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ASSESSING KENYAN PRE-SERVICE EFL TEACHERS' READINESS FOR TECHNOLOGY INTEGRATION USING THE TPACK FRAMEWORK

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Abstract:
Integrating educational technology into English as a Foreign Language (EFL) teaching is key to supporting 21st-century learning in Kenya. Yet, there is limited research on how Kenyan pre-service EFL teachers are prepared to utilize technology effectively in their classrooms. This study uses the Technological Pedagogical Content Knowledge (TPACK) framework to assess how ready Kenyan pre-service teachers are for teaching language with technology. The framework helps identify strengths and opportunities to enhance teacher education. Data were collected using a self-report TPACK questionnaire completed by 84 pre-service teachers at a Kenyan university. The study also analyzed 12 lesson plans to compare teachers' reported skills with their actual planning. This mixed-methods approach offers a comprehensive view of both perceived skills and tangible lesson-planning strategies. The study had two main results: First, there were notable differences in the self-confidence and knowledge of TPACK domains between male and female participants, suggesting potential gender-based disparities in technology integration readiness. Second, there was a significant gap between teachers' self-assessed confidence in integrative knowledge (TPK, TCK) and their real-world application in lesson planning, highlighting a vital theory-practice divide that suggests a need for more practical training in technology use. The results show that the TPACK framework is an indispensable resource for Kenyan teacher education programs. It helps identify specific areas, such as technological pedagogical knowledge (TPK), that need more support. This research goes beyond examining access to technology; it provides practical, evidence-based advice for curriculum developers to help pre-service teachers use technology effectively in EFL classrooms.

Keywords: Technological Pedagogical Content Knowledge (TPACK), English as a foreign language (EFL), teacher preparedness, pre-service teacher education, Kenya, technology integration, mixed-methods study

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1. Introduction

Kenya's Competency-Based Curriculum (CBC) highlights digital literacy and technology integration as key 21st-century skills (KICD, 2017; Ministry of Education, 2021). This makes language teaching important for building communication skills in a global economy. However, challenges such as uneven ICT infrastructure, large class sizes, and gaps in professional development persist (Hennessy *et al.*, 2010; Kafyulilo *et al.*, 2015). For example, there is only one computer for every 60 students in Kenyan secondary schools (Atambo, 2020), and 80% of teachers have an IT knowledge gap (Miao *et al.*, 2021). This creates a 'preparedness paradox' for pre-service teachers, who are expected to use technology in teaching, even though ICT is often treated as a separate skill rather than a core teaching tool (Tondeur *et al.*, 2012; Wambiri & Ndani, 2016). This paradox highlights the gap between policy expectations and the practical realities faced by teachers, who may lack the necessary training and resources to integrate technology effectively. This study uses the Technological Pedagogical Content Knowledge (TPACK) framework as a diagnostic tool to identify specific gaps in Kenyan pre-service EFL teacher education.

Effective integration of technology in education requires teachers to understand and apply distinct but interconnected knowledge domains in their classroom instruction. The TPACK framework (Mishra & Koehler, 2006) offers a clear model for understanding the dynamic interplay of teaching knowledge domains (Mekheimer, 2025). It does this by extending Shulman's (1986) foundational work on Pedagogical Content Knowledge (PCK) and adding the critical dimension of technology. Mishra & Koehler (2006) continue the thesis that effective teaching with technology arises from the dynamic interplay among Content Knowledge (CK), Pedagogical Knowledge (PK), and Technological Knowledge (TK), and their intersections, i.e., Technological Pedagogical Knowledge (TPK), Technological Content Knowledge (TCK), and Pedagogical Content Knowledge (PCK). However, it's important to recognize that TPACK is context-dependent, as its theoretical development and application are heavily shaped by educational settings. The latest, most authoritative version of the framework, introduced by its original creators, emphasizes this connection by combining two key views: one sees *context* as an external influence, while the other, *Contextual Knowledge* (XK), is an internal knowledge area vital for expert teaching (Petko, Mishra & Koehler, 2025).

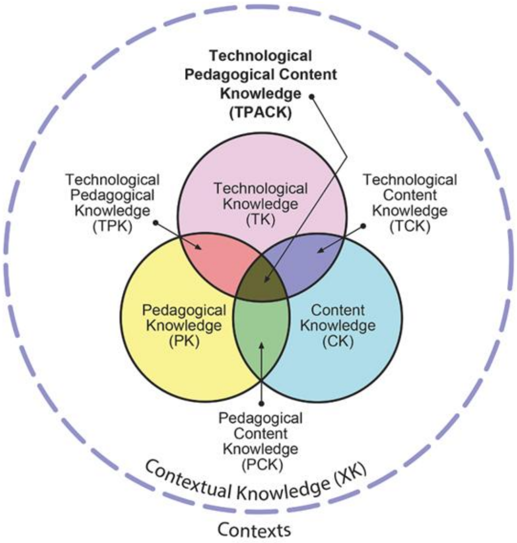

Figure 1: The Updated TPACK Model (Petko, Mishra, & Koehler, 2025)

The updated framework endeavors to address ambiguities such as the unclear role of context in TPACK. This dual representation of *context* and *contextual knowledge* is critical and can be broken down into two key components:

- **Context as external factors:** These include national policies, school infrastructure, and available classroom resources that affect the application of TPACK.
- **Internal knowledge:** This refers to the teacher's expert understanding of how to navigate and incorporate these external factors into effective teaching strategies.

The renewed TPACK framework offers a valuable way to examine pre-service teachers' knowledge in relation to their future teaching environments, not just their technological skills. All these improvements highlight the urgency of teacher knowledge to keep pace with technological developments and society.

To link this updated framework to the focus of this study, the next section explores how TPACK manifests in English as a Foreign Language (EFL), particularly within Sub-Saharan Africa. It utilizes self-reported surveys and lesson plans to assess Kenyan pre-service EFL teachers' preparedness across TPACK domains and compares these with their lesson plans. The goal is to evaluate whether teachers feel equipped to incorporate technology into their EFL teaching. Through this approach, the study aims to offer insights for enhancing pre-service teacher education in Kenya.

1.1 TPACK in Subject-specific Contexts: The Case of EFL

The TPACK framework manifests differently across subjects, and EFL teaching is no exception (Liu & Kleinsasser, 2015; Baser *et al.*, 2016; Bostancıoğlu & Handley, 2018). Research shows that pre-service teachers need more than just Technological Knowledge (TK); they also need confidence and skills to use tools like podcasts, blogs, and collaborative platforms, which is part of Technological Pedagogical Knowledge (TPK) (Tseng *et al.*, 2022; Wang, 2022). There is little research on how TPACK applies to pre-service EFL teachers in sub-Saharan settings (Kafyulilo *et al.*, 2015), so more studies, like the present ones, are needed to examine this. like the present one, are needed to fulfil two key purposes: (1) to move beyond self-reported confidence and measure applied TPACK competence in lesson planning and teaching, and (2) to identify context-specific strategies for integrating technology within the infrastructural and curricular realities of sub-Saharan African classrooms.

