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Technological, Pedagogical, and Content Knowledge (TPACK) Level and Technology-Based Self-Regulated English Learning Strategies (SRL) of Pre-Service Teachers

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ABSTRACT

Teacher preparation programs in the Philippines continue to struggle with developing pre-service teachers' Technological, Pedagogical, and Content Knowledge (TPACK) and self-regulatory competencies. Current studies show low levels of both TPACK and technology-based self-regulated English learning strategies (SRL), revealing a critical gap in the prevailing context. Hence, this study was conducted with the primary aim of identifying the level of TPACK and the usage of SRL of the pre-service teachers. Moreover, this specifically sought to determine if there is a significant relationship between their usage of SRL and their TPACK level. In doing so, this study used a descriptive-correlational design with 139 respondents selected through stratified random sampling, and the data were gathered through a structured survey and analyzed using Pearson r-correlation. This was guided by the TPACK and SRL frameworks, with TPACK used to measure the pre-service teachers' level of technological, pedagogical, and content competence, and SRL used to assess their usage of self-management strategies. Together, these frameworks support the study's aim of evaluating both constructs and examining their relationship. The results revealed that their TPACK level is average, and they usually use the SRL strategies. A significant relationship was also found between TPACK level and technology-based English SRL strategies, indicating that effective

technological integration depends on a holistic understanding of how tools align with pedagogy and content. This enables the pre-service teachers to make metacognitively informed decisions, monitor learning, and apply strategies effectively. The findings suggest that teacher education programs should strengthen TPACK and SRL skills to promote more effective, pedagogically sound technology use in English learning.

Keywords: *Technological knowledge, pedagogical knowledge, content knowledge, technology-based self-regulated English learning strategies, pre-service teachers*

Introduction

The advent of the new era brings drastic and fast-paced changes in almost all aspects of human life. These changes can be attributed to the emergence of the new technology that widely dominated and was incorporated into many human activities, including the field of education. The educational landscape has shifted from traditional to modern and from teacher-centered to student-centered approaches, a change largely driven by the immense use and integration of technology in educational processes and practices. This drastic and sudden shift underscores the need to produce competent, efficient, and effective teachers (Ramos et al., 2020) who are not only flexible and adaptable to change but also knowledgeable enough to meet the concerns of 21st-century learners and classrooms. Since 21st-century teaching and learning require the integration of technology into both content and pedagogy, pre-service teachers (PSTs) must develop a strong understanding of technology integration during their training so that they are fully prepared to address their students' needs once they become professional teachers. In this regard, the Technological, Pedagogical, and Content Knowledge (TPACK) provides a framework for understanding how teachers integrate technology with pedagogy and content knowledge to enhance learning outcomes (Ammade et al., 2020; Mishra & Koehler, 2006). Its relevance extends beyond general classroom instruction, as teachers with higher TPACK are better positioned to implement self-regulated learning (SRL) strategies, which are critical for fostering student autonomy and metacognitive skills (Panadero, 2017, as cited in Aydogmus & Ibrahim, 2022; Par, 2022). Cognitive load theory supports this connection, suggesting that teachers with integrated TPACK can design learning experiences that optimize students' cognitive resources, facilitating better planning, monitoring, and regulation of learning.

Furthermore, due to the flexibility of the TPACK as a framework encompassing the three core areas of knowledge into a single unit that the teachers need in this digital era (Ammade et al., 2020), the knowledge of its three areas is also a significant predictor of the preparation of teachers for using technology for teaching, even in the case of language learning. The integration of technology in complement with the right pedagogy and strong foundational knowledge of the content in teaching language can assist the students in their proper learning of language, particularly the English language. The need for learning the English language arises due to the context of globalization, wherein this language serves as the lingua franca in the fields of business, industry, and even in the academe. This points to the crucial role of learning the language through the aid

of technology and hence, gives prominence to the idea of technology-based self-regulated learning (SRL), which is a self-directed process where individuals use digital tools and environments to manage their own pursuit of learning goals (Dogra, 2023).

