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Re-examining Pre-service EFL Teachers' Readiness for Technology Integration: A TPACK Analysis in the Indonesian Context

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Abstract

The rapid expansion of digital technologies in education has renewed scholarly interest in how teachers conceptualize and enact technology integration. The Technological Pedagogical Content Knowledge (TPACK) framework provides a theoretically robust lens to comprehend the interconnected interaction among technology, pedagogy, and disciplinary knowledge. This study investigates Indonesian pre-service English as a foreign language (EFL) teachers' self-perceived TPACK competencies and their readiness to integrate technology into future instructional practice. Using a quantitative design, a validated TPACK questionnaire was administered to 100 pre-service teachers. The findings demonstrated a familiar yet theoretically significant pattern: participants report strong technological knowledge but comparatively weaker pedagogical, content, and pedagogical-content knowledge. This imbalance suggests that technological familiarity alone does not translate into integrated professional competence. The study argues that TPACK development must be understood as a situated, iterative process shaped by institutional structures, epistemic beliefs, and disciplinary demands. Implications are offered for redesigning teacher education curricula to foreground epistemic integration rather than tool-centered training.

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INTRODUCTION

Given the abundance of technologies available for educational purposes, there is growing interest in research on how Information and Communication Technologies (ICT) can be integrated into the classroom (Asipi & Diniya, 2025). Integrating classroom activities and technology can be applied in varied ways. Furthermore, much recent research distinguishes two complementary orientations that align with current TPACK perspectives, cognitive and sociocultural orientations. A cognitive orientation views digital tools as supports for constructing knowledge and deepening understanding through interaction with language

and tasks (Zhao, 2022). Digital tools can support learners in constructing knowledge, developing conceptual understanding, and engaging in higher-order thinking through meaningful interaction with language and tasks. In contrast, a sociocultural orientation emphasizes how technology enables participation in authentic social practices, allowing learners to collaborate, communicate, and engage in meaningful community-based activities (Reinhardt, 2020). A community-based approach provides students opportunities to participate in genuine social experiences to practice through engagement in actual activities. Both orientations reflect recent TPACK discussions, which reflect the pedagogical and contextual dimensions emphasized in recent TPACK, and the integration requires not only knowledge of tools but also the ability to design cognitively rich and socially meaningful learning environments (Schmidt et al., 2021).

However, further studies are needed to address this topic in certain contexts, especially regarding digital literacy. The digital technology integration in language education has moved from a peripheral concern to a central pedagogical imperative. As digital tools increasingly mediate communication, literacy practices, and knowledge production, language teachers are expected to orchestrate learning environments where technology is not merely an add-on but an epistemic resource that shapes how learners engage with language (Sivrikaya, 2020: Zou et al., 2022). This shift has intensified scholarly interest in gaining comprehension of teachers' knowledge, which requires meaningful technology integration.

In Indonesia, national education reforms and the post-pandemic acceleration of online learning have placed additional pressure on teacher education programs to cultivate graduates who are technologically competent. Although many future teachers are increasingly familiar with digital platforms, this familiarity does not turn those teachers' technological comfort into decisions that reflect solid pedagogical knowledge (Ariyanti & Santosa, 2021).

Mishra and Koehler's 2006 model underscores that effective integration requires teachers to coordinate their knowledge or understanding of subject matter, teaching methods, and digital tools. Yet, current literature indicates that pre-service teachers frequently develop these domains unevenly, with technological knowledge outpacing pedagogical and content-related competencies (Tondeur et al., 2021). This imbalance is not merely a skills gap; it reflects deeper epistemic and structural issues within teacher education (Almusharraf & Bailey, 2021; Anjarani, 2020).

Research on TPACK in Indonesia has grown in recent years, reflecting the increasing emphasis on technology integration in education. Research in multiple fields, including English education, has explored how teacher candidates build their TPACK in various disciplines. These studies generally show that while technological knowledge tends to be strong, pedagogical and content-related knowledge require further development (Bahari et al., 2025; Chen, 2025; Sari & Wahyudi, 2020).

Findings from Bahari et al., (2025) reported that even when advanced digital tools such as CALL and AI-assisted platforms are introduced, preservice teachers often struggle to translate technological familiarity into coherent pedagogical strategies. Similarly, Sari and Wahyudi (2020) highlight that Indonesian preservice teachers' TPACK development remains uneven, with limited opportunities to apply technology meaningfully during coursework or teaching practicum. Chen (2025) adds that constraints such as limited digital literacy, lack of confidence, and insufficient institutional support continue to hinder effective technology integration in EFL settings. Taken together, these studies suggest that although pre-service teachers may possess fundamental technological skills, they still face challenges in mobilizing TPACK in ways that are in accordance with the pedagogical and linguistic expectations of ELT in Indonesia.

