

Innovative approaches to professional development: Exploring the interplay between Technological Pedagogical Content Knowledge (TPACK), teachers' motivation, engagement, and teachers' professional development

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ABSTRACT: This study aimed to explore the relationship between teachers' Technological Pedagogical and Content Knowledge (TPACK), teaching English (TEE) motivation, TEE engagement strategies, and professional development. A total of 415 valid questionnaires were collected from teachers across China, with a majority from Shaanxi Province. The data was gathered through a survey conducted online over a two-week period, with the questionnaire being translated and back-translated to ensure linguistic accuracy. Statistical analyses were performed using SPSS (version 27) and AMOS (version 24), including descriptive statistics, correlation, regression, and structural equation modeling (SEM). The findings revealed that teachers with higher levels of TPACK were more likely to exhibit increased motivation for teaching English and adopt more effective engagement strategies, which contributed to their professional development. TPACK was also found to act as a mediator between TEE motivation and TEE engagement strategies, highlighting the role of TPACK in enhancing teachers' professional growth by improving their teaching practices. These results suggest that strengthening TPACK can positively influence both teacher motivation and engagement, leading to more effective teaching and professional advancement. The significance of this study lies in its demonstration of how enhancing teachers' TPACK can improve their motivation, engagement strategies, and professional development, offering valuable insights for targeted professional development programs in English language teaching. By highlighting the mediating role of TPACK, the study contributes to a deeper understanding of the factors that drive effective teaching practices and teacher growth.

Keywords: Professional development, Technological Pedagogical Content Knowledge (TPACK), Teachers' motivation, Teachers' engagement, Technology-enhanced learning

Enfoques innovadores para el desarrollo profesional: Explorando la interacción entre el Conocimiento Pedagógico, Tecnológico y de Contenido (TPACK), la motivación del profesorado, su compromiso y el desarrollo profesional de los docentes

RESUMEN: Este estudio tuvo como objetivo explorar la relación entre el Conocimiento Tecnológico, Pedagógico y de Contenido (TPACK, por sus siglas en inglés) de los profesores, la motivación para la enseñanza del inglés (TEE, por sus siglas en inglés), las estrategias de compromiso en la enseñanza del inglés y el desarrollo profesional. Se recopilaron un total de 415 cuestionarios válidos de profesores de toda China, con una mayoría proveniente de la provincia de Shaanxi. Los datos se obtuvieron mediante una encuesta realizada en línea durante un período de dos semanas, y el cuestionario fue traducido y retrotraducido para garantizar la precisión lingüística. Los análisis estadísticos se realizaron utilizando SPSS (versión 27) y AMOS (versión 24), incluyendo estadísticas descriptivas, correlación, regresión y modelos de ecuaciones estructurales (SEM, por sus siglas en inglés). Los hallazgos revelaron que los profesores con niveles más altos de TPACK tenían más probabilidades de mostrar una mayor motivación para la enseñanza del inglés y adoptar estrategias de compromiso más efectivas, lo que contribuyó a su desarrollo profesional. También se encontró que el TPACK actuó como mediador entre la motivación para la enseñanza del inglés y las estrategias de compromiso en la enseñanza del inglés, destacando el papel del TPACK en la mejora del crecimiento profesional de los profesores al optimizar sus prácticas docentes. Estos resultados sugieren que fortalecer el TPACK puede influir positivamente tanto en la motivación como en el compromiso de los profesores, lo que conduce a una enseñanza más efectiva y a un avance profesional. La importancia de este estudio radica en su demostración de cómo el fortalecimiento del TPACK de los profesores puede mejorar su motivación, estrategias de compromiso y desarrollo profesional, ofreciendo ideas valiosas para programas de desarrollo profesional específicos en la enseñanza del inglés. Al destacar el papel mediador del TPACK, el estudio contribuye a una comprensión más profunda de los factores que impulsan prácticas docentes efectivas y el crecimiento de los profesores.

Palabras clave: Desarrollo profesional, Conocimiento Pedagógico, Tecnológico y de Contenido (TPACK), Motivación del profesorado, Compromiso del profesorado, Aprendizaje potenciado por la tecnología.

1. INTRODUCTION

In today's educational landscape, the effective integration of technology into teaching practices has become paramount, particularly within the realm of language education (Derakhshan, 2025; Huang et al., 2024; Guo & Wang, 2024; Yim, 2024). As educators strive to prepare students for a technology-driven world, the need for innovative approaches to professional development has emerged as a critical focus (Dai & Wang, 2024; Wang & Xue, 2024). TPACK serves as a foundational framework that enables educators to blend their content knowledge, pedagogical methods, and technological skills, facilitating more dynamic and relevant instruction (Jin et al., 2024). However, the mere possession of TPACK is not sufficient; teachers' motivation to engage with technology and the strategies they employ to foster student engagement are equally vital. Understanding how these elements interact can provide insights into the conditions that promote effective teaching and positive student outcomes (Derakhshan & Fathi, 2024a; Su et al., 2023).

