Psycho-emotional dimensions of language learning: Investigating the interplay between learner digital tool efficacy, anxiety, motivation, and their engagement in technology-enhanced environments

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ABSTRACT: The present study explores the psycho-emotional dimensions of language learning, focusing on the interplay between learner digital tool efficacy, anxiety, motivation, and engagement in technology-enhanced environments. Using a random sampling approach, data were collected from 409 EFL students in Chengdu, Urumqi, Beijing, and Chongqing. Statistical analyses, conducted via SPSS (version 27) and AMOS (version 24), included descriptive statistics, correlation analyses, regression, and structural equation modeling (SEM) to uncover relationships and visualize complex interactions among the variables. The findings revealed significant relationships between digital tool efficacy, anxiety, motivation, and engagement. Higher digital tool efficacy was positively correlated with motivation and engagement, while negatively correlated with anxiety. Motivation emerged as a critical mediator between digital tool efficacy and engagement, emphasizing its role in transforming digital confidence into active participation. Additionally, digital tool efficacy was identified as a strong predictor of reduced anxiety, increased motivation, and enhanced engagement. These findings highlight the importance of fostering digital tool efficacy to alleviate anxiety, enhance motivation, and boost engagement among EFL learners in technology-enhanced educational contexts.
Keywords: digital tool efficacy, anxiety, motivation, engagement, technology-enhanced environments

Dimensiones psicoemocionales del aprendizaje de idiomas: Investigación de la interacción entre la eficacia del aprendizaje en herramientas digitales, la ansiedad, la motivación y su compromiso en entornos mejorados por la tecnología

RESUMEN: El presente estudio explora las dimensiones psicoemocionales del aprendizaje de idiomas, centrándose en la interacción entre la eficacia de los alumnos en herramientas digitales, la ansiedad, la motivación y su compromiso en entornos mejorados por la tecnología. Mediante un método de muestreo aleatorio, se recogieron datos de 409 estudiantes de inglés como lengua extranjera (EFL) en Chengdu, Urumqi, Beijing y Chongqing. Los análisis estadísticos, llevados a cabo mediante SPSS (versión 27) y AMOS (versión 24), incluyeron estadísticas descriptivas, análisis de correlación, regresión y modelado de ecuaciones estructurales (SEM) para descubrir relaciones y visualizar las complejas interacciones

entre las variables. Los hallazgos revelaron relaciones significativas entre la eficacia de las herramientas digitales, la ansiedad, la motivación y el compromiso. Una mayor eficacia en herramientas digitales se correlacionó positivamente con la motivación y el compromiso, mientras que se correlacionó negativamente con la ansiedad. La motivación surgió como un mediador crítico entre la eficacia de las herramientas digitales y el compromiso, enfatizando su papel en transformar la confianza digital en participación activa. Adicionalmente, la eficacia de las herramientas digitales se identificó como un fuerte predictor de una reducción de la ansiedad, un aumento de la motivación y un mayor compromiso. Estos hallazgos destacan la importancia de fomentar la eficacia de las herramientas digitales para aliviar la ansiedad, potenciar la motivación y aumentar el compromiso entre los estudiantes de EFL en contextos educativos mejorados por la tecnología.
Palabras clave: eficacia en herramientas digitales, ansiedad, motivación, compromiso, entornos mejorados por la tecnología

1. Introduction

In the modern educational landscape, the integration of technology in language learning has reshaped traditional pedagogical approaches, introducing innovative tools that enhance teaching and learning experiences (Derakhshan & Ghiasvand, 2024; Goagoses et al., 2024; Liu & Wang, 2024; Zhi & Wang, 2024). As educators and researchers explore the potential benefits of digital tools, it becomes increasingly important to understand the psycho-emotional dimensions that significantly impact language acquisition (Wang et al., 2023; Zhi et al., 2023). This study seeks to investigate the interplay between learner anxiety, motivation, and the use of technology-enhanced environments, thereby shedding light on the intricate processes that shape language learning in the digital age. Anxiety, as a prevalent emotional response in educational contexts, can profoundly affect learners' engagement with language acquisition (Zhong et al., 2024). For many students, the prospect of speaking a foreign language or engaging in unfamiliar linguistic tasks may trigger feelings of apprehension and self-doubt, which can hinder their willingness to participate fully in the learning process. Understanding how anxiety manifests in technology-enhanced environments, particularly when interacting with digital tools and platforms, is crucial for developing effective instructional strategies that promote positive outcomes (Alavi et al., 2022; Guo & Wang, 2024; Lin & Wang, 2024; Qu & Wu, 2024; Pan & Wang, 2024).