Overall, prior research indicates that even when pre-service teachers possess basic technological abilities, they often find it difficult to apply TPACK in ways that align with the instructional and linguistic demands of teaching English in the Indonesian context. Although discussions on TPACK are not new in the country, most studies concentrate on general competence levels and rarely consider how teachers' digital literacy shapes their ability to use technology meaningfully in the classroom. This oversight is particularly relevant in English instruction, where educators must navigate multimodal materials, online interaction, and technology-supported tasks. To address this issue, the present research examines how teachers' digital literacy relates to their use of TPACK when planning technology-supported language learning tasks. This explicit focus on the relationship between TPACK and digital literacy in the Indonesian EFL context constitutes the main novelty of this research and underscores its urgency in today's digitally mediated learning landscape.

Recent literature highlights that teacher candidates need well-designed opportunities to work with digital tools when planning instruction. When such learning experiences are limited, they often find it difficult to build the kind of interconnected understanding required by the TPACK framework (Tondeur et al., 2021; Wang & Chen, 2023). Addressing this issue, the current research explores how Indonesian pre-service EFL teachers view the use of technology in their learning environment and examines how these interpretations connect to their readiness to meet TPACK-based competency demands. In this regard, readiness is defined as self-perceived competence across the domains of the TPACK framework.

METHODS

Research Design

This study employed a descriptive quantitative design to analyze how future EFL teachers evaluate their competence in the TPACK domains. This design was chosen because it allows the researcher to quantify participants' self-evaluations across all seven areas of the framework. A questionnaire-based quantitative study was selected using closed-ended items because it involved many participants, facilitated straightforward coding and tabulation, and offered greater objectivity. Structured questionnaires with fixed alternatives are particularly effective for statistical work because the responses can be processed quickly and analyzed with precision. Descriptive quantitative research is also well suited for identifying overall tendencies and highlighting areas where participants show either confidence or difficulty (Creswell & Creswell, 2021; Dörnyei & Taguchi 2009). Because the study also examined the relationships among the TPACK domains, correlational analysis was conducted. The following hypotheses guided this part of the analysis:

H_0: There is no significant relationship between pre-service EFL teachers' overall TPACK competence and the TPACK component domains.

H_1: There is a significant positive relationship between pre-service EFL teachers' overall TPACK competence and the seven TPACK component domains.

In line with the study's descriptive purpose, mean scores and standard deviations were used to summarize participants' perceived competencies within each TPACK domain. These descriptive statistics made it possible to identify general patterns, trends, and areas of relative strength or weakness within the population (Creswell & Creswell, 2021).

In addition to descriptive analysis and to examine the relationships among the TPACK domains, a Pearson product–moment correlation test was conducted. Pearson correlation is suitable for interval-level data and is commonly applied to examine how strongly continuous measures relate to one another and the direction of that relationship (Creswell & Creswell, 2021; Salkind, 2022). To determine whether the relationships among the

domains were statistically meaningful, the Pearson *r* coefficients and the significance values ($p < .01$) were used.

In this study, the design allowed the researchers to capture a broad overview of pre-service teachers' readiness to incorporate technology in teaching. It explored TPACK from the EFL perspective of Indonesian pre-service teachers. Studies on TPACK in the English as a foreign language (EFL) context are still limited. The next part will elaborate on the research design, the participants, the instruments that were used, and the data collection process.

Subjects of Research

The present study investigated a descriptive quantitative method to assess how Indonesian EFL teacher trainees evaluate their TPACK domains. The research population included students from English education programs at universities in Indonesia. From this population, 100 individuals were recruited through convenience sampling, which relies on the accessibility and voluntary participation of respondents and is widely applied in educational research (Creswell & Creswell, 2021).

The sample size was considered sufficient for identifying general trends in how teacher candidates view their TPACK abilities. Similar sample size considerations are consistent with earlier Indonesian EFL research when exploring readiness for technology-enhanced teaching (Rusmanayanti & Nasrullah, 2020). By involving participants from various points in their teacher-training programs, the dataset brought diverse experiences with technology and teaching practice. Data were gathered through a structured questionnaire or a closed-ended questionnaire, distributed to pre-service teachers in Indonesia to gain an overview of their perceptions of TPACK.

Instrument of the research

The instrument was designed to explore how TPACK, viewed as part of broader ICT integration, can be applied in EFL instructional settings. In order to pursue the aim, three main questions are formulated:

1. What are the pre-service teachers' perceptions of TPACK in Indonesia?
2. Which knowledge (technological, pedagogical, or content knowledge) components from TPACK are the most acknowledged by the pre-service teachers?
3. What relationships describe the pre-service teachers' perceptions of the dimensions of the TPACK framework?