In the rapidly evolving landscape of education, the integration of technology in EFL instruction has become both a necessity and a challenge (Wang et al., 2023; Wu et al., 2024). As educators strive to enhance their teaching practices through technology, it is crucial to understand the interplay between various factors that contribute to effective teaching (Ma & Wang, 2024; Qu & Wang, 2024). TPACK encompasses the knowledge educators need to effectively integrate technology into their teaching, blending content knowledge, pedagogical

knowledge, and technological knowledge. Understanding how these components interact can provide insights into how EFL teachers can be better supported in their professional growth (Derakhshan & Fathi, 2024b; Tan et al., 2024). By examining whether TPACK serves as a vital link that influences how motivation and engagement strategies translate into professional growth, this study aims to uncover the complexities of technology integration in EFL instruction.

Engagement strategies refer to the methods, approaches, or techniques employed by educators to actively involve students in the learning process, fostering motivation, participation, and sustained attention. These strategies aim to create a dynamic and interactive classroom environment where students are not only receptive to the content being taught but are also encouraged to engage cognitively, emotionally, and behaviorally. In the context of education, engagement strategies can encompass a wide range of instructional practices, including both teacher-driven and student-centered activities, designed to enhance the overall learning experience (Li & Wang, 2024). Investigating these variables is essential in establishing a framework for enhancing EFL teachers' competencies in using technology effectively. The findings could inform professional development programs and help in designing interventions that foster a culture of continual improvement and innovation among EFL educators. Ultimately, this research aims to contribute to the broader field of educational technology by providing a nuanced understanding of the dynamics at play in EFL teaching contexts (Ateş & Koroğlu, 2024).

The integration of technology in EFL instruction presents both opportunities and challenges for educators (Derakhshan, Teo, & Khazaie, 2024; Xin & Derakhshan, 2025; Gao et al., 2025; Kholid et al., 2023). As the demands for effective technological integration in teaching increase, understanding the factors that contribute to EFL teachers' professional development becomes crucial. Despite the recognized importance of TPACK in enhancing the quality of education, the specific dynamics between TPACK, teachers' motivation toward technology-enhanced education (TEE), engagement strategies, and overall professional growth remain underexplored. Research indicates that teachers equipped with strong TPACK are better positioned to incorporate technology effectively within their instructional practices. However, there is limited empirical evidence clarifying how this knowledge directly relates to their motivation and engagement strategies and how these elements collectively impact professional development. Addressing this gap is essential for designing effective professional development programs that foster technology integration (Leibovitch et al., 2025).

Moreover, the potential mediating role of TPACK in the relationship between TEE motivation, engagement strategies, and professional development has not been adequately examined. It is imperative to explore whether TPACK serves as a critical link that transforms teachers' motivation and engagement into meaningful professional growth. Without this understanding, professional development initiatives may lack the targeted support necessary to enhance teachers' skills and practices effectively. Thus, this study seeks to address these gaps by investigating the relationships outlined in the research questions. By doing so, it aims to provide insights into how EFL teachers can be better supported in navigating the complexities of technology adoption in their teaching, ultimately leading to improved educational outcomes for their students (Derakhshan, Teo, Saedy Robot, et al., 2024; Gao et al., 2024; Mohammadi, 2024).

This study emphasizes the importance of innovative professional development programs that not only enhance teachers' technical skills but also inspire motivation and engagement. By analyzing how TPACK influences teachers' pedagogical choices and, consequently, student learning, this research seeks to identify best practices that facilitate meaningful technology integration in the classroom. Ultimately, this exploration aims to contribute to the broader discourse on educational reform, advocating for a holistic approach to teacher development that recognizes the interconnectedness of knowledge, motivation, and engagement. Through this lens, the findings of this research have the potential to inform policies and practices, equipping educators with the tools they need to foster effective learning experiences in a rapidly changing educational environment.

This study offers an innovative perspective by exploring the dynamic interplay between TPACK, teachers' motivation, engagement, and professional development. Unlike traditional professional development models that often treat these elements in isolation, this research investigates how they interact to shape teachers' growth and effectiveness in the classroom. By focusing on TPACK, this study uniquely integrates technology, pedagogy, and content knowledge into the context of teachers' ongoing professional development, an area that remains underexplored. Additionally, the study's emphasis on teacher motivation and engagement strategies within this framework provides new insights into how these factors can enhance or hinder professional growth. This research contributes to both theory and practice by offering evidence-based recommendations for designing more holistic and effective professional development programs that consider the interrelatedness of these critical components.

2. LITERATURE REVIEW

As the educational landscape continues to evolve, particularly in the context of EFL instruction, understanding the interplay between technology and pedagogy has become increasingly vital (Leibovitch et al., 2025). Research indicates that TPACK is fundamental for educators to integrate technology effectively into their teaching methodologies (Jin et al., 2024). It encompasses a comprehensive understanding of how technology can enhance content delivery and pedagogical approaches, thereby fostering enriched learning experiences for students. However, the extent to which this knowledge correlates with teachers' motivation to utilize technology and their engagement strategies is still a matter of ongoing inquiry. Addressing this relationship is essential for informing professional development initiatives aimed at helping EFL teachers navigate the complexities of technology integration. Furthermore, the mediating role of TPACK in the relationship between TEE motivation, engagement strategies, and professional development has yet to be thoroughly investigated. Understanding whether and how TPACK influences this dynamic can provide critical insights into the mechanisms that drive effective technology use in the classroom (Derakhshan & Zhang, 2024; Yim, 2024).