The integration of technology in language learning environments has introduced both opportunities and challenges (Zhang et al., 2024). While digital tools and resources have the potential to enhance engagement, foster personalized learning experiences, and improve educational outcomes, the psycho-emotional dimensions of language learning—particularly learner anxiety and motivation—remain critical factors that are not yet adequately understood (Blackmon & Major, 2023; Wang et al., 2024). This disconnect poses a significant challenge in maximizing the effectiveness of technology-enhanced educational practices. Anxiety frequently arises in language learning contexts, particularly among learners navigating unfamiliar digital environments or facing the pressure to perform in a second or foreign language (Abu Arqub et al., 2024). Elevated levels of anxiety can hinder learners' willingness to participate in communicative activities, negatively impacting their engagement and overall language acquisition. As learners interact with digital tools, their emotional responses can vary widely; while some may feel empowered and motivated, others may experience increased stress and

apprehension. This variability raises essential questions about how technology influences students' emotional states and their subsequent language learning outcomes.

Similarly, motivation plays a crucial role in driving language learners' engagement, persistence, and success (Shafiee Rad et al., 2024). In technology-enhanced environments, the presence of digital tools can significantly impact motivation levels, yet the specific mechanisms through which these tools affect motivation—either positively or negatively—remain unclear (Guan et al., 2024). Understanding the interplay between anxiety and motivation in the context of technology-enhanced language learning is essential for developing effective pedagogical strategies that support emotional well-being and facilitate successful language acquisition (Yuan & Liu, 2025). Despite the evident importance of these psycho-emotional dimensions, there is a notable lack of comprehensive research that considers the complex interactions between learner anxiety, motivation, and the use of digital tools in language learning contexts (Abu Arqub et al., 2024; Guan et al., 2024). This gap in the literature presents an urgent need to investigate how these factors interrelate and influence learners' experiences in technology-enhanced environments (Goagoses et al., 2024).

By examining these questions, this research seeks to fill the existing gap in understanding the psycho-emotional dimensions of language learning, providing valuable insights that can inform effective instructional practices and enhance the overall learning experience for language learners in digital settings. By investigating how technology impacts learner anxiety and motivation, the study provides actionable insights for educators seeking to optimize their teaching methodologies in technology-enhanced environments. Understanding the psycho-emotional dimensions of language learning might inform the development of instructional strategies. Educators might implement techniques and interventions that reduce learner anxiety, such as fostering a supportive classroom environment, offering structured guidance on using technology, and promoting peer collaboration. This study addresses a crucial gap in the literature regarding the psycho-emotional factors influencing language learning in technology-enhanced settings. By focusing on the relationship between anxiety and motivation, it contributes to the field of educational psychology by providing empirical evidence on how emotional factors intertwine with technology use, enhancing the understanding of learner behavior in educational contexts.

2. Review of the related literature

This section outlines the key theories and constructs that inform the study, illustrating how they contribute to my understanding of language acquisition in the context of emerging educational technologies. Affect theory posits that emotional and psychological states significantly influence learning outcomes. In the context of language learning, affective factors such as anxiety and motivation play pivotal roles in learners' engagement and success. Language acquisition can evoke varying emotional responses, and high levels of anxiety can be detrimental to learners' performance, reducing their willingness to communicate or take risks in using a new language (Tang & Tang, 2024). Conversely, positive emotions and motivation can enhance engagement and increase learners' persistence in overcoming challenges (Novak et al., 2023). This theory highlights the necessity of addressing learners' emotional experiences, particularly in environments enriched with digital technologies.

Motivation plays a pivotal role in driving learners toward successful language acquisition (Naeem et al., 2023; Pourgharib & Shakki, 2024). It fuels students' desires to engage with the subject matter, approach challenges with enthusiasm, and persevere through difficulties (Cao & Yu, 2023). The motivation to learn a language can be influenced by a myriad of factors, including personal goals, social interactions, and the perceived relevance of language skills in their lives. In technology-enhanced environments, where learners frequently interact with various digital tools, motivation may be shaped by the features and functionalities of these tools, potentially fostering a more engaging and supportive learning atmosphere (Teichert et al., 2023). The interplay between anxiety and motivation is particularly significant in technology-mediated language learning contexts. Increased anxiety can detract from motivation, creating a cycle that impedes progress and development. On the other hand, effective digital tools can alleviate anxiety and enhance motivation, leading to more productive language-learning experiences (Allcoat et al., 2021; Derakhshan et al., 2025). By investigating this dynamic relationship, researchers can identify strategies to help educators manage anxiety while fostering motivation, ultimately enriching the learning journey for language students.

