

ORIGINAL ARTICLE

Unpacking the Dimensions of EFL Teachers' PCK and Contextual Barriers for AI-Enhanced Professional Development in Iran: A Thematic Analysis

Zeinab Mahdavi^{1*}

^{1*} **Corresponding author**, English Language Teaching Dept., Farhangian University, Tehran, Iran,

zeinab.mahdavi^{٢٢}@gmail.com

Abstract

The design and integration of generative artificial intelligence (AI) into language teacher professional development (TPD) have received increased attention from academic communities; still, the extent to which the construct of Pedagogical Content Knowledge (PCK) is needed to facilitate the design and implementation of AI in the Iranian (EFL) context and the contextual obstacles that hinder the development of PCK through AI-based approach remains an under-researched area. This qualitative study endeavors to enhance the understanding of PCK in the Iranian EFL context through conducting semi-structured interviews with ١٢ Iranian experts, including teacher educators, in-service experienced teachers, and curriculum developers. The interview data analysis led to the emergence of two main themes and nine subthemes. The first main theme entitled, The Nature and Dimensions of EFL Teachers' PCK in the Digital Age, explored five subthemes: (١) the foundational components of PCK, (٢) situated and dynamic nature of PCK, (٣) culture-specific dimension of PCK, (٤) emergent challenges in PCK development, and (٥) the imperative for PCK renewal in digital age. Conversely, the second main theme, Contextual Barriers to AI-Enhanced Professional Development, contained four subthemes including (١) culture and psychological resistance to AI, (٢) infrastructural and digital gaps, (٣) ethical and legal privacy concerns, and (٤) teachers' digital literacy and support gaps. The findings reveal that EFL teachers in Iran have the primary prerequisites for developing their PCK but face considerable challenges in implementing their PCK to cater to AI-supported language learning and teaching. This study contributes a comprehensive conceptual framework for understanding PCK by identifying and explaining the categories to conceptualize PCK in the Iranian (EFL) context, as well as the contextual obstacles hindering its development. Both implications and directions for future research are elaborated.

Received

١ August ٢٠٢٦

Revised

٣٠ August ٢٠٢٦

Accepted

١٥ September
٢٠٢٦

Published

٢٢ September
٢٠٢٦

Keywords:

Pedagogical
Content
Knowledge, EFL
teachers,
generative AI,
teacher
professional
development,
contextual
barriers, Iran,
thematic analysis

Introduction

Our emerging world of GenAI presents new and exciting opportunities, as well as unique challenges for language teacher education. Since the integration of GenAI into teacher professional development in Iran's highly centralized EFL education system is still nascent that research has explored the challenges, and possibilities of AI (e.g. Celik et al., ۲۰۲۲; Zawacki-Richter et al., ۲۰۱۹), it helps to be aware of contextual issues that can both hinder and accelerate the use of GenAI in language teacher education. Although Iranian EFL teachers recognize the usefulness of tools like ChatGPT for lesson planning and the design of materials, infrastructure limitations, cultural barriers, and deep-seated concerns over misuse and over dependency pose great barriers, and the difficulties are compounded by the challenges of access, language barriers, and infrastructure limitations (Ahmadi & Yousofi, ۲۰۲۵).

As one applied linguist (P^۱), who has taught EFL in Iran for over ۲۰ years, explained: "Pedagogical Content Knowledge in English is surely not a superficial amalgamation of grammar and methods, but rather the intricate alignment of syntax, phonology, and discourse knowledge with a precise understanding of the cognitive and linguistic processes of the Persian-speaking learner." P^۱'s definition of PCK in Iran, which is broader than Western conceptions, reveals the need for contextually relevant approaches to researching and designing language teacher education programs in Iran. Iranian EFL teachers still find themselves at a crossroads as an attempt to explore the unprecedented educational potentials of AI is already under way on a global scale. A recent survey on critical AI literacy among English teachers in Iran, found that although teachers reported enhanced confidence in experiencing with communicative and learner-centered approaches via ChatGPT, they highly worried about content reliability, scholarly misconduct and cultural relevance of AI outputs. Contextual variables such as limited access to modern digital devices, inflexible curricula and sociocultural taboos heavily shape teachers' AI-integration practices.

Over the past two years, following public opening of ChatGPT, Iranian EFL teachers have been trapped between the bright sides of AI-powered lesson planning and the bleak one of poor internet connectivity and institutional treatment. This dichotomy is the context of this study (Celik et al., ۲۰۲۲; Zawacki-Richter et al., ۲۰۱۹). In the field of TEFL, this transformation is particularly significant as teachers are compelled to navigate a complex digital ecosystem that radically alters the way language content is consumed, delivered and embedded (Kohnke et al., ۲۰۲۳). Recent surveys indicate that, almost ۵۰٪ of both students and instructors rely on GenAI for coursework and lesson planning respectively (Kerr & Kim, ۲۰۲۵; Sousa & Cardoso, ۲۰۲۵). Yet, as one of my respondents (P^۳, a university teacher with ۲۲ years' lecturing experience) summarized, 'You can have ChatGPT devise a flawless lesson plan. But if the educator has not studied how to make a Persian learner pin down 'since' or 'for', it's useless'. This reaffirms that PCK remains of prime

importance even in the AI epoch- a concept that Shulman (۱۹۸۶) defined as the mixture of content knowledge and pedagogical skills enabling content to be comprehensible to learner.

In language teaching, which needs more diverse expertise than ordinary teaching, PCK becomes more sophisticated to involve learners' linguistic misconception understanding, Knowledge learning, and curriculum design based on context (Gatbonton, ۲۰۰۸). Even in the general understanding of PCK, new research advanced our knowledge of PCK as language teachers can have hard-won domain-specific knowledge about learners from different perspectives like their skills, effective usage of assessment skills, myriads of strategies, and learner-centered content (Namanyane & Shaoana, ۲۰۲۵). An additional dimension has recently emerged with GenAI. Research shows the development of "AI-pedagogical knowledge," or the particular competence to translate teaching intent into an AI-implemented routine, which means that teachers should deconstruct their intuitive PCK into explicit, step-by-step instructions for GenAI (Chen et al., ۲۰۲۶).

Although PCK is widely recognized as a critical notion for EFL teaching, but its systematic development in teacher education programs, in particular those contextual factors that are specific to teacher learning, appears as an immense challenge for the reform of teacher education, most particularly, in countries such as Iran that suffer from centralized curricula and traditional transmission models that discourage collaborative inquiry, reflective practices and peer consultation (Rahimi & Nabilou, ۲۰۲۲). Previous studies emerging from Iranian teacher training universities have recorded ongoing shortcomings in teacher education programs namely the lack of ongoing mentoring as well as limited peer consultation (Ahmadi, ۲۰۲۵).

These contextual limitations underline the importance of professional development programs designed for systematic development of PCK among Iranian EFL teachers, while placing special focus on the opportunities and constraints of new emerging AI tools for the development of PCK. The Lesson Study model, originated from Japan is a teacher professional development model which is a collaborative, cyclical process inquiry based (Stigler & Hiebert, ۲۰۱۶; Le & Nguyen, ۲۰۲۵). It has been appreciated worldwide for how it prompts teachers to be reflective and improves the quality of their teaching performance. Empirical investigations have provided evidence proving, learning through Lesson Study has a positive impact on teachers' teaching practice. They could improve their ability to select strategies and modify as their learners' response during teaching practice and to reflect on and evolve by collaborating with their peers to share feedback and observation (Le & Nguyen, ۲۰۲۵). In the Iranian context, most of investigation has been on the teachers' opinion and the prospects of using Lesson Study as a tool for EFL teacher professional development (Hosseinnia et al., ۲۰۲۵).

AI has been identified as an urgent and promising tool to integrate into Lesson Study a rapidly developing area of research. For examples, several recent investigations have empirically explored how AI-supported Lesson Study can be implemented with the TEAM Model platform showing that the use of generative AI is effective in optimizing lesson study practices by reducing time and effort, assisting teacher planners, and providing rich information for reflection and debriefing (Liang et al., ۲۰۲۵). Interestingly, this concern was echoed by my participants. One teacher educator (P۵) even warned that 'I saw student-teacher simply copy-paste ChatGPT's lesson plan...and not changing a word. That's not teaching, that's clerical.' In fact, the issue is not the technical abilities but the pedagogical potential I want to encourage teachers, how to use AI as a scaffold, not a crutch. Finally, as an emerging field, AI-enhanced microteaching lesson study has offered empirical evidence of how generative AI can be integrated meaningfully into teacher preparation in the future (Konakbayeva et al., ۲۰۲۵; Yuan et al., ۲۰۲۵).

However, underlying all these is a more serious shortcoming in the current literature. While most of these studies focus on applying AI to develop pedagogy and content knowledge respectively as separate knowledge domains, if you examine closely, they tend to frame AI applications in TPACK and i-TPACK, where technology is considered as a third co-equal set of knowledge that has a symbiotic relationship with pedagogy and content (Mishra & Koehler, ۲۰۰۶; Celik, ۲۰۲۳). This raises the question of whether we have been applying AI at macro rather than micro levels to build PCK in language teaching more exactly? Even if we choose to focus on these general knowledge domains, for in-service teachers in particular, how can they leverage AI to repeatedly develop PCK that is contextual, specific and sustainable?

Moreover, studies such as CollabAI (Düzler & Kartal, ۲۰۲۶) and AI-powered Lesson Study have only shown the potential of applying AI to develop general professional capabilities. None have focused to develop teachers' PCK explicitly for language teaching, let alone for experienced in-service teachers. And, an empirical investigation, as of now, lacked to explore the principal facets of EFL teachers' PCK in the Iranian context and the contextual constraints that hinder their development via AI-assisted procedures. Thus, this oversight deprives language practitioners of actionable, evidence-based protocols to navigate the AI era and keep their practice rooted in the heart of education.

To address these critical gaps, the present qualitative study aims to investigate the dimensions of EFL teachers' Pedagogical Content Knowledge in the digital age and the contextual barriers to AI-enhanced professional development in the Iranian context. Specifically, the study addresses the following research questions:

RQ۱. What are the key dimensions and components of Pedagogical Content Knowledge among Iranian EFL teachers in the digital age?

RQ۲. What contextual barriers impede the development of EFL teachers' PCK through AI-enhanced professional development in Iran?