The integration of technology into EFL instruction is grounded in several interrelated theoretical frameworks that collectively illuminate the complexities surrounding teachers' professional development, motivation, and engagement. In the context of EFL education, TPACK emphasizes the necessity for teachers to not only understand the language content they are teaching but also to know how to teach that content effectively using technology. This

framework suggests that successful technology integration requires a holistic understanding of how these three kinds of knowledge domain intersect. By enhancing their TPACK, teachers can deliver more engaging and effective lessons, ultimately influencing their professional development (Ateş & Koroğlu, 2024). Motivation plays a critical role in teachers' willingness to adopt and integrate technology into their teaching practices. Self-Determination Theory (SDT) posits that intrinsic motivation—driven by personal interest and value in the task—leads to deeper engagement and greater persistence in professional development activities. In the context of this study, understanding EFL teachers' motivation for technology-enhanced education (TEE) can illuminate how personal and contextual factors influence their professional growth and implementation of technology in the classroom (Tan et al., 2024). Engagement strategies refer to the methods teachers use to actively involve students in the learning process, particularly through the use of technology. Kholid et al. (2023) categorizes student engagement into three dimensions: behavioral, emotional, and cognitive. Behavioral engagement pertains to participation in academic tasks; emotional engagement involves students' affective reactions; and cognitive engagement refers to the investment in learning processes. In this study, examining how EFL teachers employ engagement strategies relates closely to their motivation and TPACK, thereby affecting the overall learning environment and student outcomes (Jin et al., 2024; Qi & Derakhshan, 2025).

Professional development in education is essential for facilitating teachers' growth and adaptation to new teaching paradigms (Qi & Derakhshan, 2023). The Learning Forward Standards for Professional Learning highlight the importance of ongoing professional learning that is job-embedded, collaborative, and focused on student outcomes. This perspective aligns with the need for EFL educators to engage in meaningful professional development that fosters their TPACK and motivates them to implement effective engagement strategies (Su et al., 2023). Gao et al. (2022) explored how EFL teachers' TPACK influences their engagement with technology in instructional practices. Building on this, Lan (2024) discussed the relationship between TPACK, teacher motivation, and professional development in the context of integrating 21st-century skills into EFL education. Similarly, Leibovitch et al. (2025) examined the connections between TPACK and teachers' professional growth, emphasizing motivation and engagement strategies. Extending this discussion, Su et al. (2023) investigated the direct and indirect effects of TPACK on teachers' motivation and engagement strategies in EFL settings. In contrast, Yildiz and Arpacı (2024) highlighted how TPACK mediates the relationship between motivation and engagement strategies among EFL teachers. Finally, Li and Wang (2024) assessed the significance of EFL teachers' TPACK in enhancing their motivation and engagement with technology. These studies provide a broad spectrum of insights into how TPACK, motivation, and engagement strategies intersect in the context of EFL teaching, contributing to the understanding of professional development in technology-rich educational environments.

Determining causation between TPACK, motivation, engagement strategies, and professional development is often challenging. Some studies may suggest strong correlations without adequately addressing potential confounding variables, raising questions about the validity of their conclusions (Su et al., 2023). There are concerns that an overemphasis on technology integration in professional development could detract from essential pedagogical skills. Critics argue that focusing too heavily on TPACK might lead to a neglect of funda-

mental teaching methodologies and strategies that are equally important for effective EFL instruction. While many studies address motivation, the distinction between intrinsic and extrinsic motivation can be contentious. Researchers may disagree on the importance of these types of motivation for professional development, confusing the interpretation of data related to teachers' engagement with technology. The emphasis on TPACK and technology use may inadvertently undermine teachers' autonomy in their classroom practices. Some argue that professional development focused predominantly on technology might conflict with teachers' established pedagogical identities and beliefs (Tan et al., 2024). These controversial issues highlight the complexity of researching effective technology integration in EFL education and underscore the necessity for further nuanced investigations that consider both the context and the multifaceted nature of teaching and learning with technology.

2.1. Research Questions

- RQ1. Is there any significant relationship between EFL teachers' technological pedagogical content knowledge, TEE motivation, TEE engagement strategies, and their professional development?
- RQ2. Does EFL teachers' technological pedagogical content knowledge mediate the relationship between TEE motivation, TEE engagement strategies, and their professional development?

3. METHOD

3.1. Participants

A total of 415 valid questionnaires were collected over a two-week period from December 5th to December 18th. The participants were teachers from across the country, with the majority from Shaanxi Province. The recruitment criteria for participants included: (1) being actively employed as a teacher in any language-related field, (2) teaching in primary, secondary, or higher education institutions, and (3) voluntarily agreeing to participate in the study. The age distribution was as follows: 29 teachers (6.99%) were aged 22–29, 146 teachers (35.18%) were aged 30–37, 177 teachers (42.65%) were aged 38–45, 54 teachers (13.01%) were aged 46–53, and 9 teachers (2.16%) were over 53 years old. Regarding gender, 131 participants (31.57%) were male, and 284 (68.43%) were female. In terms of teaching experience, 74 teachers (17.83%) had less than 5 years of experience, 184 teachers (44.34%) had 6–10 years of experience, and 157 teachers (37.83%) had more than 10 years of experience. Concerning education levels, 6 participants (1.45%) held a B.A., 304 (73.25%) held an M.A., and 105 (25.3%) had a Ph.D. As for the subjects taught, 252 teachers (60.72%) taught English, 22 (5.3%) taught French, 21 (5.06%) taught Japanese, 21 (5.06%) taught Korean, 21 (5.06%) taught Russian, 16 (3.86%) taught German, and 62 selected “other.”