This type of questionnaire allowed the researcher to collect data efficiently via an online form using Google Forms. To address these inquiries, the study employed an adapted version of the questionnaire developed by Schmidt et al. (2009). It consisted of Likert-scale items modified by the researchers that measured participants' self-perceived competencies across the seven TPACK domains. Items were revised to ensure relevance to EFL contexts and clarity for Indonesian pre-service teachers. The reason for choosing a questionnaire with closed-ended items for this instrument is that a questionnaire can "reach many participants, versatility, and quick processing by either quantitative or qualitative methods" (Dörnyei, 2010). The questionnaire items were intended to capture teacher trainees' self-assessments across the seven areas of the TPACK framework. These components include Technological Knowledge (TK), Content Knowledge (CK), Pedagogical Knowledge (PK), Pedagogical Content Knowledge (PCK), Technological Content Knowledge (TCK), Technological Pedagogical Knowledge (TPK), and the combined construct known as Technological Pedagogical and Content Knowledge (TPACK) (Mishra & Koehler, 2006; Schmidt et al., 2009). The instrument was validated by experts and a pilot administration to ensure that it met standards of reliability and content accuracy.

Furthermore, a main reason for modifying the original Schmidt et al. questionnaire was that it was used to study TPACK concerning science subjects. Meanwhile, the study focused on EFL in social studies and needed a different perspective on certain questionnaire items to make it more adaptable to the EFL context. The instrument contains 61 items to assess self-efficacy among EFL pre-service teachers. As mentioned earlier, the questionnaire consists of 7 items related to TK, 28 items related to CK, 6 items related to PK, 7 items related to PCK, 4 items related to TCK, 5 items related to TPK, and 4 items related to TPACK. The data were collected from participants using a five-point Likert scale: 1. Strongly disagree; 2. Disagree; 3. Neutral; 4. Agree; 5. Strongly agree.

To ensure the instrument met acceptable quality standards, expert reviewers examined the items for content accuracy, and reliability was assessed using Cronbach's alpha. The resulting coefficient of 0.74 reflects an acceptable level of internal reliability, indicating satisfactory internal consistency based on Dörnyei's guidelines.

Data Analysis and Ethical Considerations

Descriptive statistics were used to analyze participants' responses. For each component of the TPACK framework, mean scores and standard deviations were generated to highlight general tendencies as well as areas of relative strength or difficulty among participants. The analysis focused on understanding overall patterns in participants' perceptions rather than making causal inferences. This approach aligns with the study's aim of exploring pre-service teachers' readiness for technology integration (Creswell & Creswell, 2021; Wang & Chen, 2023).

The institutional review board approved the ethical clearance. This study recruited the participants voluntarily and anonymously to ensure confidentiality. The participants in this research were EFL teacher candidates who were in the fifth to seventh semesters of their study programs. They had also completed teaching courses and skills courses in the English language study program.

Research Procedures

The questionnaire was distributed online using a secure survey platform and offline. The study's purposes and informed consent were communicated to participants prior to completing the survey. To ensure the efficiency of data collection, the online format was chosen so that it enabled participants to respond conveniently. For an offline, anonymous form of questionnaire. Data collection was carried out over two weeks.

The questionnaire was distributed using both online and offline formats to ensure broad participation and accessibility. Prior to distribution, the instrument underwent a preparation stage that included expert validation and a small-scale pilot test to evaluate clarity, relevance, and item reliability. These steps followed established guidelines for instrument refinement, which emphasize the importance of content validation and iterative revision before full deployment (Creswell & Creswell, 2021). To ensure voluntary participation, the participants were informed that this study would be conducted confidentially. In the online format, the questionnaire was administered through a secure survey platform that allowed participants to complete the items at their convenience. For participants who preferred or required an offline option, printed anonymous questionnaires were provided to ensure equitable access. Data collection was conducted over a two-week period, during which reminders were issued to encourage timely completion. At the final stage of data collection, all responses were compiled, screened for completeness, and processed for analysis.

RESULTS AND DISCUSSION

The following section presents the quantitative analysis, summarizing how future EFL teachers rated their competence in each area of the TPACK construct. The findings are organized into four main sections: (1) descriptive statistics for each TPACK domain, (2) identification of areas of strength, (3) identification of areas requiring improvement, and (4) an overall interpretation of how well future EFL teachers perceive themselves as prepared for technology-enhanced teaching. These results are based on responses from 100 participants who completed the TPACK questionnaire.