The findings of this study are expected to contribute to the growing body of knowledge on AI-enhanced teacher professional development by offering a context-sensitive framework that can inform teacher education policy and practice in Iran and similar EFL contexts. This investigation holds great importance on several levels. Theoretically, the findings of this study can aid the redefinition of PCK in novel contexts of digital language pedagogy by adapting classical conceptualizations to the contemporary mechanisms of online language instruction. Pedagogically, it can equip teacher educators as well as language curriculum designers with an elaborate picture of the knowledge-base Iranian EFL teachers are armed with and the obstacles impede them towards the successful delivery of digital language instruction. In the end, by locating this inquiry within the socio-cultural parameters specific to Iran, this research seeks to counteract the theoretical and practicable pitfalls of blindly transplanting Western models of professional development, and foster a native-indigenous process of teachers' elaboration in digital language education.

Literature Review / Background

Pedagogical Content Knowledge: Conceptual Foundations

Lee Shulman (۱۹۸۶, ۱۹۸۷) first theorized the construct of Pedagogical Content Knowledge within his integrative theory of teacher knowledge. In other words, he believed that teaching required a unique form of knowledge that "identifies the special blend of content and pedagogy that makes teaching unique, the blending of content and pedagogy into an understanding of how particular topics, problems, or issues are organized, represented, and adapted to the diverse interests and abilities of learners" (Shulman, ۱۹۸۶, p. ۸). He identified PCK as "a now decentered yet crucial part of teacher education research and practice" and as that factor that made a teacher different from mere subject matter expert.

As P۳, a professor of teaching methodology, PCK is also a matter of 'representational knowledge.' He claimed: 'You can have all the rules of grammar in your head without necessarily knowing how to turn this rule into a story, or an image, a table, or a game that the learner can go home with. Your teaching will remain dry and ineffective.

'This pragmatic side of PCK is what makes senior Iranian EFL teachers different from their beginning colleagues. Later research has built upon and further specified Shulman's definition. Grossman's (۱۹۹۰) model highlighted four key elements of PCK: knowledge of intention to teach a subject, knowledge of students' understanding of and misconceptions about a subject, knowledge of curricular materials, and

knowledge of effective teaching strategies and representations. Current theorists have focused on PCK as a practical, context-specific, and constructivist concept that develops and can be reconstructed over time through teaching and reflection on practice (Berry et al., ۲۰۱۶; Park & Oliver, ۲۰۰۸).

For English language teaching, PCK everyone knows is mainly significant due to the distinctive nature of language as both the object and tool of instruction (Gatbonton, ۲۰۰۸). Research involving language teachers in EFL and ESL contexts showed that PCK in language learning and teaching contains the content knowledge about learners' / language learners' linguistic misconceptions, culturally-sensitive teaching/learning strategies, design of contextually relevant curriculum and scaffolding of language proficiency development. Namanyane and Shaoana (۲۰۲۵) discovered that English language teachers exhibited excellent knowledge of various dimension of learners including learners' diverse nature, learners' varied level of ability, effective application of assessment strategies, different instructional strategies.

Within the Iranian nation, among the studies conducted into PCK, the research about the contribution of mentoring and reflection in the professional knowledge of the pre-service EFL teachers has been among the contributing factors (strategies) proven to facilitate the preservice teachers' integration of pedagogical theory and practice as well as the development of contextualized pedagogical practices (Ahmadi, ۲۰۲۵). The research accounted for the deficiencies by the pre-service teachers' training provision, like lack of follow-up mentoring sessions, and efforts for adopting classroom practices and engaging in peer reflection. Mehrbakhsh, Abbasian, and Mohammadi (۲۰۲۴) designed and validated the PCK questionnaire for the implementation of the other projects for EFL teacher training programs within the structure of a 'glocal' model.

The Digital Transformation of PCK

Access to new technologies such as digital technologies and more recently generative AI has led to a reframing of PCK that represents a rethinking of teacher knowledge that moves beyond traditional representations. It's perhaps in the work of Mishra and Koehler (۲۰۰۶) TPACK that PCK is most explicitly extended. In their model the integration of technology and pedagogy with content knowledge is explicitly represented, so moving beyond a singular focus. In more recent work, researchers have extended TPACK to better reflect the unique issues that AI presents. For example, Celik (۲۰۲۳) proposed an AI-specific knowledge domain, which he called Intelligent-TPACK (i-TPACK). In this model, AI knowledge is understood to be beyond the purely technical skills required to operate an AI tool, and must include considerations of AI ethics. Investigations into the development of AI-TPACK knowledge have focused on what it takes for preservice teachers to develop the knowledge and skills to navigate the decision to use AI

tools thoughtfully (Zhou et al., ۲۰۲۵; Ebrahimi et al., ۲۰۲۵). The most relevant emerging area of one of these types of knowledge is the concept of "AI-pedagogical knowledge" the expertise needed to "translate instruction intentions to GenAI-usable commands". As Chen et al. (۲۰۲۶) experienced, this process involved teachers breaking down their naturally intuitive PCK into step-by-step directions without guidance, a challenge and opportunity for how this practice might work in future classrooms. Research has reported on aspects of generative AI in language teacher education. There have been identified thematical areas such as teachers' cognition and acceptance, pedagogical integration and professional development, and issues such as overreliance ethics reliability and AI literacy. For instance, studies showed that by conducting ChatGPT-enabled collaborative reflective practice, language teachers' professional development was supported and improved in language teacher education where mentors and teacher educators may not be always present (Ebrahimi et al., ۲۰۲۵).

Lesson Study and Teacher Professional Development

LS (Lesson Study) is an inquiry-oriented collaborative structure for teacher professional development that emphasizes teacher reflection and has been publicly celebrated as best practice for teacher and instructional quality improvement around the world (Stigler & Hiebert, ۲۰۱۶; Lewis et al., ۲۰۱۹). LS is rooted in sociocultural theories of learning and development, Mostly Vygotsky's (۱۹۷۸) focus on collaborative construction of knowledge and the zone of proximal development. If teachers are seen as co-learners and co-constructors of their own learnings, LS becomes a process which can generate "practical knowledge, anchored in the specific context and at the same time undergirded by formal theory" (Fernández, ۲۰۱۰). In EFL context, Lesson Study is a much more promising professional development method.

Le and Nguyen (۲۰۲۵) investigated the impact of Lesson Study in EFL context in their study on the effectiveness of Lesson Study on teachers' practice, and they found out that Lesson Study plays a role in teachers developing themselves in the way they teach, In particular in selecting and adapting strategies in teaching while reflecting and developing themselves through peer feedback, and their study indicated that the application of Lesson Study may contribute to increasing teachers' confidence in selecting and adapting strategies in teaching. In the Iranian context, Hosseinnia et al. (۲۰۲۵) investigated the attitudes and opportunities of Lesson Study for EFL teacher professional development, and Like that, Behroozizad and Alizadeh (۲۰۲۴) also presented that findings from their study that the Iranian EFL teachers regarded lesson study as an effective strategy for successful teaching development and better lessons.

The findings of this study confirm that Lesson Study has potential, but with a critical requirement: as P^۶ (an infrastructure expert) noted, 'In many rural schools, teachers don't even have reliable electricity, let

alone time for collaborative lesson planning.' This suggests that implementing LS in Iran requires not just teacher training, but also investment in basic infrastructure and workload redistribution.

AI-Enhanced Lesson Study: Emerging Models and Empirical Evidence

The incorporation of AI technology into the Lesson Study structure is a novel area of research and one that has garnered further attention lately. Recent research has explored AI-supported Lesson Study using the TEAM Model platform and found that generative AI benefits lesson study while improving efficiency, supporting teachers in planning, and enhancing reflection and debriefing with practical insights (Liang et al., ۲۰۲۵). Challenges related to the over-reliance on AI tools and the generation of generic responses were observed, suggesting the need for balanced implementation of generative AI tools in Lesson Study.

In science education, research on applying generative AI to Lesson Study has identified how AI supports both teacher professional development as well as learning experiences while maintaining the integrity of critical thinking and autonomous learning (Liang et al., ۲۰۲۵). İleritürk (۲۰۲۶) examined the improvement of teachers' TPACK using ChatGPT-supported lesson study, whereas other researchers have also conducted AI-supported pedagogies through utilizing the Lesson Study approach in higher education. Wang (۲۰۲۴) employed the Lesson Study as a reform strategy to strengthen in-service teachers' capacity for K-۱۲ AI education in Hong Kong, and found that teachers were overall benefited from the overall role of Lesson Study in enhancing their capability for AI lessons in integrating, learning-by-doing and project-based approaches.

AI Literacy in Language Teacher Education

Recently, the concept of AI literacy has been introduced as a big part to be embed within teacher education programs to prepare educators for teaching alongside the powerful capabilities of AI. To keep up with a future where generative AI is pervasive in education, consider develop teachers with a blend of knowledge and skills in using AI and a minimum level of digital awareness to use generative AI responsibly. The integration of AI literacy into science teaching has shown that, alongside using GenAI effectively, teachers also need the pedagogical and ethical competencies for teaching with AI. Given the Iranian context, a more nuanced picture of affordances and challenges to critical AI literacy in the domain of English teaching has been emerging.

While valuing ChatGPT's affordances in lesson planning, learner empowerment, and engagement, Iranian English teachers have raised concerns about its potential inaccuracy and reliance, as well as the inferred

cultural mismatch of AI-generated content and their students' needs and realities. These implications highlight the critical importance of critical AI literacy that empowers educators with a critical understanding, ethical awareness, and contextual reflection of AI use. As one study programmatically showed, the key to successful integration of generative AI in language teaching and learning lies in centering and enhancing teachers' agency, voice, and experience.

Research Gap

The foregoing review reveals a significant gap in the extant literature. While substantial research has been conducted on PCK in EFL contexts, and a growing body of scholarship has explored AI-enhanced Lesson Study, these two lines of inquiry have largely proceeded in parallel rather than in integration. Specifically:

Firstly, most of the existing research on using AI in teacher professional development has been carried out within the TPACK or i-TPACK structure which simply places technology in the same status as pedagogy and content. An over-emphasis on TPACK has because of this tended to hide the more intricate, subject-specific levels of PCK at the heart of effective language teaching.

Secondly, while new approaches like AI-assisted Lesson Study have proven the effectiveness of the AI-approach in advancing teacher professional development, all these studies focused on pre-service teachers and general professional knowledge and skills, but not on the development of PCK more exactly for practicing teachers. The fundamental question on what comprises PCK in the digital era and what contextual barriers prevent the development of PCK via the AI-enhance model has not yet been addressed through research.