In connection to this, recent studies in the Philippines indicate that pre-service teachers demonstrate low levels of both TPACK and technology-based self-regulated learning (SRL), revealing gaps in teacher education programs (Funa et al., 2023; Peligro, 2022). This gap is particularly concerning in language education, where the integration of technology with pedagogy and content knowledge is critical for effective English language learning, a core skill in globalized contexts where English serves as the lingua franca in business, academia, and international communication (Crystal, as cited in Quibilan, 2017). Without strong TPACK, PSTs may struggle to implement strategies that enhance students' language acquisition and self-regulatory skills.

This gap between the technological competencies that teacher education programs aim to develop and the actual skills demonstrated by pre-service teachers has been increasingly documented in recent studies. Despite ongoing integration of technology in education, pre-service teachers often exhibit insufficient mastery of the TPACK required for effective teaching (Peligro, 2022; Ramos et al., 2020). This discrepancy highlights the urgent need to examine pre-service teachers' TPACK levels and their preparedness to employ technology-enhanced teaching strategies effectively, particularly in the context of language learning. Furthermore, the literature on SRL is largely general and rarely contextualized within language learning, limiting insights into how technology-mediated SRL supports English language instruction. Addressing this gap is crucial, as insufficiently prepared teachers may fail to promote autonomous learning and metacognitive strategies, which are essential for student success in 21st-century classrooms.

Given all these considerations, the conduct of this study is timely and relevant as it aimed to achieve three specific objectives. First, it sought to examine the TPACK level of pre-service teachers to determine whether Teacher Education Institutions' (TEIs) curricula align with the Philippine Professional Standards for Teachers (DepEd Order No. 42, s. 2017), which emphasize content knowledge, pedagogy, and ICT integration (Ramos et al., 2020). Second, it is intended to provide insights to TEIs for enhancing policies and programs, given that prior research indicates pre-service teachers demonstrate only moderate TPACK, reflecting irregular and often misaligned technology use (Ammade et al., 2020; Karabuz & Ogan-Bekiroglu, 2020; Ramos et al., 2020). Third, the study investigated the relationship between TPACK and SRL in English language learning, addressing a gap in the literature where SRL is frequently examined broadly rather than within language-specific contexts (Huang & Lajoie, 2021). Through accomplishing these objectives, this research contributed to a deeper understanding of how TPACK and SRL interact to support the development and preparedness of pre-service teachers.

Methods

Research Design

This study was anchored in a positivist epistemological stance, which assumes that knowledge related to respondents' competencies and learning strategies can be objectively measured and analyzed. Guided by this perspective, a descriptive-correlational research design was employed, as it is appropriate for describing existing conditions and examining relationships among variables without manipulation (Paniamogan & Dioso, 2024). The descriptive component was used to determine the

current TPACK levels and the technology-based English self-regulated learning (SRL) strategies of pre-service teachers, while the correlational component examined the relationship between these variables. This design is considered optimal for educational research that seeks to explore naturally occurring associations among variables without inferring causality (Paniamogan & Dioso, 2024), thereby aligning with the objectives of the study.

Respondents

The respondents of this study were the third-year and fourth-year pre-service teachers of the Bachelor of Secondary Education (BSE) who had already studied Purposive Communication and Technology for Teaching and Learning, which focuses on the discussion of the TPACK framework. Their inclusion ensured adequate exposure to pedagogical content and educational technology for meaningful assessment. However, focusing on upper-year students may limit the generalizability of the findings to lower-year pre-service teachers or those from other programs or institutions. The sample consisted of 139 respondents selected through stratified random sampling, with the sample size determined using Cochran's formula with 95% confidence level, 5% margin of error, and an estimated population proportion of 0.50, which provided adequate statistical power to detect meaningful correlations among the study variables.

Locale of the Study

This study was conducted at the College of Education, Isabela State University-Echague, during the first semester of the Academic Year 2023–2024. The college offers the Bachelor of Secondary Education (BSE) program with four specializations, which typically enrolls students from diverse socio-economic backgrounds and maintains a recognized standing in teacher education. This institutional context, including the program's emphasis on pedagogy and educational technology, provided an appropriate setting for the study but may have influenced the findings and limited their applicability to institutions with different student profiles or resource levels.