Cognitive Evaluation Theory (CET), emphasizes the role of intrinsic and extrinsic motivation in learning processes (Sui et al., 2024). CET suggests that learners' perceptions of their autonomy and competence can influence their intrinsic motivation levels, which are crucial in sustaining engagement and promoting effective learning. In technology-enhanced language learning environments, digital tools can either support or undermine learners' motivation, depending on how they are designed and integrated. Tools that promote autonomy and provide meaningful feedback can enhance intrinsic motivation, while those that create a sense of pressure or judgment may increase anxiety and decrease engagement. Understanding this relationship is critical for creating positive technology-enhanced learning experiences (Qu & Wu, 2024).

Self-Regulated Learning Theory highlights the importance of learners taking control of their learning processes through setting goals, self-monitoring, and self-reflection (Zhang et al., 2024). In technology-enhanced environments, where learners often have access to a myriad of digital tools, self-regulation becomes important for managing anxiety and enhancing motivation. Learners who can effectively set their learning objectives, choose appropriate digital tools, and reflect on their progress are more likely to experience positive emotional outcomes and sustained motivation (Teichert et al., 2023). The interplay between self-regulation, anxiety, and motivation in technology-rich language learning contexts warrants thorough examination. This theoretical background highlights the intersection of various frameworks that contribute to understanding the psycho-emotional dimensions of language learning in technology-enhanced environments. The insights gained from this exploration will be instrumental in creating effective learning environments that support learners' emotional and cognitive needs, ultimately leading to improved language outcomes in digital contexts.

Su and Zou (2022) explore the nature of language anxiety and its influence on language learning, highlighting how anxiety can interfere with learners' cognitive processes. Revishvili and Tsereteli (2024) review theories of motivation in language learning and provides empirical evidence linking motivation to successful language acquisition, particularly in technology-rich environments. Abu Arqub et al. (2024) investigates strategies to reduce anxiety in language learning classrooms, demonstrating the importance of emotional factors in successful language

acquisition. Tang and Tang (2024) explore the relationship between anxiety and motivation in language learning, providing rich insights into learners' personal experiences and emotional responses. Yuan and Liu (2025) examine how the use of digital tools in EFL settings influences students' motivation, highlighting the role of technology in reducing anxiety. Cao and Yu (2023) analyze how online peer assessments influence learners' motivation and anxiety, highlighting the importance of collaborative learning experiences in technology-enhanced contexts. Cao and Yu (2023) evaluate the effects of an online language learning program on learners' motivation and anxiety, providing evidence of increased engagement through digital tools. Guan et al. (2024) explores how collaborative mobile learning applications can enhance motivation and diminish anxiety in language learners, focusing on how technology can facilitate a more engaging educational experience. Novak et al. (2023) reviews various studies on mobile technology's impact on language learning and highlights the influence of motivation and anxiety on learner outcomes. These empirical studies collectively provide a robust foundation for understanding the psycho-emotional dimensions of language learning in technology-enhanced environments. They highlight the significance of anxiety, motivation, and digital tools in shaping learners' experiences and outcomes, emphasizing the need for further research to explore these dimensions in greater depth.

The studies addressing the psycho-emotional dimensions of language learning in technology-enhanced environments uncover several controversial issues that merit further exploration. While many studies suggest that technology can reduce anxiety and boost motivation, others indicate that the same digital tools can lead to increased anxiety levels among learners. For example, while some research highlights that Mobile-Assisted Language Learning (MALL) apps positively impact motivation (Guan et al., 2024), others report that students experience anxiety when facing the complexities of using sophisticated technologies (Qu & Wu, 2024). This raises questions about the conditions under which technology aids or hampers emotional engagement. The relationship between motivation and anxiety in language learning contexts remains complex and sometimes contradictory. Although anxiety is often seen as a hindrance to motivation, some studies suggest that certain anxiety levels might actually motivate learners to attempt language tasks to avoid the negative feelings associated with failure (Shafiee Rad et al., 2024). This raises questions regarding the ideal levels of anxiety conducive to favorable learning outcomes and how educators can manage this balance.