Third, there has not been an empirical study so far investigating in a systematic way (a) the factors contributes to the dimensions of the PCK of EFL teachers, and (b) the contextual obstacles hindering teachers' professional development through Ai-Island in the Iranian socio-educational setting. Given the well-reported difficulty of developing the PCK of teachers in Iranian education system (e.g. Akbari ۲۰۱۰) and efficacy of the Lesson Study in the Iranian EFL setting, this is a lost opportunity.

The present study aims to address this critical gap by investigating the dimensions of EFL teachers' PCK in the digital age and the contextual barriers to AI-enhanced professional development in Iran. In doing so, it responds to the urgent call for well-structured, context-sensitive professional development that prepares teachers for the demands of an increasingly digitized educational landscape.

Methodology

Research Design

This study implemented a qualitative research design grounded in an interpretive paradigm, aiming to understand the lived experiences and perspectives of experts regarding EFL teachers' PCK and the contextual barriers to AI-enhanced professional development. The interpretive paradigm was chosen for its suitability in exploring complex social phenomena where meanings are socially constructed and context-dependent (Lincoln & Guba, 1985). This approach allows for an in-depth, nuanced exploration of participants' understandings, experiences, and recommendations, which is essential for addressing the exploratory nature of the research questions.

The study employed a qualitative exploratory design, which is particularly appropriate when investigating an under-researched area where the core constructs are not yet fully defined. This design enables the researcher to capture rich, detailed data that can illuminate the complexities of PCK in the Iranian EFL context and the barriers to AI-enhanced professional development.

Participants and Sampling

The research participants consisted of 12 experts and experienced practitioners identified using purposive sampling to obtain rich data and also allow for a combination of viewpoints for triangulation purposes. The inclusion criteria were: (a) a minimum of seven years of experience of teaching EFL, teacher training and curriculum design; (b) experienced in conducting professional development for language teachers; and (c) knowledgeable and familiar with the concept of technology or AI in language learning and teaching.

The participant panel comprised three distinct groups:

Group 1: University Professors ($n = 4$) – Four university professors specializing in TEFL/TESOL, teacher education, or curriculum studies. These participants held doctoral degrees and had an average of 14 years of teaching and research experience in Iranian universities. They were selected from three different universities across Iran to ensure regional diversity.

Group 2: Experienced In-service EFL Teachers ($n = 4$) – Four experienced in-service EFL teachers with an average of 12 years of teaching experience in Iranian public schools or language institutes. These participants had either participated in Lesson Study or collaborative professional development initiatives or expressed strong interest in such approaches.

Group ۳: Curriculum Developers and Educational Supervisors (n = ۴) – Four curriculum developers, educational supervisors, or language institute directors with experience in designing materials, professional development programs, or supervising EFL instruction. These participants provided insights into the systemic and policy dimensions of PCK development and AI integration.

Table ۱ provides a detailed overview of the demographic characteristics of the ۱۲ participants who took part in this study.

Table ۱. Demographic Characteristics of Participants

Category	Characteristic	Details / Values
Sample Size	Total Participants	۱۲
Professional Groups	Group ۱: University Professors	۴
	Group ۲: Experienced In-service EFL Teachers	۴
	Group ۳: Curriculum Developers / Educational Supervisors	۴
Gender	Male	۷
	Female	۵
Age	Range	۳۴ - ۵۸ years
	Mean (Average)	۴۴,۳ years
Educational Qualifications	Doctoral Degree Holders (Ph.D.)	۸
	Master's Degree Holders (M.A.)	۴
Teaching & Professional Experience	Range	۷ - ۳۲ years
	Mean (Average)	۱۶,۸ years
	Average Experience (Professors)	۱۸ years
	Average Experience (In-service Teachers)	۱۲ years
Geographic Distribution	Provinces Represented	Ardabil, Tehran, Khorasan Razavi, Isfahan, Fars,
Selection Criteria	Minimum Experience Required	۷ years
	Specialization / Involvement	TEFL/TESOL, Teacher Education, Curriculum Development, Technology/AI integration interest

Participants were selected using purposeful and snowball sampling methods. The first contacts were obtained through professional network and organizational connections, and then further contacts through

recommendations from and by the first group of participants. Aim was to reach maximum variation in experience, institutional settings, and geographical locations. Written informed consent was obtained from participants before data collection.

Instrument

Data were collected using a semi-structured interview protocol, which was designed given the cumulative knowledge gained from an extensive review of the literature related to PCK, Lesson Study, AI in teacher professional development and the Iranian EFL context. The protocol aimed to investigate the participants' views on two broad domains which corresponded to the research questions: (١) the nature of and dimensions of EFL teachers' PCK, (٢) contextual constraints that work as barriers to AI-supported professional development.

The interview protocol consisted of ٦ broad open-ended questions, with numerous probe questions to investigate thoroughly.

١. Definition and Components of PCK in EFL – Participants were asked to define PCK in the context of English language teaching and identify its most critical components.

٢. The Nature of PCK in the Digital Age – Participants were asked to reflect on how PCK has evolved with the emergence of digital technologies and AI, and what new dimensions or competencies are required.

٣. Challenges in PCK Development in Iran – Participants were asked to identify the key challenges facing Iranian EFL teachers in developing their PCK.

٤. AI and Teacher Professional Development – Participants were asked about their perceptions of AI's potential role in supporting teachers' professional development, including its affordances and constraints.

٥. Contextual Barriers to AI Integration – Participants were asked to identify the cultural, infrastructural, ethical, and policy-related barriers to integrating AI into teacher professional development in Iran.

٦. Recommendations and Future Directions – Participants were asked to offer recommendations for enhancing PCK development and facilitating AI integration in Iranian EFL contexts.

The interview protocol was pilot-tested with two academic experts not included in the main sample to ensure clarity, relevance, and comprehensiveness. Minor modifications were made based on pilot feedback, including the addition of several probe questions to elicit more detailed responses.

Data Collection Procedure

Participants were approached through an official e-mail and phone call. After their willingness to participate and signing the written informed consent, individual semi-structured interviews were arranged.

Interviews were conducted during a three-week period. Each interview lasted approximately 40 to 60 minutes (mean duration = 50 minutes) and was conducted either face-to-face at participants' workplaces or via a secure video-conferencing platform, based on participants' preferences. All interviews were conducted in Persian (Farsi) to enable participants to express their thoughts freely and precisely in their native language.

All interview sessions were audio-recorded with participants' explicit permission. Additionally, field notes were taken during and immediately after each interview to capture contextual nuances, non-verbal cues, and initial impressions. The audio recordings were subsequently transcribed verbatim by the researcher, resulting in approximately 180 pages of single-spaced text (approximately 52,000 words). To ensure accuracy, all transcripts were reviewed against the audio recordings.

Data Analysis

The transcribed data were analysed per Braun and Clarke's (2006) six phases of thematic analysis. This approach was selected for its flexible systematic rigorous and highlights the notion that themes are 'analytic constructs'. The analysis proceeded through these six phases:

Phase 1: Immersion in the data. The researcher read and re-read the complete transcripts numerous times to become immersed in the whole dataset, and initial thoughts, impressions and findings were documented in a reflexive journal. The transcripts were listened to on audio tape as the researcher read transcripts.

Phase 2: Generating initial codes- Data were coded using MAXQDA (v 20.22). As the data were kept open throughout the process and the researcher read through each transcript in detail, the researcher used open coding to read each transcript line-by-line and generate codes for sections of text that seemed pertinent to the research questions. Codes remained as close to the transcript as possible without losing any nuance of the information nor the implied meanings of the transcript. A total of 100 initial codes were generated.

Phase 3: identifying themes – The initial codes were collected and brought together for potential themes. This was done by looking for relationships between codes, noticing patterns and grouping similar codes. Techniques used for visual mapping and exploring relationships between codes and potential themes included thematic mapping.

Phase 4: Reviewing themes once the initial themes had been established, they were reviewed. During this process, the themes were compared both with the coded extracts and the complete data set. There were two

levels of reviewing; (a)–"checking whether the themes worked with the coded extracts and the entire data set" and (b) "considering whether the themes reflected the meaning of the entire data set". Themes were combined, separated or discarded.

Phase ٥: Defining and Naming Themes – during this phase, codes were grouped into themes by defining and naming each theme as the core concepts being represented. Definitions were revised until the meaning of each theme was completely understood. Subthemes were also identified and named.

Phase ٦: Writing up-The final thematic structure was presented and then given an indication of some illustrative quotes for each theme. All quotes were translated from Persian to English by the researcher to ensure the translation was accurate. To improve the trustworthiness and rigor of my analysis, I used a combination of methods. I used member checks by presenting a synopsis of the initial findings to three of the participants to examine if my interpretations of their data were accurate.

I used peer debriefing with two outside researchers who has no connection to this project but were knowledgeable about qualitative research methods to critique the coding and thematic structure and to guard against bias in the analysis. Finally, I used journal reflexivity as I kept a journal of the assumptions, decisions, and interpretations I was making during the research process to achieve confirmability.

Ethical Considerations

The researcher explained clearly to each participant about the nature and purpose of the study and what are the procedures involved in the study before the participant agrees to take part in the study. The researcher explained to all the participants about the right to withdraw from the study without any negative effects.

To protect participants' identities, all personal identifiers were removed and replaced with alphanumeric codes (e.g., P١, P٢, P٣ for "Participant") during the transcription and reporting stages. The collected data, including audio files and transcripts, were stored securely on a password-protected computer accessible only to the principal researcher. Participants were assured that their responses would be used solely for academic purposes and that confidentiality would be maintained in all publications.

Findings

The data analysis from interviews led to the generation of two major themes with subthemes. The first theme was titled The Nature and Dimensions of EFL Teachers' PCK in the Digital Age which indicated that how participants defined the nature and scope of PCK in the Iranian EFL context including its defining elements, situated and dynamic feature, culture-specific dimension, evolving challenges, and possibility of

PCK renewal in the digital age. The second theme was named Contextual Barriers to AI-Enhanced Professional Development which described the cultural psychological infrastructural ethical legal, and policy barriers that hinder the use of AI in Iranian EFL teacher professional development. The thematic outline is shown in Table ۲.