Research Instrument

For data collection, standard survey questionnaires were adopted from Mishra et al. (2009) for TPACK and An et al. (2021) for Technology-Based Self-Regulated English Learning Strategies. The TPACK tool has a Cronbach's alpha of 0.75 to 0.92 across each of the seven (7) domains as validated by Mishra et al. (2009) using the same population as utilized in this study. It includes 29 items across seven domains: Technology Knowledge (TK) and Pedagogical Knowledge (PK) with seven items each, Content Knowledge (CK) with three items, Pedagogical Content Knowledge (PCK) and Technological Content Knowledge (TCK) with one item each, and Technological Pedagogical Knowledge (TPK) and Technological Pedagogical Content Knowledge (TPACK) with five items each. Responses were rated on a four-point Likert scale (1=Strongly Disagree to 4=Strongly Agree).

On the other hand, the Self-Regulated English Learning Strategies questionnaire has 26 items under five domains: Motivational Regulation Strategies (MRS, nine indicators), Goal Setting and Learning Evaluation (GS, five indicators), Social Strategies (SS, four indicators), Technology-Based English Song and Movie Learning (TE, five indicators), and Technology-Based Vocabulary Learning (TV, three indicators). It has a Cronbach's alpha value of 0.89, indicating the good reliability of the instrument. These were rated on a five-point Likert scale (1=Strongly Disagree to 5=Strongly Agree).

Data Collection Procedure

In gathering the data, the researchers first sought approval from the dean of the College of Education through a request letter stating the study's purpose. With the Dean's approval, the same request was endorsed to the BSE program chair. After approval, a consent letter and the survey questionnaire were distributed to respondents via Google Forms. The official list of enrolled students was obtained through formal coordination with the dean and program chair, and survey invitations were sent individually via Messenger. Data quality was ensured by limiting responses to one submission per participant and requiring complete responses, while anonymity, voluntary participation, and the absence of identifying information helped minimize social desirability bias. Although self-reported online data may introduce response bias, this method was appropriate given the limited physical contact during the recovery period of the country from COVID-19.

Analysis of Data

The data gathered from this study were analyzed through the employment of SPSS (Statistical Package for Social Sciences) using the statistical tools such as frequency counts and percentages for the profile of the respondents. Mean and weighted mean were also utilized in determining the TPACK level and in identifying the frequency of the employment of the technology-based English SRL Strategies. Pearson's r correlation was employed to examine the relationship between respondents' TPACK levels and their use of technology-based English SRL strategies. This statistical test was deemed appropriate as preliminary analyses confirmed that the variables met the assumptions of linearity, normality, and homoscedasticity.

Ethical Considerations

Before the study was conducted, approval was obtained from the dean of the college where the research took place. Informed consent was secured from all participants, who were clearly informed of the purpose of the study, procedures, and their right to withdraw at any time without consequences. To ensure data security and confidentiality, no personal identifiers were collected, and all responses were securely stored and used solely for research purposes.

Results and Discussion

Table 1 presents the respondents' profiles by year level and sex. Most were fourth-year students (72 or 51.80 percent), followed by third-year students (67 or 48.20 percent). In terms of sex, the majority were female (104 or 74.80 percent), while males accounted for 35 or 25.20 percent.

Table 1. Profile of the Respondents

Variables	Frequency (n=139)	Percent
Year Level		
Third Year	67	48.20
Fourth Year	72	51.80
Sex		
Male	35	25.20
Female	104	74.80

Given the predominance of female respondents, this may limit generalizability because the sample does not proportionally represent both sexes. It has been shown that gender can influence technology use and self-regulated learning, as females and males may differ in confidence, strategies, or frequency of using educational technologies (Refika, 2023). Since TPACK levels and technology-based English SRL strategies are closely related to how students engage with technology for learning, having this sample could skew the findings toward patterns more typical of female students.

Table 2. Level of Technological Pedagogical Content Knowledge (TPACK) Level of Pre-Service Teachers