3.2. Instruments

3.2.1. *Teachers' technological pedagogical content knowledge*

The Teachers' Technological Pedagogical Content Knowledge (TPACK) Questionnaire is a standardized instrument designed to assess educators' self-reported knowledge and integration of technology into their pedagogical and content expertise (Liang et al., 2013). The questionnaire typically consists of 20 Likert-scale items. Confirmatory factor analysis (CFA) is commonly performed to verify that the items align with the intended TPACK framework subdomains. The items are developed and validated by domain experts to ensure that they comprehensively represent the theoretical constructs of the TPACK framework. The questionnaire is often correlated with external measures of teaching performance or technological integration in teaching practices. A Cronbach's alpha value above 0.70 is considered acceptable for reliability. Studies frequently report subdomain reliability coefficients ranging from 0.72 to 0.90, indicating high internal consistency.

3.2.2. *Technology-enhanced environments motivation*

The Technology-Enhanced Environments (TEE) Motivation Questionnaire is a psychometric instrument designed to measure educators' and learners' motivation to engage in technology-integrated teaching and learning environments (Sui et al., 2024). This questionnaire typically consists of 20 items distributed across various motivational dimensions. Similar to previous questionnaire, the validity processes demonstrated its validity. Reported Cronbach's Alpha values typically range from 0.75 to 0.90, indicating high reliability.

3.2.3. *Technology-enhanced environments engagement strategies*

The Technology-Enhanced Environments Engagement Strategies Questionnaire is a psychometric tool designed to assess the strategies educators or learners employ to stay actively engaged in technology-integrated educational settings (Johnson-Smith, 2014). The questionnaire comprises 10 items, which capture various aspects of behavioral, cognitive, and emotional engagement. Construct, Content, Criterion-Related, Convergent, and Discriminant Validities are used to confirm the factor structure of the questionnaire. Cronbach's Alpha values for the overall scale and subscales are typically above 0.75, indicating good internal reliability. For individual subscales, Cronbach's Alpha values often range from 0.78 to 0.88.

3.2.4. *Teachers' professional development*

The Teachers' Professional Development (TPD) Questionnaire with 15 Likert-scale items is a standardized instrument designed to measure teachers' perceptions, attitudes, and experiences regarding their professional growth and development in educational settings (Bullard et al., 2017). It focuses on aspects such as skill enhancement, pedagogical improvement, collaboration, and reflective practices. The questionnaire has demonstrated good validity, and its high internal consistency is evidenced by a Cronbach's Alpha typically exceeding 0.80 for the overall scale.

3.3. Procedure

The study involved the collection of data through a survey administered to teachers across the country, with a majority of participants from Shaanxi Province. The process was conducted over a two-week period, from December 5th to December 18th. A total of 415 valid questionnaires were collected. Teachers from various provinces, including Shaanxi, were invited to participate in the study. Participation was voluntary, and all respondents provided written informed consent before completing the questionnaire, ensuring ethical compliance. The questionnaire was designed to measure key variables related to the study's objectives. To ensure accurate comprehension of the items, the back-translation method was employed. The original questionnaire was translated into the participants' native language and then re-translated into the source language by independent translators. Any discrepancies were resolved to maintain linguistic and conceptual equivalence. The survey was administered over two weeks, in online format. Participants were given clear instructions on how to complete the questionnaire to minimize errors or misunderstandings. After collecting, the questionnaires were reviewed to ensure completeness and validity. Only fully completed questionnaires were included in the analysis, resulting in a total of 415 valid responses. This systematic procedure ensured ethical adherence, linguistic clarity, and data accuracy, providing a reliable foundation for the subsequent analysis. In the analysis phase, two primary software tools were utilized: SPSS (version 27) and AMOS (version 24). SPSS was mainly used for conducting various statistical analyses, including descriptive statistics, correlation, and regression, to evaluate relationships and trends in the data. AMOS was employed for structural equation modeling (SEM) to investigate and illustrate complex interactions among variables. Furthermore, advanced techniques, such as factor analysis, were applied to streamline the data and uncover key underlying constructs. The findings from these analyses were carefully reviewed to identify patterns, correlations, and significant relationships between variables, offering valuable insights into the research hypotheses.

4. RESULTS

The researcher performed Confirmatory Factor Analysis (CFA) to assess the reliability of the surveys and explore the relationships between the variables. The results confirmed that the observed variables were consistent with theoretical constructs, highlighting both the distinctiveness and interconnections of the constructs. Convergent validity was established through significant factor loadings, while discriminant validity was demonstrated by comparing the Average Variance Extracted (AVE) values to the squared correlations between constructs. Constructs were considered distinct when the AVE values were higher than the squared correlations. The CFA offered a thorough evaluation of the relationships among the variables, with comprehensive findings presented in tables and figures, further validating the constructs' reliability and validity.