Many learning contexts in Sub-Saharan Africa are characterized by unreliable electricity, low device-to-student ratios, and teacher-centered teaching styles, which are essential to technology integration (Hennessy *et al.*, 2010; Agyei, 2020; Atambo, 2020). Comparative studies, such as those contrasting Finland's resource-rich, student-focused model against systems in the Global South, reveal that teachers' pedagogical beliefs can directly influence technology use (Loukomies *et al.*, 2018; Tondeur *et al.*, 2017; Valtonen *et al.*, 2019). The present research draws that connection between TPACK and contextual knowledge and hopes that assessing TPACK in Kenya will benefit from this holistic approach.

1.2 TPACK Measurement: Moving Beyond Self-report

The validity of TPACK assessment has evolved significantly. While early studies predominantly used self-report surveys (Schmidt *et al.*, 2009), criticism emerged regarding their susceptibility to overconfidence and their disconnect from actual teaching practice (Graham *et al.*, 2020). These concerns are substantiated by research showing that such instruments may measure self-efficacy rather than demonstrable knowledge (Schmid *et al.*, 2020). Despite that, the development of validated short instruments, such as TPACK.xs (Schmid *et al.*, 2020) respond to the need for practical tools while acknowledging these inherent constraints. In the end, their findings corroborate the original TPACK framework and support the idea that integrative knowledge (TPCK) is simultaneously determined by the intersecting components (TPK, TCK, PCK) rather than in isolation.

The methodological critique has led to a growing consensus in favor of triangulation. Recent research advocates combining surveys with performance assessments, lesson plan analysis, and classroom observations to capture TPACK more holistically (Agyei & Keengwe, 2012; Archambault, 2016; Canbazoglu Bilici *et al.*, 2016; Schmid *et al.*, 2020; Max *et al.*, 2022). In response, the current study adopts a mixed-methods approach, using a validated TPACK survey alongside a rubric-based analysis of lesson plans. This shifts from self-reported data toward evidence of applied planning competence and, consequently, responds to calls for more robust measurement in teacher education research (Scherer *et al.*, 2021; Valtonen *et al.*, 2020).

1.3 The Future Directions: Intelligent-TPACK and Ethical Preparedness in Teacher Education

With the rapid rise of generative AI tools like ChatGPT and Gemini, teachers need to grasp their opportunities and potential for learning and assessment. Çelik's (2023) Intelligent-TPACK (I-TPACK) framework adds knowledge about AI and the ethical use of these tools (Chiu, 2024; Trust *et al.*, 2023; Yue *et al.*, 2024). For Kenyan pre-service teachers, it is now important to assess both their readiness for current technology and their basic understanding of AI’s impact. Incorporating beginner-level AI tools, such as speech-to-text applications, into teacher education programs can ground the I-TPACK recommendations in real-world, accessible practice, making the concept more tangible and attainable. Adding AI policy guidance to teacher education programs would help prepare them for 21st-century classrooms (Miao *et al.*, 2021).

1.4 Identification of the Research Gap

Despite progress in TPACK theory, there is a glaring gap between its conceptualization and classroom implementation. This disconnect is especially pronounced in pre-service teacher training within the Global South and in English as a Foreign Language (EFL) context, where assessment tools must be context-aware and subject-specific (Bostancıoğlu & Handley, 2018; Wang, 2022). The expanded TPACK model, which formally incorporates Contextual Knowledge (XK) and engages with Intelligent-TPACK (I-TPACK), provides a necessary framework to address this gap (Petko *et al.*, 2025).

The present study aims to address the limitations of existing research by employing a comprehensive mixed-methods approach to assess the readiness of Kenyan pre-service EFL teachers for technology integration. It is common for research to validate TPACK in well-resourced settings with stable infrastructure, offering models that are of limited relevance to contexts defined by contextual constraints, such as Kenya (Tondeur *et al.*, 2017; Scherer *et al.*, 2021). Secondly, there has been an overreliance on self-report surveys, which fail to connect perceived competencies with evidence from actual instructional planning. This exacerbates the critical gap between theory and practice, as observed in the minimal relationship between pre-service teachers’ self-reported TPACK and the actual technology integration in lesson plans (Schmid *et al.*, 2020)

2. Objectives of the Study

This study aims to conduct a diagnostic assessment of Kenyan pre-service EFL teachers' readiness for technology integration using the extended TPACK framework. Specifically, the study has three main objectives:

- To evaluate the self-reported TPACK proficiency of Kenyan pre-service EFL teachers across the seven core domains and examine variations by gender.
- To predict the alignment between self-reported TPACK (especially in the integrative domains of TPK and TCK) and the quality of technology integration evidenced in instructional lesson plans.

The study was guided by the following research questions:

1) What is the self-reported proficiency profile of Kenyan pre-service EFL teachers across the seven TPACK domains, and how does it vary by gender?
2) To what extent do teachers’ TPACK perceptions, particularly in the integrative domains (TPK, TCK), correlate with and predict the quality of technology integration in their instructional lesson plans?

By responding to these questions, the study provides an evidence-based look at how ready pre-service teachers are to incorporate technology in their teaching. The TPACK framework serves as a practical tool that helps curriculum designers find ways to close the gap between Kenya's digital education goals and what actually happens in classrooms.

3. Materials and Methods

3.1 Research Design and Context

This study employed a mixed-methods approach (Creswell & Clark, 2017) to evaluate how prepared Kenyan pre-service EFL teachers are for integrating technology. It first gathered and analyzed survey data regarding teachers' self-efficacy in TPACK. Subsequently, lesson plans were reviewed to give context to the survey findings. This strategy allowed for a thorough evaluation, linking broad self-assessments to specific instances of applied knowledge.

3.2 Context and Ethical Considerations

The research was conducted at a public university in Embu County, Kenya as part of the teacher education program. All participants provided informed consent at the start of the online survey. The consent form outlined the study's purpose, voluntary participation, anonymity of responses, the right to withdraw without consequence, and data storage procedures. Participation was both voluntary and anonymous. Student numbers were gathered only for administrative reasons and were de-identified and anonymized prior to analysis. The study protocol received approval from the appropriate faculty at the participating university and acquired a research license from the National Commission for Science, Technology, and Innovation (NACOSTI).

3.3 Sample and Sampling

Participants were pre-service teachers enrolled in Bachelor of Education (Arts) programs specializing in English and Literature. This group consists of future secondary school EFL teachers who are the focus of the national Competency-Based Curriculum (CBC), which highlights digital literacy.

Eighty-four pre-service EFL teachers completed the TPACK survey (≈80% of the cohort). Following the survey, all participants were invited to voluntarily submit lesson plans to demonstrate applied planning skills. Six teachers (3 male, 3 female) chose to participate, each submitting two plans, resulting in 12 lessons for qualitative analysis. This sample size (see Tables 1 and 2 below) aligns with in-depth qualitative case-study designs and allowed for detailed rubric-based assessment while representing varied gender and training backgrounds.