Domains	Mean	Interpretation
Technology Knowledge (TK)		
1. I know how to solve my own technical problems.	2.96	Average
2. I can learn technology easily.	3.08	Average
3. I keep up with important new technologies.	3.16	Average
4. I frequently play around with the technology	3.03	Average
5. I know about a lot of different technologies.	2.80	Average
6. I have the technical skills I need to use technology	3.00	Average
7. I have had sufficient opportunities to work with different technologies.	2.85	Average
Weighted Mean	**2.98**	**Average**
Pedagogical Knowledge (PK)		
8. I know how to assess student performance in a classroom	3.06	Average
9. I can adapt my teaching based upon what students currently understand or do not understand.	3.14	Average
10. I can adapt my teaching style to different learners.	3.09	Average
11. I can assess student learning in multiple ways.	3.04	Average
12. I can use a wide range of teaching approaches in a classroom setting	3.02	Average
13. I am familiar with common student understandings and misconceptions.	3.01	Average
14. I know how to organize and maintain classroom management.	3.09	Average
Weighted Mean	**3.06**	**Average**
Content Knowledge (CK)		
15. I have sufficient knowledge about literacy.	3.00	Average
16. I can use a literary way of thinking	3.01	Average
17. I have various ways and strategies of developing my understanding of literacy.	3.06	Average
Weighted Mean	**3.02**	**Average**
Pedagogical Content Knowledge (PCK)		
18. I can select effective teaching approaches to guide student thinking and learning in literacy.	3.07	**Average**
Technological Content Knowledge (TCK)		

19. I know about technologies that I can use for understanding and doing literacy.	3.15	**Average**
Technological Pedagogical Knowledge (TPK)		
20. I can choose technologies that enhance the teaching approaches for a lesson.	3.19	Average
21. I can choose technologies that enhance students' learning for a lesson.	3.19	Average
22. My teacher education program has caused me to think more deeply about how technology could influence the teaching approaches I use in my classroom.	3.30	High
23. I am thinking critically about how to use technology in my classroom.	3.18	Average
24. I can adapt the use of the technologies that I am learning about to different teaching activities.	3.18	Average
Weighted Mean	**3.21**	**Average**
Technological Pedagogical Content Knowledge (TPACK)		
25. I can teach lessons that appropriately combine literacy, technologies, and teaching approaches.	3.14	Average
26. I can select technologies to use in my classroom that enhance what I teach, how I teach, and what students learn.	3.21	Average
27. I can use strategies that combine content, technologies, and teaching approaches that I learned about in my coursework in my classroom	3.14	Average
28. I can provide leadership in helping others to coordinate the use of content, technologies, and teaching approaches at my school and/or district.	3.09	Average
29. I can choose technologies that enhance the content for a lesson.	3.21	Average
Weighted Mean	**3.16**	**Average**
General Weighted Mean	**3.09**	**Average**

Technology Knowledge

The table shows the TPACK level of PSTs in technology knowledge (TK), with the highest mean of 3.16 for the item focused on keeping up with new technologies with an overall mean of 2.98, both at an average level. While this suggests that PSTs have basic technical skills and adaptability, the average rating indicates limited depth in applying technology effectively for teaching, emphasizing a need for targeted training to move beyond familiarity toward confident and pedagogically meaningful use of digital tools.

This highlights that a basic understanding of computers is now as essential as other disciplines, with ICT increasingly shaping education (Ghora & Bhatti, 2016). ICT activities foster creativity, critical thinking, and engagement, while exposure builds teachers' proficiency. Enhancing technological skills is vital for classroom ICT use, requiring teachers to collaborate online and take responsibility for effective technology integration (Akarawang et al., 2015; Dostál et al., 2017).

Pedagogical Knowledge

In terms of pedagogical knowledge (PK), the highest mean of 3.14 was obtained by the indicator dealing with teaching adaptation to students' understanding, with an overall mean of 3.06. While this suggests that PSTs demonstrate competence in using varied methods, addressing diverse learners' needs, applying assessments, managing classrooms, and recognizing misconceptions, the average level reflects a cautious self-assessment or limited confidence in fully implementing pedagogical strategies. This points to potential gaps in translating theoretical knowledge into consistent, effective classroom practice. Quality education relies on effective teachers (Jiang et al., 2023). Thus, under the Higher Education Act of 1994, teacher education institutions must innovate to equip future teachers with strong knowledge, pedagogical skills, and alignment with Philippine culture and values.

Content Knowledge

For content knowledge (CK), the highest mean of 3.06 was accounted for the item on using various strategies to develop understanding of literacy, with an overall mean of 3.02, described as average level. While this indicates that PSTs employ multiple techniques and demonstrate foundational literacy competence, the average rating points out limited depth or consistency in applying these strategies effectively, highlighting the need to strengthen their ability to translate content knowledge into more advanced and impactful teaching practices.