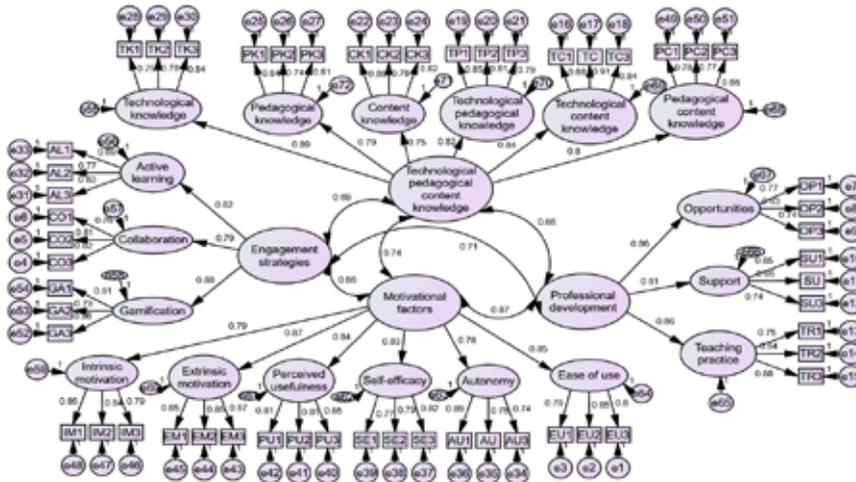


Figure 1. The final adjusted CFA model with standardized estimates

The analysis highlights the central role of TPACK in influencing teachers’ motivation, engagement strategies, and professional development. The strongest pathway is observed from Motivational Factors to Professional Development (.88), suggesting that enhancing teachers’ intrinsic and extrinsic motivation, as well as their perceived ease of use and autonomy in using technology, directly impacts their growth. Additionally, Engagement Strategies serve as a bridge between motivational factors and professional development, emphasizing the importance of active learning, collaboration, and gamification in improving teaching practices. This integrated model underscores the interconnectedness of technological, pedagogical, and motivational constructs in fostering professional development among teachers, with TPACK serving as the foundational knowledge framework.

Table 1. The Goodness of fit estimation

| CRITERIA | | THRESHOLD | | | EVALUATION |
|----------|----------|-----------|------------|-----------|------------|
| | | TERRIBLE | ACCEPTABLE | EXCELLENT | |
| CMIN | 7352.631 | | | | |
| DF | 2561 | | | | |
| CMIN/DF | 2.871 | > 5 | > 3 | > 1 | Acceptable |
| RMSEA | .072 | | < .08 | < .06 | Acceptable |
| GFI | .953 | > .8 | > .9 | > .95 | Acceptable |
| CFI | .952 | > .8 | > .9 | > .95 | Acceptable |
| PNFI | .652 | | > .5 | | Acceptable |
| TLI | .951 | > .8 | > .9 | > .95 | Acceptable |

Note: CMIN: Chi-Square Minimum Discrepancy; DF: Degrees of Freedom; CMIN/DF: Chi-Square Minimum Discrepancy divided by Degrees of Freedom; RMSEA: Root Mean Square Error of Approximation; GFI: Goodness of Fit Index; CFI: Comparative Fit Index; PNFI: Parsimony-Adjusted Normed Fit Index; TLI: Tucker-Lewis Index

Table 1 presents the evaluation criteria used to assess the goodness of fit for a model in structural equation modeling (SEM). Based on the provided fit indices and their corresponding thresholds, the overall goodness of fit for the model can be considered acceptable. Several indices, such as CMIN/DF, RMSEA, GFI, CFI, PNFI, and TLI, all fall within the acceptable range, indicating that the model fits the data reasonably well. However, none of the indices exceed the thresholds for an excellent fit, meaning there is still room for improvement. Specifically, the GFI and CFI values are close to the excellent range but do not meet the threshold of 0.95 for an optimal fit.

Table 2. Reliability and validity of the variables

| | CR | AVE | MSV | MaxR(H) | TPACK | TEE Motivation | TEE Engagement Strategies | TPD |
|---------------------------|------|------|-------|---------|--------------|-------------------|---------------------------------|--------------|
| TPACK | 0.91 | 0.91 | 0.877 | 0.878 | 0.954 | | | |
| TEE Motivation | 0.89 | 0.88 | 0.742 | 0.852 | 0.589*** | 0.941 | | |
| TEE Engagement Strategies | 0.88 | 0.87 | 0.63 | 0.851 | 0.623*** | 0.721*** | 0.933 | |
| TPD | 0.90 | 0.86 | 0.798 | 0.785 | 0.711*** | 0.628*** | 0.681*** | 0.928 |

Note: CR: Composite Reliability; AVE: Average Variance Extracted; MSV: Maximum Shared Variance; MaxR(H): Maximum Reliability (H); TPACK: Teachers’ Technological Pedagogical Content Knowledge; TEE: Technology-Enhanced Environmental; TPD: Teachers’ Professional Development
 *** It is significant at .000 level

Table 2 presents the reliability and validity statistics for several variables in the context of a study. The reliability and validity of the variables in this study are overall strong. The Composite Reliability (CR) values for all variables are above 0.8, which is an indication of good internal consistency. The Average Variance Extracted (AVE) values for each variable are also high (above 0.8 for most), indicating strong convergent validity. The Maximum Shared Variance (MSV) values are generally lower than the AVE, suggesting that the constructs are distinct from each other. The Maximum Reliability (MaxR(H)) values for all variables are also good, further confirming the reliability of the measurements. The significant correlations ($p < .000$) between the variables suggest strong relationships between TPACK, TEE Motivation, TEE Engagement Strategies, and TPD, highlighting the interdependencies between these aspects of teachers’ professional development and technology-enhanced education.