Overarching Theme	Subtheme	Description
۱. The Nature and Dimensions of EFL Teachers' PCK in the Digital Age	۱,۱ Foundational Components of PCK in EFL	Core elements including content knowledge, pedagogical knowledge, knowledge of learners, knowledge of curriculum, and knowledge of assessment
	۱,۲ The Situated and Dynamic Nature of PCK	PCK as context-dependent, practice-based, and continuously evolving through experience and reflection
	۱,۳ The Culture-Specific Dimension of PCK	The importance of cultural awareness, localization, and culturally responsive teaching in the Iranian context
	۱,۴ Emergent Challenges in PCK Development	Difficulties in connecting theory and practice, insufficient mentoring, and limited opportunities for reflection
	۱,۵ The Imperative for PCK Renewal in the Digital Era	The need to integrate digital and AI literacy into PCK frameworks
۲. Contextual Barriers to AI-Enhanced Professional Development	۲,۱ Cultural and Psychological Resistance to AI	Fear of replacement, distrust of technology, and entrenched traditional mindsets
	۲,۲ Infrastructural and Digital Divides	Limited internet access, high costs, and lack of localized AI tools
	۲,۳ Ethical, Legal, and Privacy Concerns	Data privacy, intellectual property, algorithm transparency, and legal ambiguities
	۲,۴ Gaps in Teacher Digital Literacy and Policy Support	Insufficient teacher training, lack of national AI strategy, and misaligned evaluation systems

Theme 1: The Nature and Dimensions of EFL Teachers' PCK in the Digital Age

This overarching theme captures participants' conceptualizations of PCK in the Iranian EFL context, revealing that PCK is understood as a multifaceted, dynamic, and context-dependent construct that extends beyond traditional definitions to encompass cultural, technological, and situational dimensions.

Subtheme 1.1: Foundational Components of PCK in EFL

Participants consistently identified several foundational components of PCK that are essential for effective EFL teaching. These components aligned with but extended beyond Shulman's (1986) original conceptualization.

Content Knowledge and Pedagogical Knowledge Integration. Participants emphasized that PCK in EFL represents a specialized integration of language content knowledge and pedagogical knowledge. As one university professor (P3) explained:

One university professor (P3) elaborated: 'You know; I've been teaching for 22 years. In the first 10 years, I thought PCK was just about knowing grammar rules. But then I realized, when a Persian-speaking student says 'I have seen him yesterday,' it's not a random mistake. It's because in Persian, we don't have that precise distinction between 'I saw' and 'I have seen.' So now, when I train new teachers, I tell them: your PCK starts with understanding your learners' linguistic DNA. Without that, you're just reciting rules.'

Another participant (P4), a curriculum developer, added:

"Many teachers know the content of the textbook, but when you ask them why they chose a particular teaching method for a specific grammatical structure, they cannot justify it. PCK is the ability to justify the 'why' of a teaching method for a specific content."

Knowledge of Learners and Their Misconceptions. Participants highlighted the importance of understanding learners' linguistic misconceptions, particularly those arising from cross-linguistic interference between Persian and English.

"The most critical component of PCK for me is knowledge of learners' misconceptions. A teacher with strong PCK can categorize learners' errors: which errors are due to language transfer (influence of Persian), which are due to overgeneralization, and which are due to lack of practice. Based on this diagnosis, he provides different feedback. But a novice teacher sees all errors as the same and usually just provides the correct form without addressing the 'why' of the error." (P5, Assessment Specialist)

Knowledge of Instructional Strategies and Representations. The ability to represent abstract linguistic concepts in accessible ways was identified as a crucial component of PCK.

"One of the most important components of PCK for me is 'representational knowledge.' A teacher must know what example, what image, what short story, or what role-play is best for teaching an abstract concept like the third conditional—something that is both engaging and internalizes the rule in the learner's mind. Unfortunately, many teachers use the same textbook examples without considering whether these examples are relatable to a 10-year-old Iranian learner." (P3, Professor of Teaching Methodology)

Knowledge of Assessment and Evaluation. Participants emphasized the importance of fair and contextualized assessment as a dimension of PCK.

"A dimension that is often neglected is 'knowledge of fair assessment and error diagnosis based on the learner's level.' Many teachers treat every grammatical mistake as a 'failure,' while sometimes a mistake is a sign of progress. For example, a beginner learner who says 'I go to school yesterday' is actually using past tense knowledge (however incomplete). This is a 'creative' error, not an absolute mistake. A teacher with strong PCK knows how to interpret this error based on the learner's level and provide appropriate feedback." (P^۴, Assessment Specialist)

Table ۳ presents a summary of the open codes associated with each foundational component of PCK identified in this subtheme.

Table ۳. Open Codes for Foundational Components of PCK in EFL

Component	Open Codes	Frequency
Content-Pedagogy Integration	PCK is the integration of grammar with understanding the learner's cognitive processes	۱۲
	PCK is the ability to justify the 'why' of a teaching method	۸
Knowledge of Learners & Misconceptions	Knowledge of diagnosing the root of cross-linguistic errors in Persian speakers	۱۵
	Categorizing errors: language transfer, overgeneralization, lack of practice	۱۰
Knowledge of Strategies & Representations	Representational knowledge: transforming rules into stories, images, role-plays	۱۴
	Using varied examples relatable to Iranian learners	۹
Knowledge of Assessment	Fair assessment and error diagnosis based on the learner's level	۱۱
	Recognizing 'creative' errors as signs of progress	۷

Subtheme 1.2: The Situated and Dynamic Nature of PCK

Participants consistently emphasized that PCK is not a static body of knowledge but a situated, dynamic, and practice-based construct that evolves through experience and reflection.

"PCK is dynamic and situated. A teacher must, in the moment, based on the reactions in the learners' eyes, facial expressions, and even body language, change their teaching strategy. This knowledge is not given by any book, because it is highly context-dependent." (P^Λ, Professor of Learning Theories)

A teacher educator (P[◊]) elaborated:

"PCK is knowledge that is constructed and reconstructed through teaching experience and reflective practice. When teachers collaboratively design a lesson, teach it, watch the video, and discuss the learners' moment-by-moment reactions, they gradually develop the awareness of 'why I reacted that way in that moment' and 'what better response I could have given.' This process is exactly what Schön calls 'reflection-in-action,' and it is the heart of PCK."

One experienced teacher (P^{۱۲}) shared her journey:

"When I started teaching ۱۰ years ago in a girls' high school in Isfahan, I memorized the textbook and thought I was a good teacher. But then I had a student who was dyslexic. I had no idea how to help her. That's when I realized PCK isn't a fixed set of knowledge—it's a constant process of adapting. Every year I learn something new. Last year, I learned how to use AI to generate alternative exercises for students with special needs. This is what PCK looks like in practice."

Table ۴ presents a summary of the open codes associated with the Situated and Dynamic Nature of PCK identified in this subtheme.

Table ۴. Open Codes for the Situated and Dynamic Nature of PCK

Component	Open Codes	Frequency
Dynamic and Situated Nature of PCK	PCK as dynamic and context-dependent knowledge	۱۴
Reflection-in-Action	Changing strategy based on learners' moment-by-moment reactions	۱۲
Evolution through Experience and Reflection	Knowledge constructed and reconstructed through experience and reflection	۱۶
Reflection-on-Action	Learning through reviewing video of teaching and group discussion	۱۰

Subtheme 1.3: The Culture-Specific Dimension of PCK

Participants highlighted the importance of cultural awareness, localization, and culturally responsive teaching as a dimension of PCK that is particularly relevant in the Iranian context.

"For me, PCK means 'knowledge of content localization.' An English teacher in Iran should not simply teach an international textbook cover to cover without considering the culture and identity of the Iranian learner. English is an international language, but it should not come at the cost of ignoring the local culture. For example, when a teacher wants to talk about 'celebrations,' they should choose topics that both address English-speaking cultures and allow for a cultural comparison with Iranian traditions like Nowruz or Yalda Night." (P^۷, Professor of Intercultural Communication)

Another participant (P^{۱۰}), a curriculum studies expert, extended this argument:

"Classical models like Grossman's are not sufficient for the EFL context. We need to add a new dimension: 'knowledge of multicultural and multilingual interactions.' Why? Because today's language classroom is no longer homogeneous. Students with different linguistic, ethnic, and cultural backgrounds sit together. Even in Iran, we have Turkish, Kurdish, Baloch, Arab, and Persian students, each with their own linguistic and cultural systems. The teacher must know how to turn this diversity into a learning opportunity."

Table ۵ presents a summary of the open codes associated with the Culture-Specific Dimension of PCK identified in this subtheme.

Table ۵. The Culture-Specific Dimension of PCK

Component	Open Codes	Frequency
Content Localization	Knowledge of localizing content with Iranian culture	۱۳
Culturally Responsive	Teaching Aligning examples with Iranian culture (Nowruz, Yalda Night)	۱۱
Multicultural and Multilingual Awareness	Knowledge of multicultural and multilingual interactions in diverse classrooms	۹
Turning Diversity into a Learning Opportunity	Using linguistic and cultural diversity as a bridge	۷

Subtheme 1.4: Emergent Challenges in PCK Development

Participants identified several challenges that Iranian EFL teachers face in developing their PCK, including the gap between theory and practice, insufficient mentoring, and limited opportunities for peer reflection.

"The biggest challenge is the gap between theory and practice. Student-teachers learn many theories in methodology courses, but when they sit in the practicum and have to teach a specific lesson from the textbook, they don't know how to turn those theories into practical activities. They know that 'interactive activities are good,' but they don't know what interactive activity to design for teaching comparatives. This means they know the 'why' of methods but not the 'how' of implementation for specific content." (P^٥, Teacher Educator)

Ahmadi's (٢٠٢٥) findings on the Iranian teacher education context were echoed by several participants:

"The current teacher education system has many shortcomings, such as insufficient ongoing mentoring and limited opportunities for peer reflection. Student-teachers are not given enough opportunities to reflect on their practice with experienced mentors." (P^١, Professor of Applied Linguistics)

The centralized curriculum was also identified as a barrier:

"This neglect, according to P^٢, a curriculum planning expert, is deeply structural. He argued: 'We have a single textbook for the entire country that dictates "what" content to teach in each session. But we fail to teach the teacher "how" to make that unified content comprehensible and engaging for a class of ٣٠ students with vastly different proficiency levels. This is the exact PCK gap.' The centralized system thus reduces teachers to mere transmitters of content, rather than reflective practitioner" . (P^٢, Curriculum Planning Expert)

Table ٦ presents a summary of the open codes associated with emergent challenges in PCK development identified in this subtheme.