Table 1: Participant Demographics (n=84)

Characteristic	Category	Frequency (n)	Percentage (%)
Gender	Female	60	71.4
	Male	24	28.6
Prior Tech Training	Yes	30	35.7
	No	54	64.3
Degree Program	B.Ed Arts	84	100.0

Table 2: Lesson Plans and Topics

Teacher	Lesson Plan	Lesson Topic
Teacher 1	Lesson 1	Stress (Listening & Speaking)
	Lesson 2	Silent Reading (Reading)
Teacher 2	Lesson 3	Comprehension (Environment) (Reading)
	Lesson 4	Pronunciation of Sounds /l/ and /r/ (Oral Skills)
Teacher 3	Lesson 5	Invitation Letters (Writing)
	Lesson 6	Phrasal Quantifiers (Grammar)
Teacher 4	Lesson 7	Homophones, Similar Sounds (Reading)
	Lesson 8	Reading Aloud (Study Skills)
Teacher 5	Lesson 9	Phrasal Quantifiers (Grammar)
	Lesson 10	Ogre Story (Listening & Speaking)
Teacher 6	Lesson 11	Possessives (Grammar)
	Lesson 12	Telephone Etiquette (Listening & Speaking)

3.4 Instrumentation

3.4.1 Quantitative Tools: TPACK Survey

The TPACK survey was administered online via Microsoft Forms. The instrument comprised three sections: demographic information, self-reported TPACK proficiency, and optional qualitative reflections.

- **Demographics Section**: This section collected key participant characteristics, including gender, degree program, and a question regarding prior formal training in technology for EFL teaching.
- **TPACK Survey**: The core of the survey consisted of 28 items adapted from established TPACK instruments (Baser *et al.*, 2016; Chai *et al.*, 2013) and structured according to the validated, four-item-per-domain approach of the TPACK.xs framework (Schmid *et al.*, 2020). Items corresponded directly to the seven TPACK domains: Content Knowledge (CK), Pedagogical Knowledge (PK), Technological Knowledge (TK), Pedagogical Content Knowledge (PCK), Technological Content Knowledge (TCK), Technological Pedagogical Knowledge (TPK), and Technological Pedagogical Content Knowledge (TPCK). Participants responded using a 5-point Likert scale (1 = *Strongly Disagree* to 5 = *Strongly Agree*). The reliability of this adapted scale in the present study was confirmed with excellent internal consistency (Cronbach's α = .937; see Results). The mapping of items to TPACK domains is presented in Table 3.
- **Open-Ended Comment**: An optional, open-ended question concluded the survey ("Any other general thoughts about TPACK for English teaching and learning?")

to capture participants' perceptions, reservations, or suggestions regarding technology integration in EFL instruction.

Table 3: Mapping of Survey Items to TPACK Domains

TPACK Domain	No. of Items	Sample Item from Survey	Construct Measured
Content Knowledge (CK)	4	*"I have sufficient knowledge in developing content in the English subject."*	Knowledge of English subject matter.
Pedagogical Knowledge (PK)	4	*"I can adapt my teaching style to different learners."*	General teaching methods and strategies.
Technological Knowledge (TK)	4	*"I can solve ICT-related problems."*	Knowledge of and skills with technologies.
Pedagogical Content Knowledge (PCK)	4	*"I know how to select effective teaching approaches to guide student thinking and learning in the English language."*	Subject-specific teaching methods.
Technological Content Knowledge (TCK)	4	*"I know educational technologies that I can use to understand the contents of the English subject better."*	Knowledge of technologies for representing English content.
Technological Pedagogical Knowledge (TPK)	4	*"I can choose technologies that enhance the teaching approaches for the English subject."*	Knowledge of using technology for teaching.
Technological Pedagogical Content Knowledge (TPCK)	4	*"I can teach lessons that appropriately combine my teaching subject, technologies, and teaching approaches."*	Integrated knowledge for technology-enhanced EFL teaching.

3.4.2 Qualitative Tools: Lesson Plans

The participants who completed the survey were invited to submit a detailed lesson plan for a secondary school English class using a designated template. The template asked for standard components: learning objectives, step-by-step procedures, learning activities, and teaching resources.

The twelve lesson plans were analyzed using a structured rubric (Table 4) based on TPACK and technology use in lesson design (Harris & Hofer, 2009). In accordance with Schmid *et al.* (2021), each lesson plan was checked and marked for the presence or absence of planned technology use. Therefore, this TPACK-informed rubric moved beyond binary categorization and captured the quality of integration to assess three specific dimensions shown below:

- Technology Selection & Rationale (focusing on TK and TCK),
- Pedagogical Integration (focusing on TPK and TPACK), and
- C-P-T Alignment (focusing on TPACK).

Table 4: Lesson Plan Analysis Rubric

Criterion	TPACK Focus	Low Evidence (1)	Moderate Evidence (2)	High Evidence (3)	Coding Guidance
1. Technology Selection & Rationale	TK, TCK	Tech not mentioned or generic (e.g., "video").	Tech is relevant to the topic (e.g., "audio for pronunciation").	Tech is specific and addresses a core content challenge (e.g., "contrasting audio for /l/ vs /r/ sounds").	Code based on "Teaching Resources" column.
2. Pedagogical Integration	TPK, TPACK	Tech use is passive/add-on (e.g., "show a video").	Tech supports the activity (e.g., "listen to model pronunciation").	Tech is essential for constructive student activity (e.g., "analyze speech after listening").	Code based on verbs in the "Learning Activities" column.
3. C-P-T Alignment	TPACK	No clear link between the objective, the activity, and the tech.	Tech & activity loosely align with the objective.	Tech & activity are directly designed to achieve the specific objective.	Cross-reference Objectives, Activities, and Resources.

3.4.3 Data Analysis

A step-by-step analysis strategy was used, starting with quantitative survey data and progressing to qualitative lesson-plan analysis, with integration at the interpretation stage.

3.5 Quantitative Analysis

3.5.1 Confirmatory Factor Analysis (CFA)

The factor structure of the adapted TPACK instrument was validated using confirmatory factor analysis (CFA) in AMOS v28.0. A seven-factor measurement model was specified, corresponding to the theoretical TPACK domains: Content Knowledge (CK, 4 items), Pedagogical Knowledge (PK, 4 items), Technological Knowledge (TK, 4 items), Pedagogical Content Knowledge (PCK, 4 items), Technological Content Knowledge (TCK, 4 items), Technological Pedagogical Knowledge (TPK, 4 items), and Technological Pedagogical Content Knowledge (TPCK, 4 items).

All latent factors were allowed to covary, reflecting the integrative nature of the TPACK framework (Mishra & Koehler, 2006). The model was estimated using maximum likelihood estimation. Model fit was assessed using multiple indices: χ^2/df ratio (< 3 indicating acceptable fit), Comparative Fit Index (CFI > 0.90), Tucker-Lewis Index (TLI > 0.90), Root Mean Square Error of Approximation (RMSEA < 0.08), and Standardized Root Mean Square Residual (SRMR < 0.08). Standardized factor loadings ≥ 0.50 were considered adequate evidence of convergent validity (Hair *et al.*, 2019).