Descriptive Statistics of TPACK Domains

Research on TPACK within English language education has gained attention, as teaching EFL presents complexities comparable to those found in subjects with mathematically or scientifically oriented curricula (Cahyono et al., 2016; Chai, 2020).

The answers received from the participants were automatically entered into a spreadsheet provided by Google Forms, and the resulting data were then imported into SPSS 25 for statistical analyses. Reliability for each of the seven dimensions was examined using alpha coefficients (see Table 1). All coefficients were above 0.70, indicating acceptable reliability or satisfactory internal consistency (Creswell & Creswell, 2021; Dörnyei, 2007).

Table 1 Reliability Coefficients for the TPACK Dimensions

Construct	***Cronbach's α***
Technological Knowledge (TK)	.833
Content Knowledge (CK)	.776
Pedagogical Knowledge (PK)	.829
Pedagogical Content Knowledge (PCK)	.840
Technological Content Knowledge (TCK)	.868
Technological Pedagogical Knowledge (TPK)	.757
Technological Pedagogical Content Knowledge (TPACK)	.790

All seven scales reached an acceptable level of reliability. To measure reliability, known as internal consistency among score items, Cronbach's alpha was used. The results showed that item-level responses were strongly associated with the total scale scores, with the highest item–total correlations found in TCK (.868), PCK (.840), and TK (.833).

Comparison of the TPACK Domains

Following the reliability assessment, descriptive statistics and correlation analyses between the scales were conducted in this study. Descriptive statistics of the scales were examined in this study to examine the mean and standard deviation of each TPACK component. Additionally, Pearson's correlation was used to determine how technological knowledge interacts with the other constructs within the TPACK instruments.

In response to the research question on Indonesian EFL teacher candidates' views of their TPACK abilities, summary statistics for each domain, which include mean and SD values, are displayed in Table 2. Among the seven components, the highest mean scores were found in the areas of technological content knowledge, technological knowledge, and Technological Pedagogical Knowledge.

It can be explained from Table 2 above that TK is in first place, followed by TCK, TPK, CK, TPACK, PCK, and PK. It can be inferred that the pre-service teachers have a strong foundation in technology or are technology-savvy. They can quickly adapt the technologies to their teaching and be more creative in using those devices and applications. This can be linked to the willingness to adapt and learn more from up-to-date ICT knowledge and information regarding their technology use. The ability they have learned might be related

to access to new ICT information and its use, either through the course's assignments or other sources.

Table 2 Summary statistics for the TPACK components (N = 100)

Construct	Mean value	Standard deviation
Technological Knowledge (TK)	3.71	.619
Content Knowledge (CK)	3.59	.449
Pedagogical Knowledge (PK)	3.51	.499
Pedagogical Content Knowledge (PCK)	3.53	.495
Technological Content Knowledge (TCK)	3.70	.622
Technological Pedagogical Knowledge (TPK)	3.62	.521
Technological Pedagogical Content Knowledge (TPACK)	3.54	.587

The descriptive analysis above revealed noticeable variation in how participants evaluated their competence across the TPACK dimensions. The highest mean scores appeared in TK, TPK, and TCK, suggesting that the respondents generally view themselves as capable of using and adapting technology for teaching purposes. This also implies that many teacher candidates feel at ease working with digital tools and believe they can incorporate technology to support instructional tasks.

In contrast, lower mean scores were observed from the participants. The results reveal the domains related to CK, PK, and PCK received comparatively lower averages. One possible explanation is that many respondents are still early in their professional preparation or have limited teaching experience. This means their exposure to real classroom practice and subject-specific pedagogy remains limited. In addition, these domains relate more closely to the core instructional competencies required for effective teaching, suggesting that participants may still be developing their understanding of how to teach English content and align pedagogical strategies with language-learning goals.

The TPACK domain, which represents the integrated knowledge required for technology-enhanced instruction, showed moderate scores. The results suggest that while the respondents show a solid grounding in using digital tools, many are still developing the ability to integrate technological, pedagogical, and disciplinary elements in a more coordinated and unified instructional approach. This aligns with findings from recent literature, which frequently reports that pre-service teachers rate their technological capabilities more highly than their pedagogical or content-based knowledge (Tondeur et al., 2021; Wang & Chen, 2023).

Strengths in Technological Knowledge

The highest mean scores were found in the TK domain. Participants indicated that they are comfortable exploring new digital tools, navigating online platforms, and using technology for communication and content creation. Many reported frequently using digital tools in their daily lives, which may contribute to their confidence in this area.