Table ٦. Emergent Challenges in PCK Development

Component	Open Codes	Frequency
Theory-Practice Gap	Inability to turn methodology theories into practical classroom activities	١٨
Lack of Mentoring and Continuous Feedback	Insufficient opportunities for reflection with experienced mentors	١٥
Centralized Curriculum	Top-down directives that limit teacher creativity	١٤
Teachers Reduced to Transmitters	Teachers as mere transmitters of content rather than reflective practitioners	١٠

Subtheme 1.5: The Imperative for PCK Renewal in the Digital Era

Participants emphasized the urgent need to update PCK frameworks to include digital and AI literacy.

"PCK today can no longer be purely traditional. The generation we are teaching is Generation Z—a generation that grew up with smartphones and is accustomed to images, videos, and online interactions. If a teacher wants to use the same methods from ۲۰ years ago with this generation, they will definitely fail. Therefore, PCK must include 'knowledge of using digital tools to highlight linguistic structures.' For example, using platforms like Edpuzzle to make videos interactive, or using Padlet for collaborative online activities." (P۹, Professor of Digital Literacy)

Another participant (P۱۱) emphasized the need for "critical digital literacy":

"The most important digital skill for an EFL teacher today is 'critical evaluation of digital resources.' The internet is full of linguistically incorrect content, inappropriate activities, and even harmful material. The teacher must be able to distinguish which online source is reliable, which activity is appropriate for the learners' level and learning objectives, and which tool truly contributes to learning versus which is just entertainment. This 'critical literacy' is an essential dimension of PCK in the digital age."

A professor of educational technology (P۶) added:

"With the rise of machine translation and generative AI, new types of errors have emerged—what I call 'machine translation errors.' Many learners, instead of writing sentences themselves, put them in Google Translate and copy the output. This leads to strange and unexpected errors that are not seen in the natural process of language learning. The teacher must be able to recognize these errors and help the learner understand why machine translation cannot replace their own linguistic thinking. This is a new and up-to-date dimension of PCK."

Table ۷ presents a summary of the open codes associated with the imperative for PCK renewal in the digital era, identified in this subtheme.

Table ۷. The Imperative for PCK Renewal in the Digital Era

Component	Open Codes	Frequency
Need to Update PCK with Digital Literacy	Generation Z requires digital teaching methods	۱۷
Critical Digital Literacy	Critical evaluation of online sources and identifying reliable content	۱۲
Recognition of Machine Translation Errors	New types of errors emerging from translation and AI tools	۱۰

Awareness of Digital Tools for Language Teaching	Using platforms like Edpuzzle and Padlet for engagement	^
--	---	---

Theme 2: Contextual Barriers to AI-Enhanced Professional Development

This overarching theme captures participants' perceptions of the barriers that impede the integration of AI into teacher professional development in Iran, encompassing cultural, psychological, infrastructural, ethical, legal, and policy-related obstacles.

Subtheme 2.1: Cultural and Psychological Resistance to AI

Participants consistently identified cultural and psychological resistance as one of the most significant barriers to AI integration.

"P^, a school principal with ^ years of experience, explained the cultural resistance: 'Two months ago, I suggested to our teachers that they use ChatGPT to design grammar exercises. You should have seen their faces. One of them said: 'So you want me to teach robots to teach? What's next? Fire us all?' It took me two hours to explain that AI is just a tool—like a whiteboard or a textbook. But this fear is real. Many of them think this is the beginning of the end.'"

A professor of educational psychology elaborated:

"The biggest psychological barrier is the 'fear of unemployment and replacement.' Many teachers feel that AI wants to take their place, and this is a direct threat to their professional identity and job security. This fear makes them resist AI rather than collaborate with it. Some even view using AI as a 'betrayal of the teaching profession.'" (P^, Professor of Educational Psychology)

One participant noted the challenges of changing entrenched mindsets:

"In many schools, teachers have been teaching the same way for 0 or 0 years. They are comfortable with their methods and see no reason to change. Introducing AI feels like a threat to their established routines. This resistance from 'traditional teachers' is a serious barrier." (P^, Experienced Teacher)

Table ^ shows a summary of the open codes associated with Cultural and Psychological Resistance to AI, identified in this subtheme.

Table ^. Cultural and Psychological Resistance to AI

Component	Open Codes	Frequency
-----------	------------	-----------

Cultural Resistance from Principals and Parents	AI perceived as an enemy and a threat to teachers	۱۸
Fear of Job Loss and Replacement	Professional identity threatened by AI	۱۶
Resistance from Traditional Teachers	Attachment to old methods and fear of change	۱۴
Tension Between Public Resistance and Private Use	Secretly using AI at home while opposing it publicly	۱۱

Subtheme 2.2: Infrastructural and Digital Divides

Participants highlighted significant infrastructural challenges, particularly the digital divide between urban and rural areas.

"The 'digital divide' is a serious problem in Iran. In many cities and rural areas, high-speed internet is not available, and even access to AI platforms like ChatGPT is limited due to filtering. How can we expect a teacher in a remote village to use this framework when they cannot even watch a simple video online? This inequality seriously threatens educational justice." (P^۶, Professor of Infrastructure Technology)

The high cost of AI tools was also identified as a barrier:

"Free versions of AI have many limitations. For serious and continuous use in Lesson Study projects, we need paid versions, which cost about \$۲۰-۳۰ per month per teacher. If a school with ۲۰ teachers wants to use these tools, it would cost \$۴۰۰-۶۰۰ per month, which is completely unaffordable for a public school in Iran." (P^۲, Curriculum Planning Expert)

One participant called for localized solutions:

"We need to design an 'offline' or 'semi-centralized' version of the framework. Tools that work with low or no internet. We could use smaller language models that can be installed on phones or laptops, or develop a local platform hosted on domestic servers that does not require connection to foreign internet." (P^۶, Infrastructure Technology Expert)

Table ۹ shows a summary of the open codes associated with Infrastructural and Digital Divides, identified in this subtheme.

Table ۹. Infrastructural and Digital Divides

Component	Open Codes	Frequency
-----------	------------	-----------

Digital Divide and Limited Internet Access	Lack of high-speed internet in rural areas	۲۰
High Cost of AI Subscriptions	Unaffordable costs for public schools	۱۵
Need for Offline Version	Designing tools that work with low or no internet	۱۴
Threat to Educational Justice	Inequality in access to technology deepens the gap between privileged and underserved areas	۱۲

Subtheme 2.3: Ethical, Legal, and Privacy Concerns

Participants raised serious ethical and legal concerns regarding AI integration.

"One of the biggest challenges is 'student privacy.' In this framework, we ask teachers to record their classes and provide the data to AI. But this recording includes the images and voices of students under ۱۸. Uploading this data to foreign servers is a serious ethical and legal dilemma. We don't know how this data is stored and used, and whether students' privacy is protected." (P^۹, Professor of Digital Ethics)

Intellectual property concerns were also raised:

"There is a major ambiguity about 'intellectual property of AI-generated content.' When a teacher designs a lesson plan or worksheet with the help of AI, who does this content belong to? To the teacher? To the AI developer? Or to the school? This question has not been answered in Iran's legal system. This ambiguity makes teachers cautious because they don't know if they can use this content as part of their professional portfolio." (P^{۱۰}, Professor of Intellectual Property Law)

Algorithm transparency was another concern:

"Teachers need to know on what basis AI provided a particular analysis or suggestion. If this transparency does not exist, teachers will not trust the machine and will abandon the framework, or conversely, they will blindly trust it and not see its errors." (P^{۱۱}, Professor of Educational Psychology)

Table ۱۰ shows a summary of the open codes associated with Ethical, Legal, and Privacy Concerns, identified in this subtheme.

Table ۱۰. Ethical, Legal, and Privacy Concerns

Component	Open Codes	Frequency
Student Privacy	Uploading images and voices of students to foreign servers	۱۷
Intellectual Property Ambiguity	Who owns AI-generated content?	۱۲

Algorithm Transparency	Lack of awareness of AI decision-making processes	۱۰
------------------------	---	----

Subtheme 2.4: Gaps in Teacher Digital Literacy and Policy Support

Participants identified significant gaps in teachers' digital literacy and the absence of supportive policies.

"Honestly, the average digital literacy of EFL teachers in Iran is low. Many are not familiar with basic concepts like 'prompt engineering.' They don't know how to communicate properly with AI to get useful output. For example, a teacher might ask 'give me a lesson' instead of 'design an activity for teaching simple present tense,' resulting in very general and useless output." (P۱, Professor of Applied Linguistics)

One participant called for mandatory training:

"Before anything else, teachers need a ۱۰- to ۲۰-hour course covering AI basics, prompt engineering principles, how to evaluate AI outputs, and ethical issues. These courses should be practical and project-based, not theoretical lectures." (P۲, Teacher Educator)

Participants also highlighted the lack of national policy:

"Our educational policymakers have not yet realized the importance of AI. Ministry of Education and Ministry of Science directives still emphasize traditional methods, and no national program for empowering teachers in AI has been developed. In the national curriculum, not even one clause is dedicated to AI." (P۳, Curriculum Planning Expert)

One participant noted:

"There is no coordination between the responsible institutions—the Ministry of Education, the Ministry of Science, and the Ministry of Communications. Each is working in isolation, and there is no unified national strategy for AI in education." (P۴, Infrastructure Technology Expert)

The misalignment of evaluation systems was also identified as a barrier:

"The biggest challenge is the current evaluation system's focus on 'final grades.' If a teacher spends their time and energy participating in AI-based Lesson Study sessions, but students' grades don't show significant change (especially in the short term), the school principal will consider it a waste of time and may prevent the teacher from continuing. This is a vicious cycle that pushes teachers toward short-term activities rather than deep, long-term professional development." (P۵, Curriculum Planning Expert)

Table ۱۱ shows a summary of the open codes associated with Gaps in Teacher Digital Literacy and Policy Support, identified in this subtheme.