This is consistent with the aim of the teacher education programs to strengthen content knowledge for flexible lesson mastery and effective classroom delivery, as skilled teachers use subject expertise to enhance learning and adapt to diverse needs. These results align with Ozturk and Ozturk (2023), who emphasized that Content Knowledge (CK), or Subject Matter Knowledge (SMK), is central to effective teaching (Guerra-Liaño et al., 2010; Santos et al., 2021). As Guerra et al. (2013) explained, CK includes declarative (knowing that), procedural (knowing how), and conditional knowledge (knowing how and why). Santos et al. (2021) further stressed that CK is essential for pre-service teachers to teach topics and subject matter effectively.

Pedagogical Content Knowledge

In pedagogical content knowledge (PCK), the indicator about selecting effective teaching approaches to guide student thinking and learning in literacy received a mean of 3.07. While this suggests that PSTs feel capable of choosing appropriate methods, the average level poses cautious confidence or uneven skill in integrating content and pedagogy. This highlights the need for further development in applying PCK consistently to design instruction that effectively supports diverse learners and deepens understanding. PCK is a combination of CK and pedagogy or the strategies to be an effective teacher (Santos et al., 2021). The studies have highlighted that having a deep understanding of the content or having the knowledge in the content in combination with pedagogy plays a vital role in the improvement of teachers in the field of education, especially in their instructional practices.

Technological Content Knowledge

In the TCK domain, respondents reported a mean of 3.15, indicating agreement that they are familiar with technologies useful for understanding and teaching literacy. While this reflects awareness of technology's potential to support content comprehension, the average level infers that PSTs may still be developing the ability to

integrate these tools effectively and strategically into instruction, rather than using them routinely or superficially. This result coincides with the study of Huang and Lajoie (2021), which states that Technological Content Knowledge (Mishra & Koehler, 2006) is a key component of teacher technology education and is essential for instructors to use educational technology effectively.

Technological Pedagogical Knowledge

The TPK domain obtained the highest weighted mean of 3.32, implying that PSTs perceive their teacher education program as effective in fostering deeper reflection on how technology shapes teaching approaches. However, despite this relatively strong perception, the overall mean for this component is 3.21, which indicates only a moderate level of competence in selecting and adapting technologies to enhance student learning. This disparity uncovers that while PSTs are encouraged to think critically about technology integration, they may have limited opportunities to translate this conceptual understanding into consistent, practice-oriented application. This is parallel with what Ozturk et al. (2023) note that technology is now integral to education, including tools like audio recordings, texts, animations, and films. Thus, teachers must develop the competencies to use these technologies effectively and appropriately by having more exposure in terms of application (Jiang et al., 2023).

Technological Pedagogical Content Knowledge (TPACK)

In the TPACK domain, the highest mean score of 3.21 was obtained for pre-service teachers' ability to choose technologies that enhance lesson content, indicating that respondents generally recognize the value of technology in improving instructional quality. However, this finding also implies that PSTs' confidence is largely concentrated on surface-level enhancement of content rather than on deeper pedagogical integration, indicating a functional but still limited understanding of how technology can be strategically aligned with pedagogy and learning objectives. This is consistent with the study of Mercader (2021), which emphasized that Technological Pedagogical Content Knowledge (TPACK) is essential for teaching 21st-century skills but also highlights that teachers often equate technology use with content enhancement rather than with transformative pedagogical practice. As advances associated with the Industrial Revolution have accelerated the shift toward technology-driven 21st-century learning, the findings underscore the importance of examining teachers' depth of understanding in integrating technology.

Technology-Based Self-Regulated English Learning Strategies Employed by the Pre-Service Teachers

Table 3 shows the extent of use of the pre-service teachers of technology-based self-regulated English learning strategies. The findings are discussed in every domain to provide a clearer and more logical textual presentation.

Motivational Regulation Strategies (MRS)

Table 3 exhibits a comprehensive overview of the technology-based self-regulated English learning strategies employed by the pre-service teacher under MRS (Motivational Regulation Strategies). The indicators highlight possible implications. Firstly, the students always search related materials online when faced with difficulties in the process of studying English, with a calculated mean of 4.24. Moreover, the use of technology has received increasing recognition as a means capable of bridging formal

and informal settings in the target language learning (Jian et al., 2023; Katemba & Wei, 2018) and enabling students to actively and effectively use technology both inside and outside the classroom.