The quantitative data from the 84 completed surveys were further analyzed using R (version 4.5.2) in RStudio (2025.09.2 Build 418). The following statistical procedures were employed, each addressing specific aspects of the research questions:

- **Descriptive Statistics**. Mean scores and standard deviations were calculated for each of the seven TPACK domains to create a profile of participants' self-efficacy, directly addressing Research Question 1 (RQ1).
- **Inferential Statistics**:
  - Independent samples t-tests were conducted to examine differences in TPACK domain scores by gender and by prior technology training. These tests addressed the group comparison component of RQ1.
  - Pearson's correlation coefficients were calculated to assess the relationship between self-reported integrative TPACK domains (TPK and TCK) and lesson plan integration quality scores, directly addressing Research Question 2 (RQ2).
- **Normality Assessment**: Skewness and kurtosis values were examined for each TPACK domain to verify distributional assumptions and confirm the suitability of parametric tests.

3.6 Qualitative Analysis

The qualitative analysis employed a structured, iterative coding process to evaluate technology integration in the submitted lesson plans. The twelve lesson plans were coded using the TPACK-informed rubric (Table 3), which assessed three dimensions: Technology Selection & Rationale, Pedagogical Integration, and C-P-T Alignment.

The coding process was iterative and evidence-based. For example, when evaluating "Pedagogical Integration," researchers examined specific instructional verbs and activity structures, such as "guided student discussion" versus "teacher presentation", in order to distinguish between passive, supportive, and transformative technology use. This allowed for consistent application of the rubric's criteria across all lesson plans.

Inter-rater reliability was established using Cohen's kappa, yielding a score of $\kappa > 0.85$, indicating substantial agreement between coders. Any discrepancies were resolved through collaborative discussion until consensus was reached. Each lesson plan subsequently received a score of 1 (Low), 2 (Moderate), or 3 (High) for each of the three rubric criteria.

Aggregate scores for each lesson plan were then calculated by summing the three criterion scores, resulting in a total integration quality score ranging from 3 to 9. These aggregate scores were categorized as Low (3–4), Moderate (5–6), or High (7–9) integration, enabling both qualitative insight and quantitative comparison across the sample.

3.7 Mixed-Methods Integration

To address the alignment between self-reported knowledge and applied practice, the quantitative and qualitative data strands were integrated through triangulation and exploratory analysis. This mixed-methods approach enabled a more nuanced understanding of the theory–practice relationship central to Research Question 2.

3.8 Triangulation Analysis

To examine the theory–practice alignment (RQ2), participants' self-reported TPK and TCK survey scores were directly compared with their corresponding lesson plan integration scores (Criteria 2 & 3). This was accomplished using:

- **Visual analysis** in the form of scatterplots (Figures 2 & 3) to display the relationship between survey and performance data.
- **Descriptive comparison matrices** to juxtapose individual participants' high or low self-efficacy ratings with their lesson plan rubric scores, highlighting cases of alignment and disconnect.

3.9 Exploratory Qualitative Analysis of Open-Ended Comments

Responses to the optional open-ended survey question ($n \approx 20$) were analyzed thematically to provide contextual depth to the quantitative and lesson plan findings. Comments were inductively coded and grouped into themes such as:

- *Perceived opportunities* for technology in EFL teaching
- *Noted constraints* (e.g., infrastructure, training gaps)
- *Suggestions for improved preparation*

These themes were not treated as primary data but served as illustrative excerpts to enrich the discussion, particularly in interpreting the theory–practice gap and contextual barriers faced by pre-service teachers.

4. Results

Pre-service teachers completed a TPACK questionnaire (n=84) adapted from established scales (Schmid *et al.*, 2020), comprising four items per subscale measuring the 7 TPACK domains. The reliability of the instrument was assessed using Cronbach's alpha. The overall scale demonstrated excellent internal consistency ($\alpha = .937$), well above the .70 threshold required for acceptable reliability. This indicates that the instrument reliably measured TPACK constructs in the Kenyan EFL context.

4.1 Measurement Model Validation

A confirmatory factor analysis (CFA) was conducted in AMOS 28.0 to validate the seven-factor structure of the TPACK instrument. The model demonstrated acceptable fit to the data: $\chi^2(329) = 512.47$, $p < .001$, $\chi^2/df = 1.56$, CFI = 0.94, TLI = 0.92, RMSEA = 0.06 (90% CI: 0.05-0.07), SRMR = 0.05. All standardized factor loadings were statistically significant ($p < .001$) and ranged from 0.26 to 0.87 (Table 5). One item, CK2 ("I know the basic theories and concepts of the English subject"), showed a relatively weak loading (λ = 0.26), while the remaining items demonstrated adequate convergent validity with loadings above 0.50. The strongest loadings were observed for TPK2 (λ = 0.87), TPK1 (λ = 0.85), and TPCK2 (λ = 0.84), indicating robust measurement of technological-pedagogical and integrated knowledge domains.

Table 5: Standardized Factor Loadings for TPACK Domains

Domain	Item	Loading	Domain	Item	Loading
CK	CK1	0.50	**TCK**	TCK1	0.69
	CK2	0.26		TCK2	0.71
	CK3	0.67		TCK3	0.68
	CK4	0.61		TCK4	0.74
PK	PK1	0.79	**TPK**	TPK1	0.85
	PK2	0.83		TPK2	0.87
	PK3	0.54		TPK3	0.75
	PK4	0.61		TPK4	0.71
TK	TK1	0.75	**TPCK**	TPCK1	0.80
	TK2	0.78		TPCK2	0.84
	TK3	0.76		TPCK3	0.82
	TK4	0.82		TPCK4	0.67
PCK	PCK1	0.68			
	PCK2	0.78			
	PCK3	0.61			
	PCK4	0.63			

Note: All loadings significant at $p < .001$

4.2 Descriptive Statistics: Profile of TPACK Self-efficacy (RQ1)

The descriptive statistics provide a profile of participants' self-efficacy across the seven TPACK domains (Table 6). Pedagogical Knowledge (PK, M = 4.37, SD = 0.56) and Pedagogical Content Knowledge (PCK, M = 4.05, SD = 0.55) received the highest mean scores, indicating strong confidence in teaching competencies. In contrast, Technological Knowledge (TK, M = 3.15, SD = 0.83) and Technological Content Knowledge (TCK, M = 3.32, SD = 0.77) scored lowest, reflecting lower self-efficacy in technology-related areas. The integrative domains of Technological Pedagogical Knowledge (TPK, M = 3.76, SD = 0.71) and Technological Pedagogical Content Knowledge (TPCK, M = 3.79, SD = 0.77) showed moderate levels of confidence.