Participants also expressed confidence in using digital tools to support their teaching, as seen in the higher scores for the technology-related integrated domains. These results suggest that many respondents see technology as a useful resource for language learning and feel able to choose tools that fit particular instructional purposes. This aligns with recent research showing that younger generations of teacher candidates are digitally adept and open to experimenting with emerging technologies (Lin et al., 2022; Zou et al., 2022).

Areas Requiring Improvement

Despite strong technological confidence, lower ratings were reported for CK, PK, and PCK, indicating that participants feel less assured in areas related to pedagogy and subject matter.

These domains are essential for designing effective lessons, selecting appropriate instructional strategies, and understanding how learners acquire language.

Content Knowledge (CK)

The CK score (M = 3.59) suggests that some participants expressed uncertainty about their mastery of English linguistic concepts, such as grammar, discourse features, and language functions. For CK, this pattern is not surprising and reflects a common issue in EFL preparation programs. Many candidates are still consolidating their linguistic competence and deepening their understanding of the subject area. Therefore, limited CK may affect their ability to evaluate digital materials or adapt technology-enhanced resources to meet specific language objectives.

Pedagogical Knowledge (PK)

PK received the lowest mean score (M = 3.51), which may indicate that participants feel less confident in general teaching skills areas such as classroom management, assessment strategies, and instructional planning. This is consistent with research showing that pedagogical knowledge often develops gradually through coursework and teaching practicum experiences (Ariyanti & Santosa, 2021). It can be said that a weak PK may also limit their ability to integrate technology meaningfully, as effective technology use requires a solid foundation in general pedagogy.

Pedagogical Content Knowledge (PCK)

PCK (M= 3.53) also emerged as one of the lowest scores among the domains. Participants reported difficulty in selecting appropriate teaching strategies for specific language skills and in designing tasks that align with learning objectives. For PCK, the lower ratings reflect what earlier research has also noted. Similarly, the challenges reported that this is typically one of the hardest for novice teachers to develop (Sari & Wahyudi, 2020; Chai et al., 2020). The reason for the struggles is that it requires the integration of both subject-matter knowledge and pedagogical expertise. In the EFL context, limited PCK may hinder their ability to design technology-enhanced lessons that are both pedagogically sound and linguistically appropriate**.**

From an overall perspective, the descriptive statistics show a clear pattern: participants are technologically confident but still developing the pedagogical and content-related competencies needed for effective usage of technology. Taken together with their higher confidence in technology-related domains, the results suggest that although participants are “technology-savvy,” they still require further guidance in CK, PK, and PCK to ensure that technology use contributes meaningfully to effective instructional principles.

Overall Readiness for Technology Integration

Taken together, the findings suggest that these participants possess a strong foundation in technological skills but may require additional support in developing pedagogical and content-related competencies. Their moderate scores in the TPACK domain indicate that while they are aware of the importance of integrating technology with pedagogy and content, they may still be learning how to do so effectively.

These results align with recent research showing that pre-service teachers often feel technologically ready but pedagogically underprepared for technology-enhanced instruction (Tondeur et al., 2021; Wang & Chen, 2023). The findings highlight the demand for teacher education programs to furnish more chances for pre-service teachers to practice how to design and implement lessons integrated with technology, particularly in EFL contexts where language learning requires careful alignment between content, pedagogy,

and technology. The growing interest in examining TPACK in EFL education has gained attention because teaching English as an additional language presents levels of complexity comparable to subjects such as mathematics and science (Cahyono et al., 2016).

Furthermore, the breakout components of the Technology Knowledge (TK) show that the participants' highest mean values are mostly on three items: I can learn technology easily, I frequently play around with technology, and I keep up with important new technologies (see Table 3).

Table 3 Pre-service EFL teachers' perception of technology knowledge

I	Technology Knowledge (TK) = 7 items	M	SD
1	I know how to solve my own technical problems.	3.57	.877
2	I can learn technology easily.	3.98	.853
3	I keep up with the latest important technologies.	3.87	.928
4	I frequently play around with the technology.	3.96	.931
5	I know about a lot of different technologies.	3.58	.878
6	I have the technical skills I need to use technology.	3.67	.817
7	I have had sufficient opportunities to work with different technologies.	3.34	.844

The respondents' results showed that these pre-service teachers have ability on technology knowledge because they realize the importance of technology and they can adapt it quickly and frequently use the ICT. Furthermore, if it is compared to the items of the Technological Knowledge (TK), three main items are chosen based on the highest percentage for agree and strongly agree by the participants. The bar chart shows that 57% of the participants agree that they learn ICT easily, while 26% chose "strongly agree." The bar chart also shows that 47% of the participants agree that they keep up with new ICT, while 27% strongly agree. Regarding frequent ICT use, 31% of participants strongly agree with this item, and 47% agree. It can be concluded that the pre-service teachers are familiar with and have an ability in technological knowledge, as most of them can easily and frequently learn about devices, applications, and the use of ICT. This is also related to the items of keeping up with new technological knowledge in their daily activities (see Figure 1).