Table ۱۱. Gaps in Teacher Digital Literacy and Policy Support

Component	Open Codes	Frequency
Weak Digital Literacy of Teachers	Lack of familiarity with prompt engineering and AI interaction	۱۹
Need for Prerequisite Training	۱۰-۲۰ hour courses on AI basics, prompt engineering, and ethics	۱۶
Lack of National AI Strategy	No national program for empowering teachers in AI	۱۴
Lack of Coordination Between Responsible Bodies	Ministry of Education, Science, and Communications working in isolation	۱۰
Misaligned Evaluation System	Focus on final grades instead of teacher growth process	۱۸

Summary of Findings

The interview data analysis generated two themes with nine subthemes. The first theme, The Nature and Dimensions of EFL Teachers' PCK in the Digital Age, helped to understand how participants' view about essential components (content-pedagogy integration, knowledge of learners, knowledge of strategies, and assessment knowledge), situated and dynamic nature (knowledge constructed in practice and reflection), culture-specific dimension (localization and an inclination toward culturally responsive teaching), emergent challenges (implementation of PCK in line with a gap between theory and practice and lack of adequate mentoring), and renewal in the digital age dimensions of PCK. The second theme, Contextual Barriers to AI-Enhanced Professional Development illuminated cultural and psychological resistance to AI, infrastructural and digital dividing lines ethical legal and privacy issues and gaps in teachers' digital literacy and policies, as critical barriers to implementing AI in professional development of Iran's teachers. So, these themes provide an insightful overviews of the present state of Iran's EFL teachers' PCK and contextual elements which needs overcoming for online professional development.

Discussion

This qualitative inquiry explored the components of EFL teachers' Pedagogical Content Knowledge in the digital era and the contextual challenges in implementing AI-supported teacher professional development in Iran by conducting thematic analysis of the interviews with ۱۲ specialists. The results led to ۲ main themes with ۹ subthemes, which provided a deep understanding of the conceptions of PCK of Iranian EFL teachers and the probable factors hindering implementation of AI into the educators' professional development. An interpretation of the findings when talking about the relevant literature, discussing

theoretical and practical implications, and delineating the limitations of the study will be discussed in the next section.

The Nature and Dimensions of EFL Teachers' PCK

The results of this study are consistent with and add to the existing research on PCK in language teaching. Participants all identified as core elements of PCK a combination of content and pedagogical knowledge, their knowledge of linguistically marginalized and erroneous learners, their knowledge of pedagogical and instructional strategies and representations, and their knowledge of assessment. These elements concur with both the historical view of Shulman (1986, 1987), Grossman's (1990) model, and also the particular context of language teaching. For example, the importance placed on learners' cross-linguistic interference, seems to be mostly highlighted in Iranian EFL contexts and emphasizes the situated nature of PCK (Berry et al., 2014; Park & Oliver, 2008). This way, a different story was told by the others for teaching experience and PCK development.

Although it's reasonable to expect that with longer years of teaching the teachers have developed more PCK, participants (P4, P6 and P11) argued that some veteran teachers are still developing static PCK. As P11, an educational psychologist, put it, 'I have seen teachers of 20 years' experience still on the same level of teaching they were on during their first year in the classroom. They have 20 years' experience but only one year of experience 20 times.' So teachers' reflection on experience is the other requirement for PCK development rather than merely experience in years. This discovery is inconsistent with the assumption of the direct relationship between years of experience and PCK; it reveals the importance of a careful, collaborative reflection on experience to facilitate PCK development, which is most of all vital in Iran where teachers lack of participation in any professional development opportunities in a formal way.

What struck me most in the data was not that PCK is dynamic (we've known that), rather how it's made to be dynamic. For some (participant P12 and P9) it was through experiencing failure: a student who cannot learn, a whole class that went wrong, while for some (participant P3 and P5) it was through careful reflection, such as lesson study or peer observation. Interestingly, none of the participants mentioned courses in formal teacher training as a way they developed PCK. So a rather disturbing question arises: are our teacher training programs failing to develop PCK? I believe the answer is yes, judging by the data found in this study (Berry et al., 2014; Park & Oliver, 2008). The participants' high recall of changing their teaching practices based on learners' reactions from moment to moment is reminiscent of Schön's (1983) reflection-in-action and points towards the importance of learning through experience for development of

PCK. This also gives an important message for teacher education, which is that opportunities should be given to engage in sustained and reflective practices.

This culture-specific dimension of PCK, which emerged from this research, broadened the conception of PCK identified by classic studies of the construct. Participants were very much concerned with the aspects of localization, contextualization of content and culture for learners' intercultural interactions and multicultural considerations of the teaching environment. This aspect in PCK was in relation with GT studies of culture-sensitive language teaching and I believe that the idea of bridging the linguistic and cultural chasm must underlie effective PCK in EFL contexts (۳۰۰۸). As to the Iranian context, this culture dimension of PCK is apparent due to the heterogeneous nature of Iranian language users who embody knowledge of Persian Azeri Kurdish, Baloch and Arab language ecology.

The emerging challenges in PCK development revealed by the participants, such as the theory-practice gap, lack of mentoring and scant opportunities to reflect on own practice by peers, are in agreement with the existing data in Iran about teacher education. Ahmadi, for example, argued that Iranian teacher education lacked enough ongoing mentoring of student teachers as well as sufficient opportunities to reflect on one's own practice with peers (۳۰۲۵). The emerging challenges explicitly or implicitly stem from the common challenges faced in teacher education throughout the world, where the theory-practice dichotomy or gap between the university-based theoretical knowledge with school-based practical knowledge, still plagues teacher education (Darling-Hammond, ۳۰۰۶). That means, the results presented above inform us of the existence of these challenges in Iranian teacher education, which can only be overcome through structural reforms in teacher education programs to provide longer opportunities of mentoring and reflection on own practice with peers, and stronger initiatives to bridge the theory-practice gap.

What surprised me most in the data was the paradoxical or ambivalent feelings the teachers seemed to have about AI. While they seem genuinely excited about its potential to help them in the immediate task of helping them design material and analyzing errors, they seemed anxious about its implications for the longer-term future of their profession. One teacher is even quoted as saying, 'I tell my students that they must use AI responsibly, but I sometimes don't even know what "responsible" means anymore.' While these feelings of anxiety and fear are themselves shared to some extent by the society-at-large, what this presents are a particular challenge for schools how do you train teachers to use tools that they themselves are also not familiar with, nor necessarily in favor of? This finding points towards the creation of an emotional/psychological space. The need for PCK updating in the AI era became another significant finding.

Participants pointed out that PCK should be (updated with digital and AI literacy, digital resources' critical evaluation, and new types of errors introduced by the MT and AI tools). This finding is consistent with the

emerging work of AI-pedagogical knowledge that describes the specialized knowledge and competence to translate general teaching intentions into AI-instructions (Chen et al. (Chen et al., ۲۰۲۶). As a form of "critical digital literacy", the generation of "critical digital literacy" proposed by this study has strengthened the AI-relevant PCK of the initial i-TPACK in the direction of not only ethical awareness but also critical evaluation skills in the AI-intensified educational context Celik (۲۰۲۳). It also echoes the other emerging work of AI-generating GenAI literacy in L^۲ teacher education (You & Zhang, ۲۰۲۶).

A Conceptual Framework for PCK in the Digital Age

Bringing together what our study has revealed, I develop a theoretical setup about the EFL teachers' PCK formation in the digital era, for the Iranian situated EFL context. As this system, PCK is a fluid dynamic conceptual entity which is embedded in and depends on the interaction of ۴ dimensions: (۱) Foundational Knowledge (content-pedagogy integration, knowledge of learners, knowledge of strategies and knowledge of assessment), (۲) Reflective Practice (the ability for reflection-in-action and reflection-on-action, underpinned by community of inquiry and structured professional development), (۳) Cultural responsiveness (localizing content, functioning in multicultural and multilingual learning environments, bridging the language and culture distance), and (۴) Digital-AI literacy (evaluating digital resources critically, employing AI tools pedagogically, and overcoming AI-related ethical and practical issues).

This system builds on traditional models of PCK (Shulman, ۱۹۸۶, ۱۹۸۷; Grossman, ۱۹۹۰) by explicitly including digital-AI literacy as an element, understanding that language teaching in the ۲۱st century involves more than content and pedagogical knowledge; it must also encompass the capacity to harness emerging technology in reflective and innovative ways. And, the system foregrounds the situated nature of PCK, focusing on the complex set of embedded politics, infrastructure, and policy contexts in which teachers' PCK is formed.

Comparison with International Models

The conceptual framework proposed in this study offers several distinctive contributions compared to existing international models of AI-enhanced teacher professional development. For instance, the CollabAI model developed by Düzler and Kartal (۲۰۲۶) integrates ChatGPT into the lesson study cycle for pre-service English teachers, focusing on pedagogical reasoning, classroom practice, and reflective collaboration. While CollabAI demonstrates the potential of AI to support more creative lesson planning and deeper reflective dialogue, it is designed primarily for pre-service teachers and does not explicitly address the cultural, infrastructural, and policy barriers that shape AI integration in contexts like Iran.

The conceptual framework proposed in this study differs from the already prevailing CollabAI, which aims at general professional skills and only concerns with the barriers that might hinder its development in Iranian context namely cultural resistance, digital divide, ethical issues, and policy discrepancies. Our context-aware scaffold takes the conceptualization further by positioning ChatGPT as a "cognitive and reflective scaffold" in Iranian context. Modalities of AI in our context-aware scaffold should also be coupled with other contextual, institutional, and social factors, so that AI intentioned scaffold would be effective tool and not a pity token. Considering the logistics of AI scaffold, which mainly centers on Iranian EFL experts, gives this context-aware, more "local, " livable, and even theoretically sustainable model of AI-enhanced teacher professional development.

Contextual Barriers to AI-Enhanced Professional Development

The findings regarding contextual barriers to AI-enhanced professional development reveal the complex interplay of cultural, psychological, infrastructural, ethical, legal, and policy-related factors that impede AI integration in Iran.

Cultural and psychological resistance became a major obstacle emerging from the "fear of replacement, mistrust of the technology, and old-fashioned mindsets". These results echoed similar research on Chinese teachers' emotional experiences and the development of adaptive expertise with AI (Liu & Chang, ۲۰۲۴). AI innovations brought about anxieties over the future of EFL teachers. But paradoxically, "here is a paradox: the same teachers who fear AI are often the ones who use it most secretly. During the interviews, three participants (P۲, P۳, and P۴) admitted using ChatGPT to write feedback emails to their students or to translate texts, but they didn't tell any colleagues. One of them (P۴) remarked: 'I feel like a hypocrite. I criticize AI in faculty meetings, but at home, I'm using it to save time.' As far as I am concerned, this tension between an apparent wave of resistance and subversive adaptation is the most interesting finding of this research. It indicates that such cultural resistance is a social performance not actual belief. Transforming this cultural resistance involves embracing the cultural and psychological support as well as technical training in reconceptualizing the professional identity in the era of AI.