Table 3. Standardized regression weights of the variables

| | | STANDARDIZED REGRESSION WEIGHTS | S.E. | C.R. | P |
|---------------------------|-----------------------------|------------------------------------|------|------|------|
| TPACK | ↔ TEE Motivation | .742 | .341 | .543 | .002 |
| TEE Motivation | ↔ TEE Engagement Strategies | .861 | .164 | .351 | .001 |
| TEE Engagement Strategies | ↔ TPD | .715 | .141 | .376 | .001 |
| TPD | ↔ TPACK | .884 | .261 | .484 | .002 |
| TPACK | ↔ TEE Engagement Strategies | .693 | .268 | .461 | .001 |
| TEE Motivation | ↔ TPD | .874 | .278 | .429 | .001 |

Note: S.E.: Standard Error; C.R.: Critical Ratio; P: Probability Value

Table 3 reveals significant and strong relationships among the variables, with all p-values indicating statistical significance. The strongest connection is observed between TPACK and TPD (standardized regression weight = 0.884), underscoring the vital role of technological-pedagogical knowledge in enhancing professional development. Similarly, teacher motivation demonstrates a profound influence on both engagement strategies (0.861) and professional development (0.874), indicating its centrality in educational practices. The findings emphasize the interdependence of motivation, engagement, and technological-pedagogical knowledge in shaping teacher professional growth.

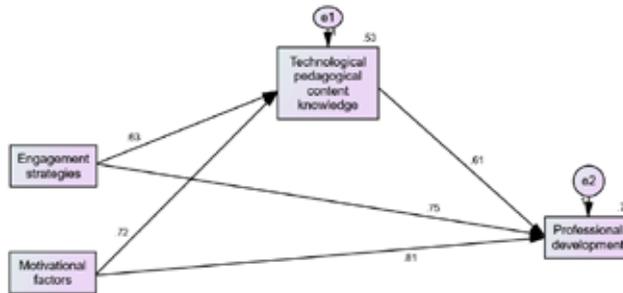


Figure 2. The Final Measurement Model

The analysis in Figure 2 demonstrates the significant pathways through which Motivational Factors and Engagement Strategies influence teachers’ Professional Development, both directly and indirectly via TPACK. The strongest direct effect is from Engagement Strategies to Professional Development (.81), emphasizing the importance of collaborative and active learning strategies in enhancing teaching outcomes. Additionally, TPACK mediates these relationships, with direct effects from Motivational Factors (.72) and Engagement Strategies (.63) suggesting that fostering technological and pedagogical integration is pivotal for professional growth. The findings underscore the interconnectedness of motivation, engagement, and technological-pedagogical knowledge in shaping professional development outcomes.

Table 4. Structural model assessment: Indirect effects

| PARAMETER | ESTIMATE | LOWER | UPPER | P |
|-----------|----------|-------|-------|------|
| Ind1 | .541 | .096 | .013 | .002 |
| Ind2 | .493 | .017 | .049 | .001 |

Ind1 = Engagement to TPACK to TPD
 Ind2 = Motivation to TPACK to TPD

Table 4 demonstrates that TPACK significantly mediates the relationships between engagement strategies and professional development (Ind1 = 0.541, $p = 0.002$) and between motivation and professional development (Ind2 = 0.493, $p = 0.001$). The confidence intervals for both paths confirm the robustness of the indirect effects. These findings underscore the importance of TPACK in leveraging teacher engagement strategies and motivation to enhance their professional development. The results highlight TPACK’s pivotal role in fostering effective teaching practices and professional growth.

Table 5. *Structural model assessment: Direct effects*

| PARAMETER | ESTIMATE | LOWER | UPPER | P |
|-----------|----------|-------|-------|------|
| TPD | .763 | .361 | .589 | .002 |

The structural model assessment reveals a significant direct effect (Estimate = 0.763, $p = 0.002$) on professional development. The positive estimate and the entirely positive confidence interval (Lower = 0.361, Upper = 0.589) indicate a robust and strong direct relationship. These findings highlight the significant contribution of the independent variable to professional development, suggesting its importance in fostering effective teaching practices and ongoing professional growth. In other words, about 76% of changes in teachers' professional development can be predicted by the combined impact of engagement strategies and their motivation.