Table 6: Descriptive Statistics of TPACK Domains (n = 84)

Domain	Mean	Std. Deviation	Skewness	Kurtosis
CK	3.6280	0.63352	-0.251	-0.698
PK	4.3720	0.55631	**-1.459**	**4.726**
TK	3.1548	0.82952	0.050	-0.116
PCK	4.0476	0.54535	-0.022	-0.619
TCK	3.3185	0.76869	0.005	-0.758
TPK	3.7619	0.71125	-0.522	0.342
TPCK	3.7946	0.76753	-0.779	0.759

4.3 Interrelationships Among TPACK Domains

The correlations among the seven TPACK latent factors reveal the interconnected nature of knowledge domains (Table 7). Several notable patterns emerged. First, Content Knowledge (CK) showed strong correlations with Pedagogical Knowledge (PK) ($r = .86$, $p < .001$) and Pedagogical Content Knowledge (PCK) ($r = .85$, $p < .001$), indicating that pre-service teachers perceive these foundational domains as highly integrated. Second, Technological Knowledge (TK) demonstrated a particularly strong relationship with Technological Content Knowledge (TCK) ($r = .81$, $p < .001$), suggesting that technological skills directly facilitate the integration of technology with English subject matter. Third, the technology-integration domains (TCK, TPK, and TPCK) showed moderate to strong intercorrelations (ranging from .71 to .76), supporting their conceptual overlap in applied teaching contexts. Notably, TPCK correlated more strongly with the technology-specific domains (TCK: $r = .71$; TPK: $r = .74$) than with the foundational domains (CK: $r = .63$; PK: $r = .49$), highlighting the centrality of technological competencies in achieving integrated knowledge.

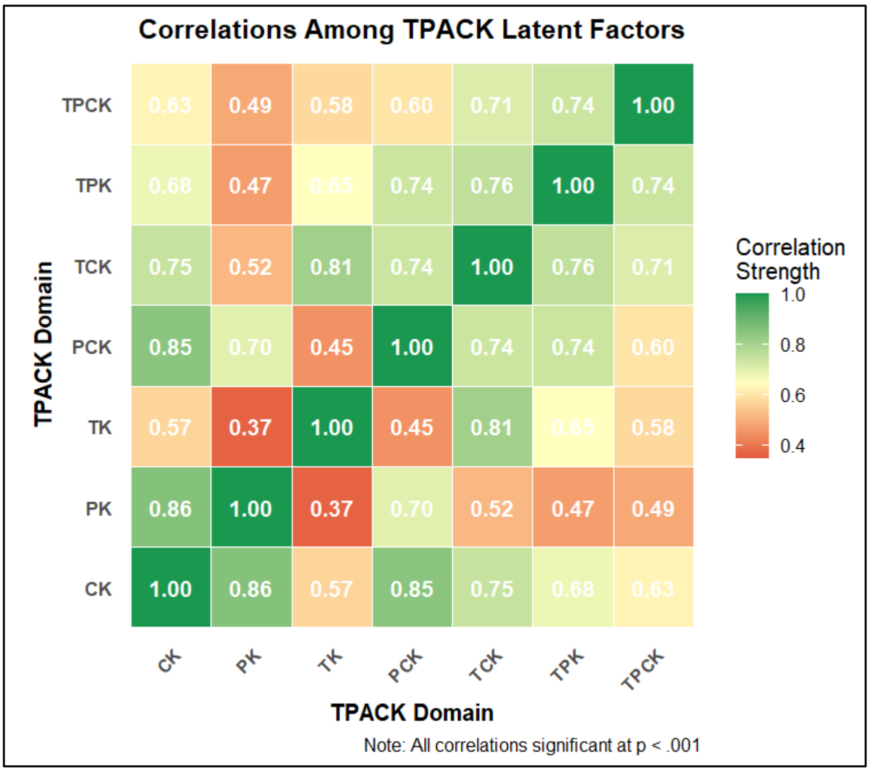

Figure 2: Correlations Among TPACK Latent Factors

4.4 Inferential Statistics: Group Comparisons (RQ1)

Independent samples t-tests were conducted to examine differences in TPACK domain scores by gender. Group statistics are presented in Table 8.

Table 8: Group Statistics by Gender

Domain	Gender	N	Mean	Std. Deviation
TK	Male	24	3.2826	1.03711
	Female	60	3.1066	0.74086
TCK	Male	24	3.4783	0.79741
	Female	60	3.2582	0.75549
TPK	Male	24	3.9239	0.51915
	Female	60	3.7008	0.76624
TPCK	Male	24	3.8913	0.79353
	Female	60	3.7582	0.76099

In the study, males reported higher means across all technology-related areas. However, the independent t-tests indicated that these differences were not statistically significant at *p* < .05 (e.g., TK: *t* (82) = 1.12, *p* = .267; TCK: *t* (82) = 1.27, *p* = .209). This indicates a possible trend toward gender disparity in technological confidence, but no significant gap was found in this sample.

4.5 Effect of Prior ICT Training

Participants were grouped based on whether they had received prior formal technology training. Independent t-tests revealed significant differences in all technology-related domains, as summarized in Table 9.

Table 9: Group Statistics by Prior ICT Training

Domain	Training	N	Mean	Std. Deviation	t-value	p-value
TK	Yes	34	3.4338	0.77925	2.67	**0.009**
	No	50	2.9650	0.81599		
TCK	Yes	34	3.5515	0.69843	2.23	**0.028**
	No	50	3.1600	0.78044		
TPK	Yes	34	3.9559	0.67552	2.02	**0.046**
	No	50	3.6300	0.71114		
TPCK	Yes	34	3.9706	0.61473	1.99	**0.049**
	No	50	3.6750	0.84099		

Participants with prior training scored significantly higher in TK, TCK, TPK, and TPCK ($p < .05$), underscoring the positive impact of structured ICT courses on pre-service teachers' technological self-efficacy.

4.6 Measures of Central Tendency and Dispersion

The means across all domains ranged from 3.15 to 4.37 on the 5-point scale. Pedagogical Knowledge (PK, M = 4.37) and Pedagogical Content Knowledge (PCK, M = 4.05) scored highest, indicating strong confidence in teaching skills. In contrast, Technological Knowledge (TK, M = 3.15) and Technological Content Knowledge (TCK, M = 3.32) were lowest, indicating lower self-efficacy in technology-related areas.

The average scores for all domains ranged from 3.15 to 4.37 on a 5-point scale. Pedagogical Knowledge (PK, M = 4.37) and Pedagogical Content Knowledge (PCK, M =

4.05) were highest, indicating strong confidence in teaching skills. Technological Knowledge (TK, M = 3.15) and Technological Content Knowledge (TCK, M = 3.32) were lowest, showing less confidence in technology areas.

Standard deviations were lowest for PK (SD = 0.56) and PCK (SD = 0.55), meaning most participants felt similarly confident in these areas. Technology-related domains had more varied scores (for example, TK SD = 0.83).

4.7 Normality Assessment: Skewness and Kurtosis

Skewness values that are within ±1 are generally considered acceptable. PK showed significant negative skewness (-1.459), indicating a clustering of high scores. Kurtosis values measure the 'peakedness' of the distribution; PK exhibited high kurtosis (4.726), suggesting a leptokurtic (peaked) distribution. Other domains fell within acceptable ranges for both skewness and kurtosis, supporting the use of parametric tests for further analysis.

4.8 The Theory-Practice Gap - Core Finding (RQ2)

To explore the relationship between self-reported TPACK and applied competence in instructional planning, Pearson's correlation coefficients were calculated using all twelve lesson plans and their corresponding survey scores, as shown in Table 10. Scatterplots were generated to visualize the association between self-efficacy in integrative TPACK domains (TPK and TCK) and lesson plan integration quality.