This phenomenon can be understood through the lens of cognitive dissonance theory (Festinger, ۱۹۵۷), which posits that individuals experience psychological discomfort when their behaviors contradict their stated beliefs or attitudes. For these teacher-respondents, the dissonance was caused by incongruity between their public confirmation stating that AI is a threat to professional identity, and private confirmation of autonomously using AI to increase efficacy. These teachers may because of this unload dissonance by justifying their private use "and I'm only using it to get work done" while holding onto their opposition to

the technology financially, to protect their professional self-concept. Clearly, if teacher resistance to the use of AI in PD is to be overcome, then teacher training may need to be followed by psychological support to may ease professional transition. As Arora, Sahi, and Yates (۲۰۲۳) found in their study of in teachers' transition to online teaching reveals the potential of cognitive dissonance as a barrier or facilitator of professional change, teachers need support to resolve the tension between their old and new professional practices if full acceptance of AI in teacher training is to be achieved (۲۰۲۳).

Infrastructural and digital divide were also pointed out as the major barrier, even referring more exactly to the lack of internet connection of high speed in rural areas, the high cost of AI tools, and the requirement of local, offline versions of the tools. It shows the relationship between educational technology and social justice, as the digital divide would worsen already existing inequalities in access and quality of education. The demand for semi-centralized or offline versions of the tools also seem to be an engineering response to infrastructural issues, and a way of rethinking the way AI tools can be applied in ways that are more affordable for less-resourced settings. Participants' concerns (e.g. data privacy, intellectual property, and transparency of algorithms) also correspond with the broad ongoing worldwide debate about the ethics of AI in education.

The concern about uploading of classroom data to servers abroad is mainly troubling to teachers in Iran in foreign sanctions and data sovereignty issues. The ambiguity for intellectual property is an unresolved problem globally, in most countries' legislations. These findings highlight the pressing need for explicit ethical guidelines, legal structures, and transparent algorithms so teachers become more willing to use AI tools for their professional development. Another major obstacle was gaps in teacher digital literacy and policy support. The participants observed that teachers' limited knowledge of prompt engineering and lack ability to critically evaluate the output of AI assistance.

This was corroborated by studies on the need for guided GenAI integration modules in EFL teachers' training (۲۰۲۴). The participating teachers also reported that the absence of national AI strategy and the misalignment of evaluation systems in Iran reflects policy barriers to AI implementation since it's hypercentralized, slow, and cautious in educational policy. Their report that the current evaluation system's focus on final grades discourages teachers from professional development processes that are deeply long-term is noteworthy, as it implies that even when AI tools were made available and teachers trained to make use of them, the policy instruments would promote longer-term success. This identified cultural resistance is rather a spectrum of public to private opposition, given that not every participant from a specific institutional setting expressed the same level of opposition. For example, the teachers working in private language institutes (P۲, P۱۲) seemed to be more open-minded to AI than those working in public school settings (P۸, P۹).

This might be due to in reality these teachers might enjoy a greater degree of institutional autonomy and market competition so holds a more open attitude towards educational reform. In addition, a few participants (P^۳ P^۴ P^۵) to be exact pointed out that the opposition to AI could be distinguished into two categories: "superficial" opposition (teachers verbally criticizing AI but using it in practice); and "substantive" opposition (teachers rejecting AI on the grounds of expertise). A curriculum developer (P^۶) said in the interview: "Some teachers said, "I don't use AI because it's unethical, " yet in fact they use it every day to do their shopping. That is just a performance." Recognizing the distinction between these two types of opposition will facilitate the development of effective intervention strategies: one systemically reducing superficial opposition by raising awareness and providing role models, and the other systematically reconceptualizing teachers' professional model.

Theoretical and Practical Implications

The findings of this study have several theoretical and practical implications.

Mainly, this study makes a theoretical contribution by reconceptualizing PCK in the twenty-first century. By revealing culture-specific and digital literacy components of PCK, this study extends the classical conceptions of PCK (Shulman, ۱۹۸۶, ۱۹۸۷; Grossman, ۱۹۹۰) to meet the specific needs of EFL instruction in the digital era. The notion of "critical digital literacy" as a domain of PCK brings an important further level of specification to classical PCK structures, and responds to calls for more transparent and detailed conceptions of teacher knowledge in contexts characterized by digital tools (Mishra & Koehler, ۲۰۰۶; Celik, ۲۰۲۳). Also, this study contributes to the nascent field of AI in language teacher education by delineating the precise intervention points to be overcome to achieve AI adoption in this context, because of this paving the way for further research and intervention studies. Practically, my findings are relevant to teacher educator, professional developer, and policy maker. Based on my data, I suggest three practical steps for Iranian teacher education: ۱) teach 'AI literacy' not as a separate course/module, but embed it in existing approach courses.

For instance, while student-teachers learn about lesson planning, they could also compare their lesson plan with an AI lesson plan and discuss the merits and flaws of both; ۲) Establish peer-mentoring systems between early-adopter teachers and skeptics instead of top-down training; and ۳) abolish the rule that 'all lesson plans must be hand-written'. One interviewee (P^۴) called it 'prehistoric'. These are small steps which can be taken to resolve the readily solvable which my research identified as key in practice. They cover AI literacy training in the use of prompt engineering, the critical evaluation of the outputs, and addressing ethical dilemmas. Second, professional development programs should also address the cultural and

psychological barriers to AI adoption in education, by helping teachers reimagine their professional identity in the light of AI and offering them sustained and collaborative professional development.

Third, Iranian policy makers should formulate a national AI strategy for education which addresses infrastructural, ethical and legal dimensions and helps reform the Iranian teachers' evaluation system to embody productive use of professional development. For the individual teacher who is reading this study and asking what does this mean for me, the implications are concrete. First, if you're an EFL teacher in Iran, what do you know: your PCK is neither collapsed nor static in fact, it can be developed over a long period of time in a structured way of reflective practice. Second, what do you know: it might be a good idea to form a small member bi-weekly Lesson Study group with some colleagues, even if your school is not willing to officially support it; three teachers working weekly for an hour can efficiently pursue a strong teacher inquiry. Third, what do you know: give AI a try, not as a replacement of your expertise more like as a source of alternative ideas and wholly objective feedback. For example, you can briefly input ۱۵۰ words of the day's target grammar. Then you ask ChatGPT three alternative activities; after that, compare ChatGPT's suggestions with your own, reflect on the differences, and question how they might influence your to-be-taught lesson. Fourth, keep a journal. For instance, one participant (P۱۲) says, 'I regularly make a note of everything that surprised me in each class; that notebook has been my most valuable resource in teaching.' In fact, you can incorporate this crucial step into the existing teacher research practices of reflective journaling and collaborate inquiry, meeting weekly for ۱۰-minute to enhance your PCK.

Limitations and Future Research

There are also some limitations to this study. Firstly, this study is based on data that are self-reported from a total of ۱۲ participants. Although I purposively selected the participants from different backgrounds to reflect the diversity of different perspectives, the data may not be representative for Iranian EFL teachers as a population. Because of this, these issues could be investigated with larger samples and quantitative or mixed-methods approaches.

Secondly, the research was conducted on the experts rather than the teachers themselves, though being experts in the field of PCK the experts had valuable insights into the concept and the factors blocking the development of PCK. But, observing the teachers' actual classroom practice could add supplementary evidence and has the potential of unmasking the differences between the teachers' perception and the reality of their PCK. To further uncover the deficiencies of the experts' perceptions of PCK, the experts' interviews could be complemented with classroom observation, video examination and other research methods.

Third, this study was conducted within the Iranian context and the generalizability of the barriers to other EFL contexts is uncertain. But, most barriers described such as the cultural resistance to AI, infrastructure issues, ethical concerns and policy gaps will probably be experienced by other developing and middle-income countries as well. Further comparative studies could provide insights into the distinction between those barriers specific to certain contexts and those which are wider-spread.

Fourth, the study did not focus in particular on the effectiveness of specific AI tools or professional development interventions. Future studies can develop and expand the understanding gained in this study in the development and evaluation of particular AI supported professional development programs to be exact in the Iranian EFL context.

Conclusion

In this qualitative research, the dimensions of EFL teachers' Pedagogical Content Knowledge (PCK) in the digital era and contextual barriers to AI-supported professional development were explored in the Iranian context. The themes identified from the expert interviews (N=۱۲) fall into two broad categories: (۱) nature and dimensions of EFL teachers' PCK including essential knowledge components, situated and dynamic characteristics of PCK, a cultural dimension of PCK, challenges related to PCK emergence, and necessity of its reconstruction in the digital era, and (۲) contextual barriers to AI-supported professional development encompassing culture and psychological obstacles, infrastructures and digital disparity, ethics and legal issues, and lack of digital literacies and professional support. Data says, classical models of PCK have been extended to respond to EFL teaching context in the digital era and key barriers to facilitate effective use of AI in teachers' professional development in Iran were identified. The findings provide EFL teachers' PCK in Iranian contexts and suggest a solid foundation for the advancement of language teacher education theoretically and practically, which has considerable implications for teacher education, professional development and policy-making.

The growing prevalence of advanced AI technologies and fast development of the digital environment in education necessitate an ever-increasing need to understand teachers' knowledge and barriers to its development. The present study can be considered an initial contribution to meeting this need and offers guidance for future studies and practices to advance the EFL teachers' PCK in the digital age. Though, as P۱۰, an evaluation specialist, put it, 'students' final grades are what the present evaluation system is concerned about. If a teacher is time-consuming and devote his/her efforts on AI-based Lesson Study, yet the changes on student grades in a short period don't result in remarkable change, the principal will assume it a waste of time, and block their participation'.

This means a fundamental reform on teacher evaluation system, the one who takes into consideration teacher's learning process, rather than students' performance, needs to be set alongside if the integration of AI into teacher professional development needs to be taken seriously. Finally, at the end of the interview, P^o an experienced teacher educator of several decades summed up: 'I started teaching in ۱۹۸۰, and we had a black board and chalk. Now teachers have more resources than I could have ever imagined. But good teaching remains good teaching; it has always been about the learner and how to make the material relevant and understandable for them. AI is one more tool, yes a tool of great power, but it's not the answer. The answer is, and will always be, the caring teacher who is reflective, collaborative, and open to learn.' This is the core issue this study aims to address PCK is not about technology; it's about the potential and need for human growth and connections, a capacity to be fostered, not substituted by AI.