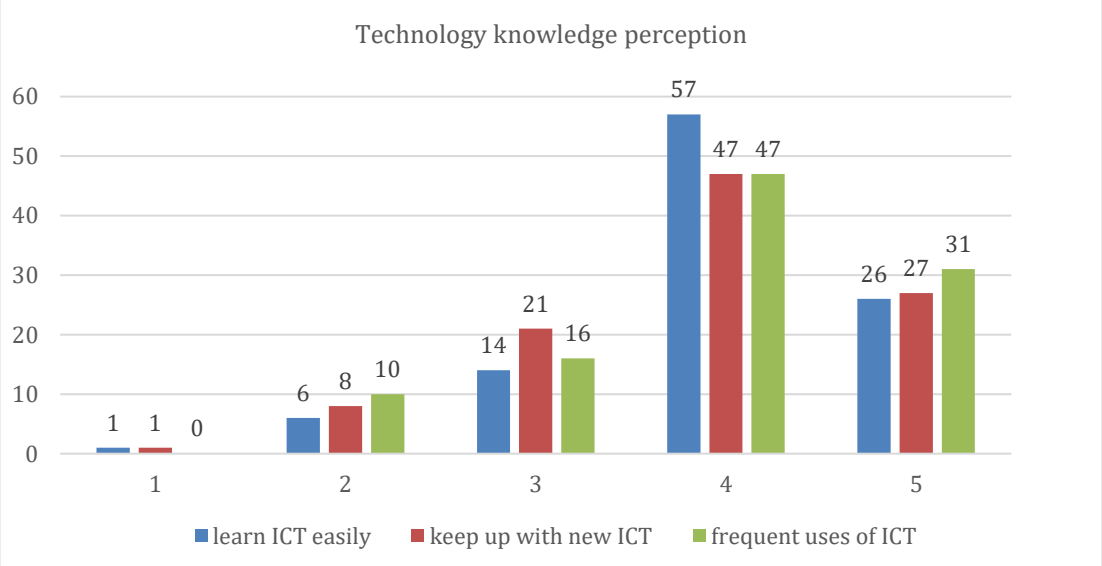

Figure 1 Pre-service EFL teachers' percentage on their technology knowledge perception

However, CK, PK, and PCK still need improvement. This is related to applying their knowledge in the class and elaborating it in their actual classes. Those pre-service teachers need more experience, examples, and input from experienced teachers. Therefore, they are still required if their problem relates to designing lessons and incorporating ICT into their lesson plans. In addition, Warschauer's early work in 1997 distinguished between cognitive and sociocultural orientations to technology-enhanced learning (Warschauer, 1997; Yim & Warschauer, 2025). The cognitive perspective highlights how digital tools can expand learners' engagement with language and support knowledge construction development through increased exposure and meaningful engagement with language. Meanwhile, the sociocultural perspective emphasizes participation in meaningful communicative practices through authentic interaction (Yim & Warschauer, 2025). Building on this foundation, Yim and Warschauer (2025) demonstrate how collaborative learning has shifted from early text-only CMC tools to dynamic, cloud-based writing platforms, highlighting the role of new literacies and digital collaboration tools in shaping learner interaction and achievement (Warschauer, 1997; Yim & Warschauer, 2025). It demonstrates how new literacies and digital collaboration tools shape interaction patterns and learning outcomes.

Inter-Scale Relationships Among the TPACK Dimensions

The third research question was "What relationships describe the pre-service teacher trainees' perceptions of the dimensions of the TPACK framework?" It explored how pre-service teachers understand the relationships among the TPACK dimensions. Table 4 displays the significant relationships identified between the overall TPACK construct and the related subscales.

Table 4 Significant correlations ($p < .01$) between the scales

Construct	1	2	3	4	5	6	7
1. Technology Knowledge	--						
2. Content Knowledge	.387**	--					
3. Pedagogical Knowledge	.423**	.581**	--				
4. Pedagogical Content Knowledge	.358**	.691**	.664**	--			
5. Technological Content Knowledge	.473**	.560**	.537**	.636**	--		
6. Technological Pedagogical Knowledge	.372**	.531**	.679**	.695**	.651**	--	
7. Technological Pedagogical Content Knowledge	.539**	.511**	.720**	.719**	.678*	.705**	--

**. Correlation is significant at the 0.01 level (2-tailed).

The Pearson correlation test is needed to examine the relationship between technology knowledge and other scales. We focus on the sig (2-tailed) score and r (Pearson correlation) from the correlation test result above. There are significant relationships with motivated learning behavior, as indicated by $p<0.01$ and r. As shown in Table 3, the correlational analyses yielded one strong (0.7-0.9) and several moderate (0.5-0.7) correlation coefficients (Salkind, 2022).