Table 10: Summary of correlation

Correlation	n	r-value	p-value	95% CI	R^2	Interpretation
TPK vs. Lesson Plan	12	0.082	0.798	[-0.52, 0.63]	0.7%	Extremely weak, non-significant positive correlation
TCK vs. Lesson Plan	12	0.048	0.883	[-0.55, 0.61]	0.2%	Extremely weak, non-significant positive correlation

The scatterplot of TPK survey scores versus lesson plan total scores (n = 12) revealed no discernible linear pattern (see Figure 2). This observation was confirmed statistically:

TPK vs. Lesson Plan Score: $r(10) = 0.082$, $p = .798$, 95% CI [-0.52, 0.63] (non-significant)

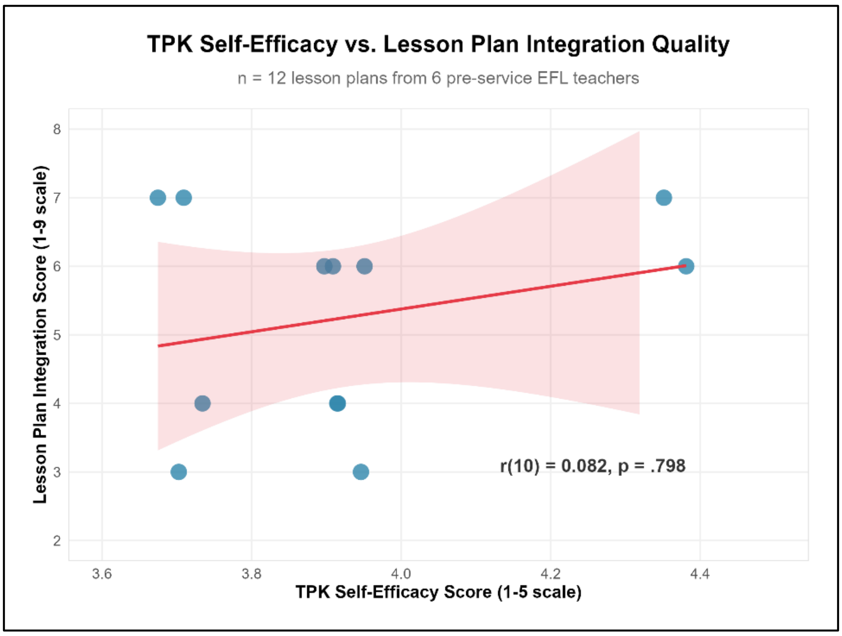

Figure 2: TPK Self-Efficacy vs. Lesson Plan Integration (n=12)

Similarly, the scatterplot for TCK survey scores versus lesson plan total scores (n = 12) showed a scattered distribution with no clear trend (Figure 3), confirmed by the following:

TCK vs. Lesson Plan Score: $r(10) = 0.048$, $p = .883$, 95% CI [-0.55, 0.61] (non-significant)

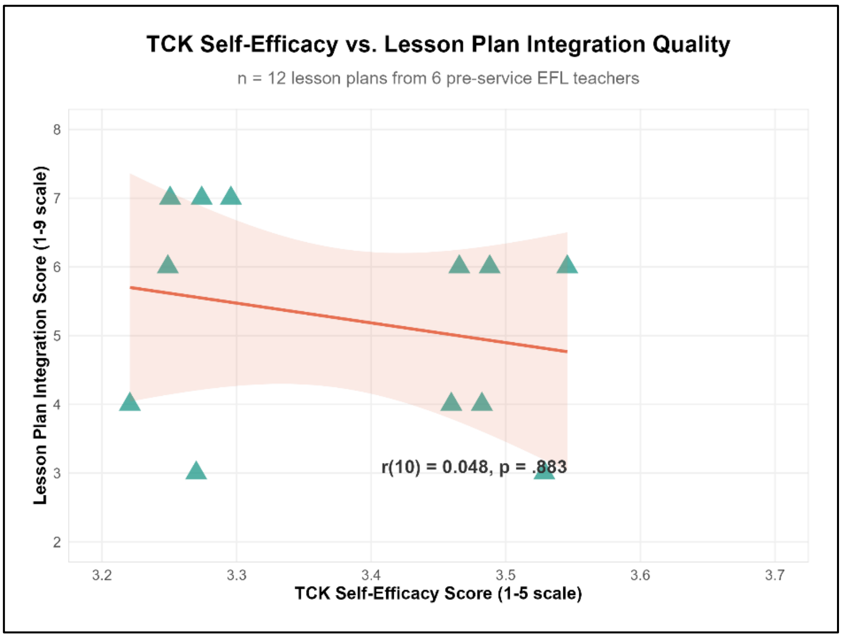

Figure 3: TCK Self-report Scores vs. Lesson Plan Integration Quality (n=12)

These extremely weak, non-significant correlations account for less than 1% of shared variance between self-reported knowledge and applied performance (TPK: R^2 = 0.7%; TCK: R^2 = 0.2%). This indicates a pronounced disconnect between perceived integrative knowledge and actual planning practice. The findings underscore a substantial theory-practice gap in technology integration, suggesting that high self-efficacy in technological-pedagogical and technological-content knowledge does not readily translate into pedagogically sound or contextually feasible technology use in lesson design. The confidence intervals spanning both positive and negative values further emphasize the uncertainty of any true relationship in this small sample, highlighting the critical need for performance-based assessment alongside self-report measures.

4.9 Lesson Plan Integration Quality (RQ2 & RQ3)

Twelve lesson plans were analyzed using a TPACK-informed rubric. Scores (1–3) were assigned for three criteria:

1) Technology Selection & Rationale (TK, TCK)
2) Pedagogical Integration (TPK, TPACK)
3) C-P-T Alignment (TPACK)

The scores for each lesson plan are presented in Table 11 below.

Table 11: Lesson Plan TPACK Integration Scores (n=12)

Lesson	Teacher	Tech Selection	Pedagogical Integration	C-P-T Alignment	Total (/9)	Level of Integration
1	Teacher 1	2	2	2	**6**	Moderate
2		2	1	1	**4**	Low
3	Teacher 2	2	2	2	**6**	Moderate
4		3	2	2	**7**	High
5	Teacher 3	1	1	1	**3**	Low
6		2	1	1	**4**	Low
7	Teacher 4	3	2	2	**7**	High
8		3	2	2	**7**	High
9	Teacher 5	1	1	1	**3**	Low
10		2	2	2	**6**	Moderate
11	Teacher 6	2	1	1	**4**	Low
12		2	2	2	**6**	Moderate

Figure 4 illustrates the variability in technology integration quality among the six pre-service teachers, plotting the total TPACK integration score (out of 9) for each of their two submitted lesson plans.