A controversial issue in these studies centers on the role of educators and institutional support in mitigating anxiety and enhancing motivation through technology (Allcoat et al., 2021; Zhong et al., 2024). Some studies suggest that without adequate teacher training in using technology, digital tools may exacerbate learner anxiety (Tang & Tang, 2024). Consequently, the question arises as to what constitutes adequate preparation for educators to effectively use technology in language teaching. The effectiveness of technology-enhanced learning is often contingent upon the availability of student support systems (e.g., tutoring, technological support). However, not all institutions provide these resources, leading to disparities in student experiences and outcomes (Zhong et al., 2024). The extent to which institutions should invest in support systems remains a point of contention.

2.1. Research Questions

RQ1. Is there any significant relationship between EFL students' digital tool efficacy, anxiety, motivation, and their engagement in technology-enhanced environments?
RQ2. To what extent does EFL students' digital tool efficacy predict their anxiety, motivation, and engagement in technology-enhanced environments?

3. Method

3.1. Participants

Using a random sampling approach, the researchers collected a total of 409 completed questionnaires. Participants were students from Chengdu, Urumqi, Beijing, and Chongqing. The sample consisted of 87 males (21.27%) and 322 females (78.73%). In terms of age distribution, 273 students (66.75%) were aged 18-21, 99 students (24.21%) were aged 22-25, 25 students (6.11%) were aged 26-29, and 12 students (2.93%) were over 30 years old. For educational levels, 352 students (86.06%) were pursuing a B.A., 51 students (12.47%) were pursuing an M.A., and 6 students (1.47%) were pursuing a Ph.D. Regarding their majors, 112 students (27.38%) were studying English Teaching, 70 students (17.11%) were majoring in English Translation, 40 students (9.78%) were focused on English Literature, 33 students (8.07%) were studying English Linguistics, and 3 students (0.73%) were engaged in National and Regional Studies. Additionally, 151 students selected "Other" as their major, which included areas such as English Literature and Linguistics, Business English, and related fields. In terms of language proficiency, 190 participants (46.45%) identified as "Elementary," 189 (46.21%) as "Intermediate," and 30 (7.33%) as "Advanced."

3.2. Instruments

3.2.1. Digital tool efficacy questionnaire

The Digital Tool Efficacy Questionnaire (DTEQ) is a self-reported instrument designed to assess individuals' confidence and proficiency in utilizing digital tools for educational and professional purposes (Peleg et al., 2024). The questionnaire consists of 15 items, grouped into three subscales: technology confidence, problem-solving with technology, and adaptability to new tools. The DTEQ is a valid and reliable instrument for measuring digital tool efficacy. Its robust psychometric properties make it suitable for research and practical applications in educational and workplace settings. The DTEQ was developed based on a thorough literature review of digital efficacy frameworks, ensuring that the items comprehensively cover the key dimensions of digital tool efficacy. Expert reviewers in educational technology and psychometrics evaluated the items to ensure they align with the theoretical construct. Exploratory Factor Analysis (EFA) revealed a clear three-factor structure corresponding to the three subscales. Each item strongly loaded onto its intended factor, with factor loadings above 0.60. Goodness-of-fit indices such as CFI ($\geq$0.95), TLI ($\geq$0.95), and RMSEA ($\leq$0.06) confirmed the hypothesized structure, supporting the construct validity of the DTEQ. Cron-

bach's alpha coefficients for the overall scale and subscales indicate high internal consistency: Overall Scale: $\alpha = 0.91$, technology confidence: $\alpha = 0.88$, problem-solving with technology: $\alpha = 0.87$, and adaptability to new tools: $\alpha = 0.85$.

3.2.2. Technology-enhanced environments anxiety levels questionnaire

The TEEALQ is designed to measure individuals' anxiety levels when engaging with technology-enhanced environments (Staddon, 2020). It aims to assess the emotional and psychological challenges faced by learners and professionals while interacting with digital tools, platforms, or virtual learning settings. The TEEALQ consists of 20 items distributed across four subscales: performance anxiety, technical anxiety, social anxiety in virtual interactions, adaptation anxiety. Each item is rated on a 5-point Likert scale, ranging from 1 (Strongly Disagree) to 5 (Strongly Agree). Content and construct validity have been confirmed through expert reviews and factor analysis. Cronbach's alpha for the overall scale is reported to be 0.92, with subscales ranging from 0.85 to 0.89.