Table 3. Technology-Based Self-Regulated English Learning Strategies Employed by Pre-service Teachers

Technology-Based Self-Regulated English Learning Strategies	Mean	Qualitative Description
Motivational Regulation Strategies (MRS)		
1. I select and use appropriate technological tools to improve the areas I'm weak in.	4.03	Usually used
2. I use technologies outside the classroom to access authentic materials in English.	3.93	Usually used
3. I search related materials online when I have difficulties in the process of studying English.	4.24	Always or almost always used
4. I seek opportunities through technological resources to practice my oral English.	4.14	Usually used
5. I use technologies to help me sustain/enhance interest in learning English.	4.13	Usually used
6. I use technologies (APPs or websites) to make the English learning task more interesting.	4.15	Usually used
7. I use mobile devices to enhance my willingness to participate in English social events.	4.06	Usually used
8. Sometimes I look through the visual and vivid courseware to arouse my interest in English learning.	3.96	Usually used
9. When I feel bored with learning English, I adopt technological resources to decrease the boredom and increase the enjoyment.	3.98	Usually used
Weighted Mean	**4.07**	**Usually used**
Goal Setting and Learning Evaluation (GS)		
1. I listen to English radio broadcasts (e.g., VOA and BBC) to improve my English proficiency	3.40	Usually used
2. At the beginning of the semester, I set technology-assisted English learning goals.	3.39	Sometimes used
3. I often monitor my technology-assisted English learning progress.	3.35	Sometimes used
4. I reflect on the effectiveness of using technologies for English learning.	3.76	Usually used
5. I adjust my English learning plans in response to different technology-assisted learning activities.	3.74	Usually used
Weighted Mean	**3.53**	**Usually used**
Social Strategies (SS)		
1. I seek advice on how to use technologies effectively for English language learning.	3.86	Usually used
2. I seek opportunities to talk with native English speakers through technological tools.	3.55	Usually used

3. When I have problems in English learning, I ask my teacher for help through technological tools.	3.47	Usually used
4. I share my problems with my classmates online so we can solve our problems together.	3.71	Usually used
Weighted Mean	**3.63**	**Usually used**
Technology-Based English Song and Movie Learning (TE)		
1. I "copy" useful words and expressions in English movies or programs.	3.86	Usually used
2. I practice saying new expressions in English movies or programs to myself.	4.09	Usually used
3. I listen to English songs to help me remember words.	4.01	Usually used
4. I use technologies (e.g., English movies) to learn more about English and the culture.	4.08	Usually used
5. I use technologies to connect English learning with my personal interest (e.g., playing English games, or listening and singing English songs).	4.00	Usually used
Weighted Mean	**4.00**	**Usually used**
Technology-Based Vocabulary Learning (TV)		
1. I use lexical apps to help me memorize new words.	3.49	Usually used
2. I use online dictionaries to check English words.	4.24	Always or almost always used
3. I use technologies (e.g., vocabulary apps) to help me persist in my English learning goals.	4.14	Usually used
Weighted Mean	**3.96**	**Usually used**
General Weighted Mean	**3.84**	**Usually used**

The MRS domain yielded a high weighted mean of 4.07, inferring that pre-service teachers frequently employ metacognitive regulation strategies. This implies a strong tendency to plan, monitor, and evaluate learning through technology, which is strategically adaptive. This pattern of frequent use may be attributed to the increased accessibility and advancement of technology, which naturally supports learners' engagement and motivation in studying English. As Christen (2019) noted, students today live in a highly technological world where routine engagement with tools such as texting, social networking, and web surfing promotes motivation and sustained involvement in language learning.