4.1. Discussion

The studies indicate that teachers with a higher level of TPACK are more likely to demonstrate increased motivation toward teaching English and employ effective engagement strategies (Azhar & Hashim, 2022; Joldanova et al., 2022; AYDIN YILDIZ, 2024; Zeng et al., 2022). This relationship can be attributed to the confidence and competence that proficient TPACK instills in educators. Teachers who effectively know how to integrate technology into their teaching methods are more confident in their abilities, which naturally boosts their motivation to enhance their instructional practices. The findings suggest that TPACK not only enhances teaching strategies but also opens up more opportunities for professional development. In environments that prioritize digital literacy, teachers with strong TPACK become key players in adopting innovative teaching methods, making them attractive candidates for professional growth opportunities. Such contexts foster both intrinsic motivation (where teachers find value and satisfaction in their work) and increased engagement in teaching practices, leading to a feedback loop where professional development initiatives are more readily embraced. Thus, these findings affirm that there is indeed a significant relationship between EFL teachers' TPACK, their TEE motivation, the engagement strategies they implement, and their professional development. This aligns with the premise that effective integration of technology facilitates a more engaging instructional environment, thereby supporting ongoing professional learning.

The findings present a strong argument for the mediating role of TPACK in the dynamics between TEE motivation, engagement strategies, and professional development. When teachers are motivated to leverage technology in their teaching, those with substantial TPACK are more adept at translating this motivation into effective engagement strategies. This adaptability enhances their professional growth. Research supports the notion that motivated teachers who have high TPACK are more likely to engage in innovative teaching approaches that incorporate technology. As they develop and implement these strategies, they experience professional development that is both meaningful and aligned with contemporary educational demands. This suggests that TPACK not only facilitates the application of technology but also enables teachers to create more dynamic classroom environments that can significantly enhance student learning outcomes. In essence, TPACK acts as a crucial link

between motivation and engagement strategies. Motivated teachers equipped with TPACK are not just passive users of technology; they actively integrate it into their pedagogical practices, fostering higher levels of student engagement. This process, in turn, elevates their professional development, as they gain new insights and skills from their experiences in implementing technology-enhanced strategies.

Earlier studies have consistently shown that a robust understanding of TPACK is essential for effective technology integration in education. For example, Ateş and Koroğlu (2024) emphasized that TPACK empowers teachers to blend knowledge of content, pedagogy, and technology, fostering greater instructional effectiveness. The current findings align with this, reinforcing that teachers with higher TPACK are more confident and motivated to integrate technology into their teaching. Research has long suggested a link between teacher motivation and professional development. The study by Su et al. (2023) highlights how intrinsic motivation fosters engagement in professional learning. This mirrors the current findings indicating that EFL teachers with higher TPACK not only demonstrate increased intrinsic motivation but also actively seek professional development opportunities. Previous studies have noted that effective engagement strategies are crucial for successful technology implementation. Tan et al. (2024) outlined the three dimensions of student engagement—behavioral, emotional, and cognitive—which correlate with the effective use of technology in the classroom. The current findings support this by showing that teachers with strong TPACK employ more effective engagement strategies, leading to better student outcomes.

While prior studies have examined the relationship between TPACK and various teacher outcomes (Azhar & Hashim, 2022; Joldanova et al., 2022; AYDIN YILDIZ, 2024; Zeng et al., 2022), fewer have explicitly focused on TPACK as a mediator between TEE motivation and engagement strategies. Current findings contribute a nuanced understanding by illustrating how TPACK serves as a critical link, enhancing the relationship between teachers' motivation to use technology and their ability to engage students effectively. This mediating role adds depth to the existing literature and suggests future research avenues. Many earlier studies on TPACK and technology integration were conducted in Western educational contexts. The current findings indicate that the relationship between high TPACK, motivation, engagement, and professional development is applicable in diverse educational environments, particularly where digital literacy is prioritized. This broadens the relevance of TPACK and encourages further investigation in varied cultural contexts. The distinction between intrinsic and extrinsic motivations, while discussed in previous literature (Lan, 2024; Leibovitch et al., 2025; Li & Wang, 2024), has not always been directly linked to TPACK development in EFL contexts. This study emphasizes how strong TPACK fosters intrinsic motivation, suggesting that professional development should not only focus on skills acquisition but also on cultivating a deeper, intrinsic interest in technology integration among teachers.

5. CONCLUSION

This study has explored the intricate relationships between TPACK, technology-enhanced education (TEE) motivation, engagement strategies, and professional development among EFL teachers. The findings indicate that teachers who possess a higher level of TPACK not only demonstrate increased motivation towards integrating technology into their teaching but

also employ more effective engagement strategies. This, in turn, contributes to their ongoing professional development. The research highlights TPACK as a critical factor that mediates the relationship between TEE motivation and engagement strategies. Teachers motivated to enhance their instructional practices through technology are more likely to develop innovative engagement strategies when equipped with strong TPACK. This mediating role underscores the necessity of comprehensive professional development programs that not only enhance teachers' technological competencies but also nurture their intrinsic motivation to engage with technology meaningfully.

Moreover, the study emphasizes the importance of context, suggesting that environments that prioritize digital literacy create fertile ground for the effective application of TPACK. As such, fostering these competencies among EFL teachers is essential not only for their professional growth but also for improving student outcomes in increasingly technology-driven classrooms. Ultimately, the insights from this study provide valuable implications for policymakers, educational leaders, and professional development facilitators. By recognizing the interplay between TPACK, motivation, engagement strategies, and professional development, stakeholders can design targeted interventions and training programs that support EFL teachers in navigating the challenges of technology integration. This study contributes to a deeper understanding of how effective technology use can enhance not only teaching practices but also the overall educational experience for both teachers and students in diverse learning environments.