3.2.3. Technology-enhanced environments engagement strategies questionnaire

The TEESQ is designed to evaluate the strategies individuals use to actively engage and interact within technology-enhanced environments (Sui et al., 2024). It focuses on behaviors, attitudes, and techniques employed to optimize learning or task performance in digital settings. The TEESQ consists of 10 items categorized into two subscales: active participation strategies and self-regulation strategies. The scale demonstrates robust content validity, with items carefully crafted based on engagement theory and expert input. Confirmatory factor analysis supports the two-factor structure. Cronbach's alpha for the overall questionnaire is 0.91, with subscale reliabilities of 0.88 (Active Participation) and 0.86 (Self-Regulation).

3.2.4. Technology-enhanced environments motivational factors questionnaire

The TEEMFQ aims to measure motivational factors influencing individuals' interactions and performance in technology-enhanced environments (Schweighofer et al., 2019). It evaluates intrinsic and extrinsic drivers, goal orientation, and persistence in such settings. The questionnaire contains 20 items divided into four subscales: intrinsic motivation, extrinsic motivation, goal orientation, and perseverance. The scale demonstrates strong construct and content validity, supported by expert reviews and factor analysis. Cronbach's alpha for the overall questionnaire is 0.93, with subscale reliabilities of 0.89 (Intrinsic Motivation), 0.88 (Extrinsic Motivation), 0.87 (Goal Orientation), and 0.85 (Perseverance).

3.3. Design of the Study

Since the first research question aims to explore the relationships between multiple variables, specifically how EFL students' digital tool efficacy, anxiety, motivation, and engagement in technology-enhanced environments are interrelated, the study adopts a correlational design. This design allows for the examination of the strength and direction of the relationships between these variables without manipulating any of them. It focuses on

understanding how changes in one variable (e.g., digital tool efficacy) might coincide with changes in another (e.g., anxiety, motivation, or engagement). On the other hand, the second research question is focused on understanding the predictive nature of digital tool efficacy, seeking to determine whether it can significantly forecast or influence the levels of anxiety, motivation, and engagement in technology-enhanced environments. To address this, the study utilizes a predictive design, which allows for the exploration of how well one independent variable (digital tool efficacy) can explain or predict changes in the dependent variables (anxiety, motivation, and engagement). By applying a predictive approach, the study can provide insights into the potential causal relationships between these variables, where digital tool efficacy is assessed as a predictor of students' emotional and behavioral responses in learning environments. Together, these two approaches—correlational and predictive—enable the study to provide a comprehensive understanding of the dynamic interplay between digital tool efficacy and key psychological factors like anxiety, motivation, and engagement, while also offering insights into how these factors might influence each other over time.

3.4. Procedure

The study's data collection was carried out using a comprehensive questionnaire that incorporated four authoritative scales related to the variables under investigation. As the original scales were in English, and the target participants were Chinese students, the scales were translated into Chinese to enhance comprehension and ensure accurate responses. To minimize semantic discrepancies during translation, a review panel comprising two linguistics experts and one expert in translation studies was formed to thoroughly evaluate the translated content. This ensured that the Chinese version of the scales was both clear and accurate in intent. The surveys were distributed via the WeChat platform, adhering to basic research ethics. An ethical statement was included at the beginning of the questionnaire to inform participants about the study's purpose and assure them of the confidentiality and privacy of their responses. Participants were then asked to respond carefully to each item. Data collection spanned from November 11 to November 14, resulting in 409 completed questionnaires from students located in Chengdu, Urumqi, Beijing, and Chongqing. Once data collection was complete, the online link was deactivated, and the dataset was carefully reviewed for accuracy.

3.5. Data Analysis

Statistical analyses were conducted using SPSS (version 27) and AMOS (version 24). SPSS was employed for descriptive statistics, correlation analyses, and regression to identify trends and relationships in the data. AMOS was utilized for structural equation modeling (SEM) to analyze and visualize complex interactions among variables. Advanced techniques such as factor analysis were also applied to simplify the data and uncover key underlying constructs. The findings from these analyses provided critical insights into the research hypotheses, revealing patterns, correlations, and significant relationships between variables.

