasizing the role of affective and psychological factors in technology integration. Prior studies have shown that structural support alone may be insufficient when teachers lack psychological readiness. For example, Raygan and Moradkhani (2022) found that teachers' attitudes mediated the relationship between school climate and technology use, while Theodorio et al. (2024) argued that insufficient technical training can lead to frustration and withdrawal, reinforcing avoidance behaviors rather than encouraging experimentation. Luo et al. (2025) likewise found that resilience, well-being, and innovativeness were strong predictors of technology acceptance, independent of demographic variables. In the present study, these patterns were reflected in teachers' accounts of confidence, caution, and willingness to engage with technology. From a UTAUT-informed perspective, these findings also suggest that effort expectancy is shaped not only by the perceived complexity of technology itself, but also by teachers' technological trajectories and the recency of relevant learning opportunities.

5.4. Implications for PD and Policy

The findings carry several implications for the design of PD in EFL and primary education contexts. First, PD should be differentiated according to teachers' technological trajectories rather than assuming uniform needs based on experience or age. Experienced teachers whose careers involved technological discontinuity may require more sustained, scaffolded support, while newer teachers may benefit from opportunities that leverage and extend their existing digital competencies.

Second, training programs should prioritize recency, continuity, and contextual relevance. Consistent with recent PD frameworks, hands-on activities, subject-specific applications, and ongoing support structures are essential for sustaining impact (Mekheimer, 2025; Siyam et al., 2025). One-off workshops or cascade models risk reinforcing existing disparities by privileging teachers who already possess digital confidence.

Third, PD should explicitly address psychological dimensions of technology integration. Recent research suggests that fostering resilience, self-efficacy, and well-being is central to sustaining long-term adoption (Luo et al., 2025; Shen et al., 2024). Strategies such as peer mentoring, opportunities for low-stakes experimentation, and recognition of successful integration may help reduce anxiety and encourage engagement, particularly among teachers who perceive high risks in adopting new tools.

Fourth, policy and school-level support should recognize the importance of both timely formal PD and teachers' self-directed learning for classroom technology integration. These should be understood as related but non-interchangeable forms of professional learning. While self-directed learning may partly compensate for limited formal provision in some contexts, it should not be treated as a substitute for timely and institutionally supported professional development. Schools therefore need to create conditions in which self-directed learning can be sustained alongside relevant and accessible formal PD.

5.5. Contributions

This study makes several contributions to the literature. First, it reconceptualizes teaching experience as a temporally situated construct shaped by teachers' technological trajectories, rather than treating it as a static indicator of years of service or seniority. This shifts attention from demographic categories to the historical and professional conditions under which teachers encounter technological change. Second, it introduces the concept of technology-related learning recency as a way of understanding how the timing of relevant learning relates to classroom technology integration. In doing so, the study highlights the importance of whether technology-related learning is recent enough to support classroom enactment. Third, it helps explain inconsistent findings in prior research by showing how technological trajectories, recent learning opportunities, institutional conditions, and psychological readiness jointly shape teachers' integration practices. This provides a more process-oriented account of why teaching experience may relate to technology integration in different ways across contexts. Finally, by drawing on a multiple-case study of primary EFL teachers in China, the study offers contextually grounded qualitative evidence on how these dynamics unfold in practice.

6. Conclusion, limitations and future research directions

This study provides a nuanced account of the uneven relationship between teaching experience and technology integration among Chinese primary EFL teachers. The findings suggest that teaching experience functioned neither as an inherent barrier nor as an automatic enabler of technology integration. Rather, its influence depended on how teachers' technological histories aligned with technology-related learning recency and affective responses. Teachers whose careers were marked by greater

technological discontinuity appeared more dependent on recent technology-related learning opportunities, particularly institutional support, whereas those with more sustained prior digital exposure were better able to maintain confidence and adapt through self-directed learning. Overall, the study suggests that technology integration is shaped less by seniority alone than by the interaction between professional history, learning recency, and affective response.

By foregrounding technology-related learning recency, this study helps explain some of the inconsistencies reported in prior research on teaching experience and technology integration. Teachers with comparable years of service may display substantially different technology-related practices and attitudes because their technological trajectories and access to recent learning opportunities differ. In this sense, the study offers a more process-oriented explanatory account of how experience becomes consequential for technology integration. It also underscores the importance of differentiated and timely PD approaches that attend to teachers' technological histories and evolving learning needs, particularly in rapidly digitalizing systems such as China.

Several limitations should be acknowledged. The qualitative design and purposive sampling of three primary schools within a single region enabled in-depth, contextually grounded analysis but constrain transferability to other regions, educational sectors, or national contexts. In addition, the study adopted a broad qualitative understanding of technology-related learning recency, encompassing both formal PD and self-directed learning. While this was useful for capturing the range of learning experiences shaping teachers' technology integration, it does not provide a standardized measure that would allow direct comparison across studies or contexts. Finally, the cross-sectional design does not capture how teachers' practices and psychological orientations toward technology may shift over time.

Future research may extend this work through large-scale or comparative studies across diverse regions to examine the broader applicability of the patterns identified here. Mixed-methods designs incorporating validated measures could allow more precise examination of the recency of technology-related learning opportunities alongside constructs such as self-efficacy, technology anxiety, and resilience. Longitudinal research would be particularly valuable for tracing how technological trajectories and technology integration practices evolve across career stages. Intervention studies evaluating sustained, differentiated PD models could further test strategies designed to support technology integration among teachers with varied technological histories.

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Ethical Considerations

This study received ethical approval from Massey University Human Ethics Committee. Approval number: 4000026540.

Consent to Participate

All participants provided informed consent prior to participation. Participation was voluntary, and confidentiality and anonymity were ensured throughout the study.

Author Contributions

The first author was responsible for conceptualization, research design, data collection, data analysis, and manuscript drafting. The corresponding author contributed to data analysis, manuscript writing, reviewing, and revising the manuscript.

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Data Availability Statement

The data that support the findings of this study are not publicly available due to ethical restrictions related to participant confidentiality. The study involves interview and observational data collected from identifiable educational settings, and open sharing could compromise

participant privacy. De-identified data may be made available from the corresponding author upon reasonable request and with approval from the Massey University Human Ethics Committee, subject to compliance with the conditions under which ethical approval was granted.

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