The hypotheses proposed in the Method section examined whether significant positive relationships exist between overall TPACK competence and the component domains. The results in Table 4 indicate that every correlation reached significance at the .01 level (two-tailed). With all p-values falling below .01, the assumption of no association between

TPACK and its related domains cannot be supported; the null hypothesis (H_0) is rejected. Instead, the evidence points to a positive link between the overall TPACK construct and each of the seven component areas; the alternative hypothesis (H_1) is accepted.
Based on the correlation test results above, we focus on the 2-tailed p-value (sig) and the Pearson correlation coefficient (r).

1. Technology Knowledge (TK)= sig 0.01 and r .539. This indicates a moderate relationship between TPACK and TK.
2. Content Knowledge (CK) = sig. 0.01, and the r value is .511. This indicates a moderate relationship between TPACK and CK.
3. Pedagogical Knowledge (PK) = sig. 0.01, and the r value is .720. It means that there is a strong relationship between TPACK and PK.
4. Pedagogical Content Knowledge (PCK) = sig. 0.01, and the r value is .719. It means that there is a strong relationship between TPACK and PCK.
5. Technological Content Knowledge (TCK) = sig. 0.01, and the r value is .678. This indicates a moderate relationship between TPACK and TCK.
6. Technological Pedagogical Knowledge (TPK) = sig. 0.01, and the r value is .705. It means that there is a strong relationship between TPACK and TPK.

In addition, among those scales, the most substantial relationship is shown by Pedagogical Knowledge and TPACK (.720), followed closely by PCK (r = .719) and TPK (r = .705). It implies that any changes between those variables are strongly connected. When Pedagogical Knowledge changes, there will be a corresponding change in TPACK. These strong correlations suggest that pedagogical understanding plays a central role in shaping pre-service teachers' integrated technological competence. This strong correlation might be that pre-service teachers who have understood Pedagogical Knowledge know better which kinds of technology they can apply in their lessons and how to use TPACK in their teaching-learning EFL activities.

H_1 acceptance indicates that increases in any of the TPACK component domains are associated with increases in overall TPACK competence. In particular, the strong correlations involving PK, PCK, and TPK highlight that technology integration is most effective when supported by solid pedagogical foundations. This finding reinforces the idea that technological proficiency alone is insufficient; meaningful technology integration depends on the interplay between pedagogy, content, and technology.

The hypotheses proposed in the Method section examined whether significant positive relationships exist between overall TPACK competence and the seven TPACK component domains (TK, CK, PK, PCK, TCK, TPK).

The Pearson correlation results (Table 4) show that all correlations are statistically significant at the 0.01 level (2-tailed). Because all p-values are below .01, the null hypothesis (H_0), which states that there is no significant relationship between TPACK and its component domains, was rejected.

Accordingly, the alternative hypothesis (H_1), which states that there is a significant positive relationship between TPACK and the seven component domains, was accepted.

Taken together, the correlation coefficients indicate that all TPACK domains are positively associated with overall TPACK competence, with varying degrees of strength. The correlation analysis revealed a clear pattern across the TPACK dimensions. Moderate associations were identified for Technological Knowledge ($r = .539$, $p < .01$), Content Knowledge ($r = .511$, $p < .01$), and Technological Content Knowledge ($r = .678$, $p < .01$). In contrast, stronger coefficients appeared for Pedagogical Knowledge ($r = .720$, $p < .01$), Pedagogical Content Knowledge ($r = .719$, $p < .01$), and Technological Pedagogical Knowledge ($r = .705$, $p < .01$). Taken together, these results indicate that participants' pedagogical abilities and their capacity to blend technology with instructional strategies are

more closely tied to their overall TPACK perceptions than their individual technological or content-focused knowledge.

Strength in Technological Knowledge

The high scores in Technological Knowledge (TK) suggest that pre-service teachers are comfortable navigating digital tools, exploring new applications, and using technology for communication and content creation. This aligns with studies showing that younger generations of teacher candidates often possess strong digital fluency due to their frequent engagement with technology in daily life (Lin et al., 2022; Zou et al., 2022). Their confidence in TK, TPK, and TCK indicates that they recognize the potential of technology to support language learning and feel capable of selecting tools that align with instructional tasks.