Goal Setting and Learning Evaluation (GS)

Subsequently, the highest mean score of 3.76 for perceived goal setting and learning evaluation shows that pre-service teachers frequently and consistently reflect on the effectiveness of technologies used for English learning. This demonstrates a strong inclination toward metacognitive awareness, suggesting that PSTs are developing the ability to plan, monitor, and evaluate their learning effectively, which is an encouraging sign for their readiness to implement technology-supported strategies in real classroom contexts. This finding aligns with the evolving demands of 21st-century language education, where the focus has shifted from rote memorization and grammar-centered instruction to meaningful communication (Gallo & Raymundo, 2024), macro skills-based communicative tasks (Raymundo, 2023), and cultural engagement (Erdogan & Serefli, 2021). Through actively reflecting on their use of

technology, pre-service teachers are better positioned to facilitate learning experiences that emphasize authentic language use, global connectivity, and communicative competence, consistent with contemporary pedagogical expectations.

Furthermore, the GS dimension gained a weighted mean of 3.53 (usually used), implying that pre-service teachers often set goals and evaluate their progress in learning English. This is consistent with the role of English as the lingua franca in both business and academia, making goal-oriented learning essential for academic and professional development. As Ushioda (2013) emphasized, learning English requires clear objectives and continuous evaluation, while Fernandez et al. (2018) accentuated that such practices support effective language acquisition.

Social Strategies (SS)

Additionally, the social strategies domain revealed a generally positive perception of seeking advice on how to use technologies effectively for English language learning, with the highest mean of 3.86 (usually used). This result signifies that pre-service teachers often ask for guidance to effectively integrate technology into their learning. Hence, technology plays an essential role in teaching, not as a mere add-on, but as an embedded part of lesson planning, delivery, and learning experiences. Thus, the issue is not whether to use technology, but how to use it properly, which underscores the value of seeking advice from more knowledgeable individuals. Supporting this, An et al. (2021) and Panadero (2017) note that language teaching methods have been significantly reshaped by technology.

Moreover, this dimension calculated a weighted mean of 3.63 (usually used), implying that pre-service teachers usually utilize technology-based social strategies in learning the English language. This suggests that PSTs actively engage with peers and collaborative tools to enhance their language learning, reflecting not only familiarity with technology but also an emerging recognition of the value of social interaction in constructing knowledge. Such consistent use of social strategies highlights their readiness to foster collaborative and communicative learning environments, which are essential components of effective 21st-century language education. This reflects the current academic context, where blended and online modalities encourage greater reliance on virtual meetings and communication. As An et al. (2021) noted, technology enhances learners' social strategies by creating opportunities for cooperative learning in online environments.

Technology-Based English Song and Movie Learning (TE)

It also shows in the table the results for the technology-based English song and movie learning. The mean scores and their corresponding interpretations offer insights into the indicator of practicing new expressions in English movies or programs, which had the highest mean of 4.09, which means that it is usually used. This points out that pre-service teachers commonly reinforced their learning by uttering new words or expressions encountered in movies and programs.

In addition, the TE domain yielded a weighted mean of 4.00, positing that pre-service teachers frequently use technology, particularly film-related applications like Netflix, to support English learning. This denotes that PSTs are effectively leveraging authentic multimedia resources to enhance language comprehension, cultural awareness, and contextualized learning. Their consistent use of technology for exposure to real-world language exemplifies an emerging ability to integrate digital tools meaningfully into learning, moving beyond passive consumption toward purposeful,

pedagogically informed engagement. Thus, exposure to movies and media is effective for language acquisition, with subtitled films serving as valuable resources for building vocabulary and expressions. By regularly engaging with authentic multimedia content, PSTs are not only enhancing their language skills but also demonstrating an emerging capacity to integrate technology in pedagogically meaningful ways, supporting both comprehension and self-directed learning (Yüksel et al., 2018).

Technology-Based Vocabulary Learning (TV)

In the domain of technology-based vocabulary learning, the data uncovered a generally positive perception of using online dictionaries to check English words, which obtained the highest mean of 4.24, indicating that it is always or almost always used. It signifies that pre-service teachers frequently rely on online dictionaries to support their English language learning. Accordingly, there has been an increase in students' use of electronic dictionaries for both ESL and EFL purposes (Mercader & Duran-Bellonc, 2021). Electronic dictionaries (EDs) have advanced rapidly in the last three decades (Par, 2022).