These findings contribute to the growing body of research that explores the importance of TPACK in shaping teachers' professional development. The study suggests that TPACK is not only a factor in the adoption of technology but also enhances motivation and engagement strategies. This further supports and extends the TPACK framework, proposing that TPACK could serve as a driving force behind teachers' intrinsic motivation and their ability to implement effective teaching strategies, making it central to the development of more engaged and effective educators. The study provides empirical support for the idea that TPACK may mediate the relationship between motivation and engagement strategies, offering a deeper understanding of how teacher competencies with technology influence not just their use of tools, but also their pedagogical approach and willingness to engage with new teaching methods. The findings contribute to theories on TPD by suggesting that professional growth is increasingly linked to digital literacy and the integration of technology in teaching. The role of TPACK in professional development expands my understanding of how professional development programs can better support teachers by focusing not only on technical skills but also on fostering motivation and developing engagement strategies. This emphasizes the need for a holistic approach to professional development that combines content knowledge, pedagogical strategies, and technological skills.

Professional development programs should be designed to focus on building TPACK rather than merely on technical skills. This involves integrating content knowledge with pedagogy and technology to help teachers not only use technology but also understand how it can be effectively incorporated into their teaching strategies. Professional development programs should focus on both motivation and engagement strategies, helping teachers see the relevance of technology in their teaching practice. For example, workshops could offer teachers opportunities to reflect on their motivation and explore strategies for incorporating

technology that matches their teaching philosophy, leading to both increased motivation and professional growth. Schools and educational authorities should create environments that enhance teachers' intrinsic motivation to adopt technology in their teaching. This can include providing autonomy, recognition, and relevant resources to teachers who seek to integrate technology into their practice. The motivation to adopt new technologies can be further strengthened by fostering a culture of support and mentorship. Offering incentives or rewards for teachers who engage with innovative pedagogical practices can also promote ongoing professional growth. By linking motivation with practical tools, schools can encourage teachers to stay engaged with their professional development.

As teachers with high TPACK are more likely to develop innovative strategies, pre-service teacher education programs should prioritize systematic integration of TPACK into curricula, which will in return enhance teachers' motivation and engagement. In addition, creating opportunities for peer collaboration should be emphasized. Schools can set up peer mentoring programs where teachers with strong technological skills mentor others, thus promoting knowledge sharing and fostering a culture of continuous professional development. Establishing communities of practice within schools or online can help teachers collaborate on how to effectively implement technology in the classroom. This enables teachers to learn from each other's experiences, thus enhancing both their motivation and professional development. For teachers to effectively integrate technology, schools must invest in appropriate digital tools and infrastructure. Educational policymakers should ensure that teachers have access to user-friendly, relevant technology and ongoing technical support. Additionally, having robust systems for feedback and evaluation will help track the impact of technological integration on professional growth. Last but not the least, TPACK-oriented trainings should be designed to foster sustained motivation, engagement and professional development.

The study may have utilized a cross-sectional design, which limits the ability to infer causal relationships between TPACK, motivation, engagement strategies, and professional development. While correlations can be identified, causality cannot be definitively established from a single snapshot in time. Future research could adopt a longitudinal design to track changes in TPACK, motivation, engagement strategies, and professional development over time. This would allow researchers to observe how these variables influence each other over an extended period and determine causal relationships more clearly. The sample size may have been limited or not sufficiently diverse, which could affect the generalizability of the findings to the broader population of EFL teachers. The study might have focused on teachers from a specific region, institution, or education level, limiting the applicability of the results. Future research should include larger, more diverse samples from different geographical regions, educational contexts (e.g., primary, secondary, and higher education), and cultural backgrounds. This would increase the external validity and generalizability of the findings. The study might not have considered important contextual factors (e.g., institutional support, socio-political climate, technological infrastructure) that could impact the relationship between TPACK, motivation, engagement, and professional development. These external variables may significantly influence the outcomes but were not accounted for in the analysis. Future research should explore how contextual factors (such as institutional resources, leadership, and cultural attitudes towards technology) interact with TPACK to influence professional development. Including these factors in the research design could provide a more nuanced

understanding of the relationships between the variables. There may be significant variability in the level of TPACK and motivation among teachers due to factors such as experience, age, and personal attitudes toward technology. These variables might not have been fully controlled or accounted for, leading to heterogeneity in the sample. Future studies could explore individual differences by examining how factors like teaching experience, age, or personal beliefs about technology influence the relationship between TPACK, motivation, and professional development. A more detailed analysis of teacher variability could reveal important moderators of relationships.

Future research could investigate potential moderating and mediating variables that might influence the relationship between TPACK, motivation, and professional development. For instance, institutional support, teacher autonomy, or collaboration opportunities could be explored as potential moderators that strengthen or weaken the relationships. More research is needed to focus on the specific types of technology that EFL teachers use, examining how different tools contribute to the development of TPACK and their impact on professional development. This could include analyzing the use of digital storytelling, virtual reality (VR), augmented reality (AR), or gamification in language teaching. By addressing these limitations and incorporating these suggestions, future studies can provide a more comprehensive understanding of the relationships between TPACK, teacher motivation, engagement strategies, and professional development, ultimately leading to more effective strategies for teacher growth and improved educational practices.

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