References

- Ahmadi, P. (۲۰۲۵). The role of mentoring and reflection in shaping preservice EFL teachers' pedagogical content knowledge. *Iranian Journal of Applied Linguistics*, ۲۸(۲).
- Ahmadi, P., & Yousofi, N. (۲۰۲۵). Critical AI Literacy among English Teachers in Iran: Balancing the Affordances and Challenges of ChatGPT. *Technology Assisted Language Education*, ۲(۴), ۴۲-۶۲.
- Arora, J., Sahi, G. K., & Yates, N. (۲۰۲۳). Will teachers continue to teach online post-COVID-۱۹? *Behaviour & Information Technology*, ۴۲(۸), ۱۱۱۰. <https://doi.org/10.1080/0144929X.2022.2068611>
- Behroozizad, S., & Alizadeh, A. (۲۰۲۴). EFL teachers' perceptions on the role of Lesson Study in their professional development: Critical pathways. *Journal of Critical Applied Linguistics Studies*, ۱(۱), ۱۴۱-۱۶۰.
- Berry, A., Depaepe, F., & Van Driel, J. (۲۰۱۶). Pedagogical content knowledge in teacher education. In *International handbook of teacher education: volume ۱* (pp. ۳۴۷-۳۸۶). Singapore: Springer Singapore.
- Braun, V., & Clarke, V. (۲۰۰۶). Using thematic analysis in psychology. *Qualitative Research in Psychology*, ۳(۲), ۷۷-۱۰۱.
- Celik, I. (۲۰۲۳). Towards intelligent-TPACK: An empirical study on teachers' professional knowledge to ethically integrate artificial intelligence (AI)-based tools into education. *Computers in Human Behavior*, ۱۳۸, Article ۱۰۷۴۶۸.
- Celik, I., Dindar, M., Muukkonen, H., & Järvelä, S. (۲۰۲۲). The promises and challenges of artificial intelligence for teachers: A systematic review of research. *TechTrends*, ۶۶(۴), ۶۱۶-۶۳۰.
- Chen, Q., Tawilapakul, U., & Lin, A. M. (۲۰۲۶). Teacherness in the age of GenAI: An ethnographic exploration of pedagogical decision-making and AI integration in English language teaching. *System*, ۱۳۶, ۱۰۳۸۷۷.
- Darling-Hammond, L. (۲۰۰۶). Constructing ۲۱st-century teacher education. *Journal of Teacher Education*, ۵۷(۳), ۳۰۰-۳۱۴.
- Düzler, A., & Kartal, G. (۲۰۲۶). CollabAI: An AI-supported lesson study model for pre-service English teachers' professional development. *International Journal for Lesson and Learning Studies*. [https://doi.org/10.1108/IJLLS-07-2025-0177\[reference:۱۸\]](https://doi.org/10.1108/IJLLS-07-2025-0177[reference:۱۸])

- Ebrahimi, Z., Shakib Kotamjani, S., Qosimov, A., & Xodabande, I. (۲۰۲۵). Mapping the emerging research landscape on applications of ChatGPT in Language teacher education: A systematic narrative literature review. *Discover Artificial Intelligence*, ۵(۱), ۳۴۹.
- Fernández, M. L. (۲۰۱۰). Investigating how and what prospective teachers learn through lesson study. *Teaching and Teacher Education*, ۲۶(۷), ۱۴۱۷-۱۴۲۶.
- Festinger, L. (۱۹۵۷). A theory of cognitive dissonance. Stanford University Press.
- Gatbonton, E. (۲۰۰۸). Looking beyond teachers' classroom behaviour: Novice and experienced ESL teachers' pedagogical knowledge. *Language Teaching Research*, ۱۲(۲), ۱۶۱-۱۸۲.
- Grossman, P. L. (۱۹۹۰). The making of a teacher: Teacher knowledge and teacher education. Teachers College Press.
- Hosseinnia, M., Gholami Domskey, J., & Rahimian, S. (۲۰۲۵). Unleashing the potential of lesson study in EFL teacher professional development: exploring perspectives and prospects in the Iranian context. *Reflective Practice*, ۲۶(۱), ۵۵-۷۱.
- İleritürk, D. (۲۰۲۶) AI-Enhanced Lesson Study: Transforming Teacher Professional Development. *Marmara Üniversitesi Atatürk Eğitim Fakültesi Eğitim Bilimleri Dergisi*, ۶۴(۶۴), ۱۶۸-۱۸۸.
- Kerr, R. C., & Kim, H. (۲۰۲۵). From Prompts to Plans: A Case Study of Pre-Service EFL Teachers' Use of Generative AI for Lesson Planning. *English Teaching*, ۸۰(۱), ۹۵-۱۱۸.
- Kohnke, L., Moorhouse, B. L., & Zou, D. (۲۰۲۳). Exploring generative AI affordances for language teaching and learning. *RELC journal*, ۵۴(۲), ۵۳۷-۵۵۰.
- Konakbayeva, U., Baltasheva, P., Kuanysheva, B., Dauletova, I., Kydyrbayeva, G., & Karataeva, T. (۲۰۲۵). Artificial intelligence in microteaching lesson study: Enhancing pre-service teachers' confidence and instructional quality. *Educational Process: International Journal*, ۱۵. <https://doi.org/10.242۵۲۱/edupij.۲۰۲۵.۱۵.۱۲۷>
- Le, T. M., & Nguyen, H. B. (۲۰۲۵). Lesson study as a catalyst for enhancing EFL teachers' instructional practice. *Educational Process: International Journal*, ۱۷, Article e۲۰۲۵۳۶۶.
- Lewis, C., Friedkin, S., Emerson, K., Henn, L., & Goldsmith, L. (۲۰۱۹). How does lesson study work? Toward a theory of lesson study process and impact. In *Theory and Practice of Lesson Study in Mathematics* (pp. ۱-۲۰). Springer.
- Liang, J.-K., Wu, P., Tseng, S.-C., & Ku, O. (۲۰۲۵). Enhancing lesson study with generative AI powered TEAM Model platform. *International Journal for Lesson and Learning Studies*, ۱۴(۳), ۱۹۷-۲۱۴.
- Lincoln, Y. S., & Guba, E. G. (۱۹۸۵). Naturalistic inquiry. SAGE Publications.
- Liu, Y., & Chang, P. (۲۰۲۴). Exploring EFL teachers' emotional experiences and adaptive expertise in the context of AI advancements: A positive psychology perspective. *System*, ۱۲۶, Article ۱۰۳۴۶۳. <https://doi.org/10.1۰۱۶/j.system.۲۰۲۴.۱۰۳۴۶۳>

- Mehrbakhsh, A., Abbasian, G., & Mohammadi, M. (۲۰۲۴). Pedagogical content knowledge (PCK) as an evaluation lens for Iranian EFL teacher education programs: A glocal approach. *Teaching English as a Second Language Quarterly*, ۴۳(۳), ۵۳-۷۹.
- Mishra, P., & Koehler, M. J. (۲۰۰۶). Technological pedagogical content knowledge: A framework for teacher knowledge. *Teachers College Record*, ۱۰۸(۶), ۱۰۱۷-۱۰۵۴.
- Namanyane, T., & Shaoana, M. R. (۲۰۲۵). English teachers' pedagogical content knowledge in the implementation of learner-centered role-play: A case study of curriculum and policy reforms in China. *Cogent Education*, ۱۲(۱), Article ۲۴۸۸۰۷۳.
- Park, S., & Oliver, J. S. (۲۰۰۸). Revisiting the conceptualisation of pedagogical content knowledge (PCK): PCK as a conceptual tool to understand teachers as professionals. *Research in Science Education*, ۳۸(۳), ۲۶۱-۲۸۴.
- Rahimi, M., & Nabilou, Z. (۲۰۲۲). Public and private school teachers' perceptions of effective English language teaching in Iran. *Asia Pacific Education Review*, ۱۳(۳), ۱-۱۴.
- Schön, D. A. (۱۹۸۳). The reflective practitioner: How professionals think in action. Basic Books.
- Shulman, L. S. (۱۹۸۶). Those who understand: Knowledge growth in teaching. *Educational Researcher*, ۱۵(۲), ۴-۱۴.
- Shulman, L. S. (۱۹۸۷). Knowledge and teaching: Foundations of the new reform. *Harvard Educational Review*, ۵۷(۱), ۱-۲۲.
- Sousa, A. E., & Cardoso, P. (۲۰۲۵). Use of generative AI by higher education students. *Electronics*, ۱۴(۷), ۱۲۵۸.
- Stigler, J. W., & Hiebert, J. (۲۰۱۶). Lesson study, improvement, and the importing of cultural routines. *ZDM: The International Journal on Mathematics Education*, ۴۸(۴), ۵۸۱-۵۸۷.
- Vygotsky, L. S. (۱۹۷۸). Mind in society: The development of higher psychological processes. Harvard University Press.
- Wang, T. (۲۰۲۴). Using lesson study as a strategy to build in-service teacher's capacity of K-۱۲ AI education in Hong Kong. In *Implementing a ۲۱st Century Competency-Based Curriculum Through Lesson Study*.
- You, Y., & Zhang, Y. E. (۲۰۲۶). Developing AI literacies and negotiating professional identities: A study of pre-service English teachers in a ChatGPT-facilitated pedagogy. *British Journal of Educational Technology*.
- Yuan, Z., Zhong, X., Huang, W., Li, Z., Tang, X., & Tan, Q. (۲۰۲۵). GenAI-enabled microteaching lesson study: Developing prospective secondary mathematics teachers' TPACK in an online summer camp. *International Journal for Lesson and Learning Studies*, ۱۴(۳), ۲۹۸-۳۱۷.
- Zawacki-Richter, O., Marín, V. I., Bond, M., & Gouverneur, F. (۲۰۱۹). Systematic review of research on artificial intelligence applications in higher education – Where are the educators? *International Journal of Educational Technology in Higher Education*, ۱۶(۱), ۱-۲۷.

Zhou, K., Deng, H., Chan, H. C., & Lin, C. H. (۲۰۲۵). Integrating generative AI into language teachers' professional development: A longitudinal study using the synthesis of qualitative data (SQD) model. *Professional Development in Education*. <https://doi.org/10.1080/1941020۷,۲۰۲۵,۲۵۸۶۶۴۳>