Consequently, the TE dimension attained a weighted mean of 3.96, conveying that pre-service teachers frequently use lexical applications, online dictionaries, and vocabulary apps to support their language development. This reflects that PSTs are actively leveraging digital tools to expand their vocabulary and reinforce language learning, reflecting not only routine use but also an emerging capacity to integrate technology purposefully into their study practices. Such consistent engagement with vocabulary-focused tools demonstrates their readiness to employ technology in ways that enhance both comprehension and autonomous learning. This aligns with research highlighting the growing value of electronic dictionaries (EDs) due to their readability, accessibility, and efficiency compared to traditional paper dictionaries. With technological advances, interest has also expanded to online dictionaries and mobile platforms as convenient tools for second and foreign language learning (Par, 2022; Santos, 2021; Zhou & Xu, 2007).

Relationship Between the TPACK Level of the Pre-Service Teachers and Their Use of Technology-Based English Self-Regulated Learning Strategies

As indicated in Table 4, among the six domains from Technology Knowledge (TK) to Technological Pedagogical Knowledge (TPK), none showed a significant correlation with SRL strategies.

Table 4. Relationship Between the Respondents' TPACK Level and Use of Technology-Based English Self-Regulated Learning Strategies

Domains	r-value	p-value
Technology Knowledge (TK)	0.06	0.49^{ns}
Pedagogical Knowledge (PK)	0.04	0.62^{ns}
Content Knowledge (CK)	0.04	0.62^{ns}
Pedagogical Content Knowledge (PCK)	0.10	0.25^{ns}
Technological Content Knowledge (TCK)	0.08	0.37^{ns}
Technological Pedagogical Knowledge (TPK)	0.06	0.46^{ns}
Technological Pedagogical Content Knowledge (TPACK)	0.17	0.05*

*Note: ^{ns} denotes not significant; * denotes a significant result*

Only the integrated TPACK construct reached a p-value of 0.05 as compared with the accepted value of level of significance, which is 0.05, indicating that it is the combination of technological, pedagogical, and content knowledge, not the individual components alone, that supports effective use of technology-based self-regulated learning strategies. This implies that deep technological integration requires a holistic understanding of how tools align simultaneously with pedagogy and content, enabling PSTs to make metacognitively informed decisions, monitor learning, and apply strategies more effectively. These findings are consistent with Huang and Lajoie (2021), who linked higher TPACK to greater SRL strategy use, and with Aydogmus and Ibrahim (2022), who observed that strong self-regulation correlates with integrated technological knowledge. The result underscores the theoretical importance of considering TPACK as an interconnected framework rather than isolated domains.

Conclusion and Future Works

The study demonstrated that technology-based self-regulated learning (SRL) strategies, supported by strong Technological Pedagogical Content Knowledge (TPACK), are essential for preparing pre-service teachers (PSTs) to implement effective technology-integrated English instruction. Findings reveal that only the full TPACK construct, not individual knowledge domains, significantly correlates with SRL strategies, suggesting that effective technological integration requires a holistic understanding of how technology aligns simultaneously with pedagogy and content. This integrated perspective enables PSTs to make metacognitively informed decisions, monitor learning processes, and apply strategies that enhance both language acquisition and learner autonomy, positioning TPACK as a theoretical and practical scaffold for operationalizing self-regulation in technology-rich English classrooms. The study's unique contribution lies in explicitly linking TPACK with technology-based SRL in English language learning, a connection rarely examined in prior research, highlighting the need for teacher education programs to cultivate not only technological competence but also PSTs' metacognitive, self-regulatory, and decision-making skills to support effective, learner-centered technology use.

Teacher education programs may integrate workshops on selecting and evaluating digital tools, embed activities for goal setting, self-monitoring, and reflective evaluation, and design microteaching sessions where PSTs implement technology-supported English lessons with feedback on both content and SRL use. Future research may employ mixed-methods, experimental, and longitudinal designs to examine the impact of TPACK-SRL interventions and explore moderating factors such as digital literacy, teacher motivation, and specific language skills to better understand their interaction in diverse English learning contexts.

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Conflict of Interest

The authors declare that there are no conflicts of interest regarding the publication of this paper.

Artificial Intelligence (AI) Declaration Statement

The authors declare that artificial intelligence (AI) tools were used only for language refinement in this manuscript (Grammarly for grammar checking and Scispace Paraphraser for clarity). All outputs were reviewed, verified, and edited by the authors, who ensured that the study's conceptualization, analysis, interpretation, and conclusions remained entirely their own.