However, technological proficiency alone does not guarantee effective technology integration. As Mishra and Koehler (2006) emphasize, meaningful integration requires an understanding of how technology interacts with pedagogy and content. The findings of this study reinforce this point: while participants are technologically ready, they may still lack the deeper, integrated knowledge represented by TPACK.

Gaps in Pedagogical and Content Knowledge

The lower scores in Content Knowledge (CK), Pedagogical Knowledge (PK), and Pedagogical Content Knowledge (PCK) highlight areas where pre-service teachers may require additional support. CK is essential for understanding the linguistic and cultural aspects of English, while PK underpins effective instructional planning, classroom management, and assessment. PCK, which represents the ability to select appropriate teaching strategies for specific content, is often one of the most challenging domains for pre-service teachers to develop (Sari & Wahyudi, 2020).

These findings recommend that teacher training and education programs may need to strengthen their focus on pedagogical and content-related training. Without a solid foundation in these areas, pre-service teachers may struggle to design lessons that align technology with instructional goals. This is consistent with recent studies emphasizing the importance of integrating pedagogical training with technology-enhanced learning experiences (Chai et al., 2020; Yunus et al., 2021).

Readiness for Technology-Enhanced EFL Instruction

The findings reported that the moderate scores in the TPACK domain indicate that participants are aware of the importance of integrating technology with pedagogy and content but may still be learning how to do so effectively. This suggests that their readiness for technology-enhanced instruction is developing but not yet fully formed. The findings echo previous research showing that TPACK development requires intentional, structured opportunities for practice, reflection, and feedback (Tondeur et al., 2021; Wang & Chen, 2023; Kukulska-Hulme, A. 2024).

In essence, these findings contribute to the broader understanding of how EFL teachers can fuse technology into effective classroom practice, as familiarity with technology alone is inadequate to ensure pedagogically and linguistically meaningful EFL instruction. Additionally, this study furnishes valuable evidence and insights for teacher education programs to better prepare pre-service teachers through guided training on aligning digital tools with reflective practice and adaptable lesson design. In the Indonesian context, where technology integration is increasingly emphasized in national education policies, these findings highlight the necessity for teachers in teacher training and education programs to facilitate more practical experiences with technology-enhanced lesson design. Such

experiences can help pre-service teachers move beyond technological familiarity toward a more holistic understanding of technology-supported pedagogy.

CONCLUSION

This study examined pre-service EFL teachers' perceptions of their readiness for technology integration using the TPACK framework. These findings indicate that while participants possess strong technological skills, they require further development in pedagogical and content-related domains. Their moderate TPACK scores suggest that they are still learning how to integrate technology, pedagogy, and content in a cohesive and meaningful way.

Overall, the study underpins the importance of balanced teacher preparation. Technological proficiency is valuable, but it must be accompanied by strong pedagogical and content knowledge to support effective technology-enhanced instruction. The results contribute to the growing body of research on TPACK in EFL contexts and offer insights that can inform teacher education programs in Indonesia and beyond.

This study has several limitations. The findings are based on self-reported questionnaire data, which may not fully reflect participants' actual teaching practices. Although the sample included participants from more than one institution, most respondents came from the same teacher-education program, which may limit the broader applicability of the results. In addition, the study focused only on perceptions rather than observing real classroom implementation.

Regarding the study's implications, teacher education programs should consider integrating more structured opportunities for pre-service teachers to design and implement technology-enhanced lessons. This may include: 1. Collaborative lesson design projects; 2. Micro-teaching sessions using digital tools; 3. Workshops on aligning technology with language learning objectives; 4. Reflective activities that encourage critical evaluation of technology use. Engaging in these kinds of activities can support future teachers in building the more integrated forms of knowledge needed to use digital tools effectively in the classroom.

Future studies may explore longitudinal TPACK development across different stages of teacher education, explore how school-based practicum experiences influence candidates' digital teaching abilities, or compare programs across various contexts to identify factors that shape readiness. These lines of inquiry would contribute to a clearer picture of how to better equip pre-service teachers for technology-supported EFL instruction.

CONFLICTS OF INTEREST

The authors declare that there is no conflict of interest.

AUTHOR CONTRIBUTIONS STATEMENT

In this research article, AR was responsible for the conceptualization, methodology, and overall data analysis. RR contributed to the data analysis, while NN conducted proofreading and ARK editing of the manuscript. All authors reviewed and approved the final version of the manuscript.

AI DISCLOSURE STATEMENT

The authors used Microsoft Copilot solely for grammar checking and language refinement during the preparation of this manuscript. All ideas, analyses, interpretations, and final revisions were developed and verified independently by the authors.

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