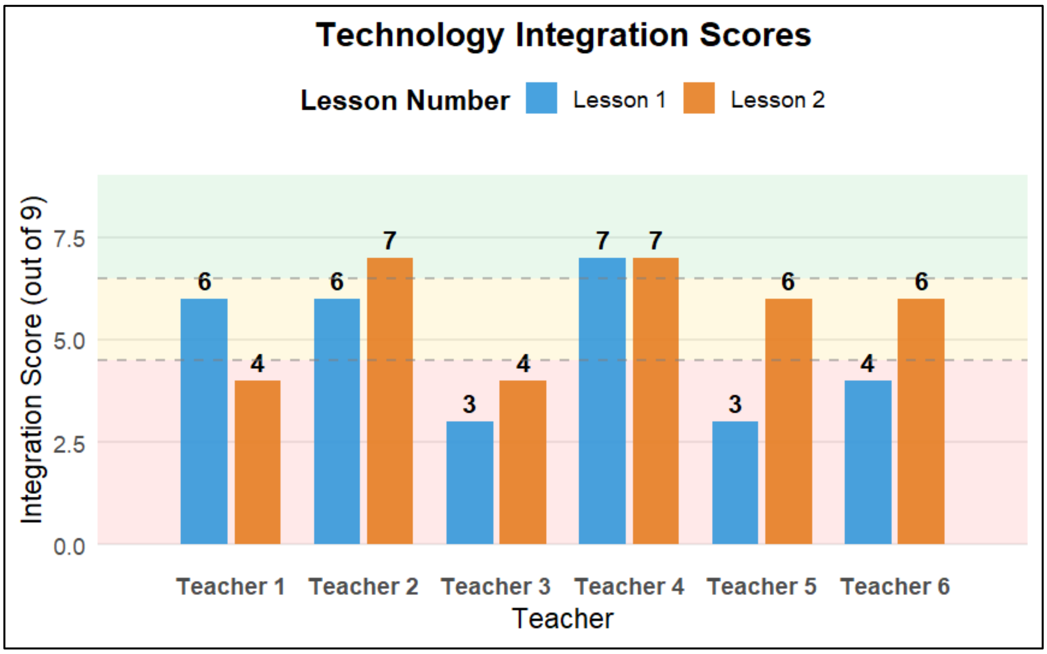

Figure 4: Technology Integration Scores per Teacher

To move beyond numerical scores and provide concrete evidence for the rubric ratings, we present detailed excerpts from lesson plans representing low, moderate, and high levels of technology integration.

4.9.1 Low Integration (Total score = 3, Lesson 5 – *Invitation Letters*):
The "Teaching Resources" column listed "Pictures" and "Sample of letters" generically. The corresponding "Learning Activities" stated: *"Students refer from the dictionary the definition of letters..." and later, "write an invitation letter."* The technology (pictures, samples) is passively presented as a reference material rather than being integral to a constructive task.

There is no rationale for why these specific resources are chosen or how they address a core challenge in learning to write invitation letters, showing weak TCK. The activity does not leverage the resources for student-centered analysis or practice, resulting in passive, add-on use (TPK), and a misalignment between the objective, activity, and technology (C-P-T Alignment).

4.9.2 Moderate Integration (Total score = 6, Lesson 1 – Stress):
Resources include "Audio tapes of pronunciation." The activity is "The teacher defines stress... and gives a few examples" and "*The learner... gives the difference between stressed and unstressed syllables*."

The audio tapes are relevant and content-specific (TCK), moving beyond a generic video. However, their use is primarily for teacher-led demonstration and listener identification. The plan lacks an activity where students actively use the technology to create, analyze, or interact with stressed syllables, keeping the pedagogical integration at a supportive, rather than transformative, level (TPK).

4.9.3 High Integration (Total score = 7, Lesson 4 – Pronunciation of /l/ and /r/):

This plan demonstrates more sophisticated integration. It specifies an "Audio on Pronunciation" and an "Audio dictionary." Crucially, the learning activity is structured: "*Teacher aids learners in identifying words in the poem that have the (r) and (l) sounds and pronounce them correctly."*

This indicates a guided discovery approach where technology (audio models) is used as a benchmark for active student practice and self-correction. The alignment is clear: the objective (correct pronunciation), the technology (accurate audio models), and the activity (identification and practice) are directly linked. The use of a poem as the content source provides an authentic context for applying TCK and TPK.

The analysis of 12 lesson plans submitted by six pre-service teachers reveals distinct patterns in technology integration quality, as visualized in Figure X. The bar chart displays each teacher's two lesson plans side-by-side, with consistent color coding: blue bars represent Lesson 1 and orange bars represent Lesson 2 across all participants. The background shading provides immediate visual reference to the three integration levels, with red (0–4.5), yellow (4.5–6.5), and green (6.5–9) zones corresponding to Low, Moderate, and High integration, respectively.

4.10 Distribution Patterns

The scores demonstrate notable variability both within and between teachers. Five of the twelve lessons (42%) fell into the Low integration category (scores 3–4), characterized by generic technology use with minimal pedagogical justification. An equal proportion (42%, n=5) achieved Moderate integration (scores 5–6), where technology was relevant to the content but served primarily supportive rather than transformative roles. Only two lessons (16%) reached High integration (score 7), demonstrating purposeful selection of technology to address specific content challenges and facilitate active, student-centered learning tasks.

4.10.1 Inter-Teacher Variability

Teacher performance showed considerable differences. Teacher 4 produced the most consistently technology-enhanced lessons, with both submissions scoring 7 (High integration). Teachers 1, 2, 5, and 6 demonstrated mixed results, with one Moderate and one Low-scoring lesson each, suggesting inconsistent application of technological pedagogical knowledge. Teacher 3 submitted the lowest-scoring lessons (3 and 4), indicating challenges in integrating technology effectively across both planning attempts.

4.10.2 Intra-Teacher Consistency

Notably, no teacher produced two High-integration lessons, and only Teacher 3 produced two Low-integration lessons. The majority (four of six teachers) showed variability between their two submissions, with differences of 2–3 points between their lessons. This inconsistency suggests that technology integration remains a developing skill, highly dependent on lesson-specific factors rather than a stable competency.

4.10.3 Measures of Central Tendency and Dispersion (Lesson Plans)

- Mean Total Score: 5.25 (SD = 1.66),
- Median: 6.0,
- Range: 4 (3 to 7),
- Score Distribution: Low (3–4): 42%, Moderate (5–6): 42%, High (7): 16%.

These updated descriptive statistics indicate moderate overall integration quality with considerable variability among participants. The inclusion of all 12 plans reveals a slightly higher proportion of lessons (42%) in the low-integration category, further emphasizing the challenge of translating technological knowledge into effective lesson design.

5. Discussion

5.1 The Theory-Practice Divide and the Role of Contextual Knowledge (XK)

This study identified a critical disconnect in the readiness of Kenyan pre-service EFL teachers for technology integration. While participants demonstrated relatively strong pedagogical confidence and technological awareness, they showed a significant inability to translate this knowledge into contextually feasible, pedagogically sound lesson plans. The near-zero correlations between self-reported TPK/TCK and applied integration quality ($r \approx .08$) provide core evidence of this theory-practice gap. Using the extended TPACK framework that incorporates the new Contextual Knowledge (XK) domain (Petko et al., 2025) as a diagnostic tool, our findings show that without intentionally developing XK, even confident teachers find it difficult to turn technological knowledge into practical, context-aware teaching strategies.

The updated TPACK model proved invaluable for this diagnosis. Our findings strongly support its dual conceptualization of context. While the Kenyan context clearly shapes teachers' knowledge, as evidenced by their awareness of infrastructure gaps and policy ambitions (KICD, 2017), the explicit, actionable knowledge needed to navigate these constraints (XK) remains underdeveloped. Lesson plans showed scant evidence of planning for low-resource scenarios, large classes, or intermittent connectivity, as key features of the Sub-Saharan African educational context (Hennessy *et al.*, 2010; Foley & Masingila, 2013). This deficiency in XK helps explain the theory-practice gap. As Petko *et al.* (2025) argue, XK distinguishes novice from expert teachers; our study finds that Kenyan pre-service teachers are still novices in this crucial domain, lacking the "filter" needed to apply TPACK knowledge effectively in resource-constrained environments.

5.2 Interpreting the TPACK Proficiency Profile

The high Cronbach's alpha ($\alpha = .937$) confirms the reliability of the adapted TPACK scale in the Kenyan EFL context, consistent with previous validation studies (Schmid *et al.*, 2020). The descriptive statistics reveal a clear profile: pre-service teachers feel most confident in pedagogical knowledge (PK, $M = 4.37$) and pedagogical content knowledge (PCK, $M = 4.05$). In contrast, technological knowledge (TK, $M = 3.15$) and related integrative domains (TCK, $M = 3.32$; TPK, $M = 3.76$) received the lowest scores. This pattern aligns with studies from similar contexts where teachers feel pedagogically prepared but technologically uncertain (Kafyulilo *et al.*, 2015; Wambiri & Ndani, 2016; Valtonen *et al.*, 2019). The significant negative skewness and high kurtosis observed in PK scores may reflect either genuine confidence or a social desirability bias in self-reporting teaching competencies.

Inferential statistics provided further insights. Prior ICT training notably enhanced performance in all technology-related domains (TK, TCK, TPK, TPCK; all $p < .05$), underscoring the importance of structured, mandatory technology courses. Although gender differences were not statistically significant, the persistent pattern of males scoring higher in technology suggests that gender-sensitive professional development could help promote equitable confidence.

5.3 Explaining the Gap: From Confidence to Application

The analysis of twelve lesson plans submitted by six pre-service teachers reveals distinct patterns in technology integration quality. Five lessons (42%) fell into the Low integration category (scores 3–4), characterized by generic technology use with minimal pedagogical justification. An equal proportion (42%, *n*=5) achieved Moderate integration (scores 5–6), where technology was relevant to the content but served primarily supportive rather than transformative roles. Only two lessons (16%) reached High integration (score 7), demonstrating purposeful selection of technology to address specific content challenges and facilitate active, student-centered learning tasks.

Teacher performance showed considerable variability both within and between teachers. Teacher 4 produced the most consistently technology-enhanced lessons (both scoring 7), while Teachers 1, 2, 5, and 6 demonstrated mixed results. Teacher 3 submitted the lowest-scoring lessons (3 and 4), indicating challenges in integrating technology effectively. Notably, no teacher produced two High-integration lessons, and the majority showed variability between their submissions (differences of 2–3 points), suggesting that technology integration remains a developing skill dependent on lesson-specific factors rather than a stable competency.

Qualitative analysis provides concrete examples of why the gap exists. In the low-integration lesson (Lesson 5), the teacher generically listed "video" without a clear rationale or pedagogical design, despite potentially reporting high TPK on the survey. This suggests that pre-service teachers may overestimate their ability to select and integrate technology in the abstract but struggle to operationalize this knowledge in concrete planning. Even when technology is appropriately selected, as in moderate and high integration lessons, pedagogical integration varies widely from passive consumption to active, constructive use. The lack of correlation, therefore, can be explained by the complex, conditional nature of TPACK, which requires not only knowledge of technology and pedagogy but also the ability to synthesize them in specific contexts (Mishra & Koehler, 2006; Willermark, 2018).

5.4 Implications for Kenyan Pre-Service EFL Teacher Education

The predominance of pedagogical knowledge (PK) and its hybrid forms (PCK, TPK) in participants' self-reports supports a transformative view of TPACK development, whereby integrative competencies arise more directly from pedagogical knowledge than from isolated technological skills (Schmid *et al.*, 2020; Mishra & Koehler, 2006). This strong pedagogical foundation provides a critical base for future development. However, the measures of central tendency and dispersion for both the survey and lesson plan data reveal a system in transition, with uneven teacher preparedness that requires differentiated support.

These findings translate into complex implications that challenge transmission-based models of teacher education prevalent in many Global South contexts (Tatto, 2021). The disconnect suggests that simply transmitting TPACK knowledge is insufficient; teacher development must embrace sociocultural and situated learning theories (Lave & Wenger, 1991) by creating communities of practice where pre-service teachers collaboratively solve authentic technology-integration problems within Kenyan classroom constraints.

Second, the gap between self-reported confidence and actual performance questions the validity of TPACK self-efficacy surveys as standalone assessment tools. This finding contributes to an ongoing methodological debate in TPACK research (Willermark, 2018) and supports calls for multi-method assessment approaches that include performance-based measures alongside self-report data.

Finally, these implications must be contextualized within Kenya's broader educational landscape. While the Competency-Based Curriculum (CBC) mandates digital literacy, its implementation faces significant infrastructural and resource constraints (Mwangi & Khatete, 2017). Therefore, any teaching intervention should balance ambitious integration goals with practical realities, possibly focusing on low-tech or mobile solutions that are more achievable in resource-limited settings. This area calls for further research tailored to specific contexts.

6. Limitations and Future Research

This study has several limitations, including its single-institution sample, a small number of analyzed lesson plans (n=12), and a cross-sectional design, which limits generalizability. Future research should address these constraints by: conducting longitudinal studies tracking TPACK development from training into early teaching; employing larger-scale lesson plan analyses or classroom observations to validate the theory-practice gap; developing validated instruments to measure Contextual Knowledge (XK) directly; and investigating how Intelligent-TPACK (I-TPACK), particularly ethical AI knowledge, can be integrated into Kenyan teacher education.

7. Conclusion

Beyond confirming TPACK's diagnostic utility, this study reveals a critical misalignment between Kenya's ambitious digital education policies and the pedagogical realities of teacher preparation. The framework's power lies not merely in identifying gaps but in providing a structured pathway for transformative teacher education reform. By treating the theory-practice gap not as a deficiency but as a design challenge, Kenyan teacher educators can reimagine preparation programs as incubators for contextually responsive innovation, ultimately ensuring that digital literacy policies translate into meaningful classroom practice rather than remaining aspirational documents.

Future research should therefore investigate specific pedagogical interventions, such as scaffolded lesson-planning workshops, classroom-based implementation, or mentorship models, that can effectively bridge the divide between perceived knowledge and enacted practice. By leveraging TPACK not only as a theoretical model but as a diagnostic and developmental blueprint, teacher educators and policymakers can design targeted interventions. These should shift the focus beyond mere access to technology toward meaningful, sustainable, and equitable integration aligned with the demands of Kenya's Competency-Based Curriculum and the realities of 21st-century EFL teaching.

Conflict of Interest Statement
The author declares no conflicts of interest.

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