4. Results

The researcher employed Confirmatory Factor Analysis (CFA) to assess the reliability of the surveys and the relationships among the variables. The analysis verified that the observed variables corresponded to the theoretical constructs, demonstrating that these constructs were both unique and interrelated. Convergent validity was established through significant factor loadings, while discriminant validity was confirmed by comparing the Average Variance Extracted (AVE) values with the squared correlations between constructs. When AVE values surpassed the squared correlations, the constructs were deemed distinct. Overall, CFA provided a comprehensive examination of variable relationships, with detailed results presented in tables and figures, confirming the validity of the constructs.

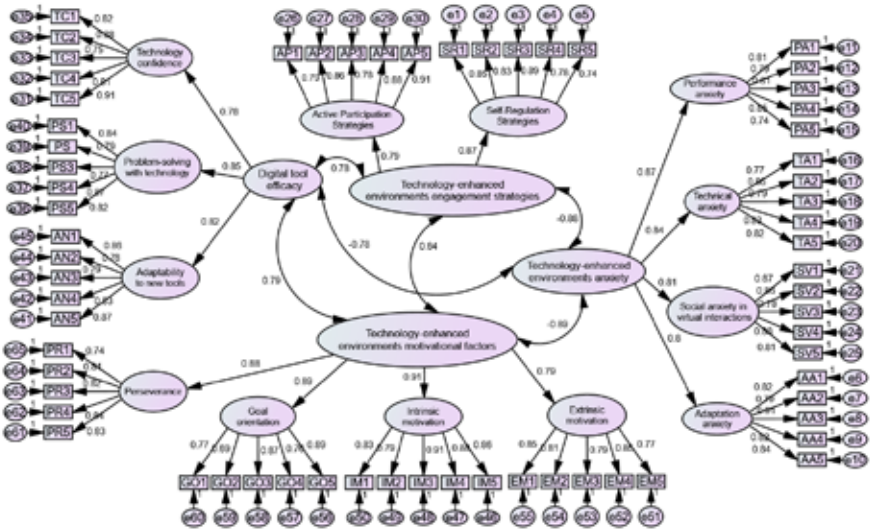

Figure 1. *The Final Adjusted CFA Model with Standardized Estimates*

The SEM model in Figure 1 revealed strong positive relationships between Digital Tool Efficacy, Motivational Factors, and Engagement Strategies (β = 0.78 to 0.87). These relationships highlight the importance of equipping individuals with technical skills and motivational resources to maximize engagement. Anxiety negatively correlates with both Digital Tool Efficacy (β = -0.88) and Motivational Factors (β = -0.89), indicating that efforts to boost efficacy and motivation can alleviate anxiety. Engagement strategies serve as a buffer against anxiety (β = -0.84), underscoring the need to foster active and self-regulated learning behaviors. Factor loadings across all constructs were high (≥ 0.74), suggesting that the measurement model is robust and the constructs are well-defined. The model emphasizes that enhancing digital tool efficacy and motivational factors is pivotal in fostering engagement while reducing anxiety in technology-enhanced environments. Interventions focusing on confidence building, adaptability, and motivational strategies are likely to yield positive outcomes in these settings.

Table 1. *The Goodness of Fit Estimation*

		THRESHOLD			
CRITERIA		TERRIBLE	ACCEPTABLE	EXCELLENT	EVALUATION
CMIN	5738.418				
DF	1938				
CMIN/DF	2.961	> 5	> 3	> 1	Acceptable
RMSEA	.073		< .08	< .06	Acceptable
GFI	.954	> .8	> .9	> .95	Acceptable
CFI	.945	> .8	> .9	> .95	Acceptable
PNFI	.576		> .5		Acceptable
TLI	.934	> .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

The S achieves a robust fit to the data, with all key indices falling within "Acceptable" thresholds. While some indices (GFI, CFI, and TLI) approach "Excellent" standards, improvements could be made to further optimize the model's representation of the observed data. Overall, the results support the validity of the model for the tested hypotheses.

Table 2. *Reliability and Validity of the Variables*

	CR	AVE	MSV	MaxR(H)	Digital Efficacy	Technology-Enhanced Anxiety	Technology-Enhanced Engagement	Technology-Enhanced Motivation
Digital Efficacy	0.91	0.89	0.877	0.878	**0.942**			
Technology-Enhanced Anxiety	0.92	0.88	0.742	0.852	-0.691***	**0.938**		
Technology-Enhanced Engagement	0.91	0.85	0.63	0.851	0.657***	-0.679***	**0.924**	
Technology-Enhanced Motivation	0.93	0.83	0.798	0.785	0.581***	-0.694***	0.662***	**0.912**

Note: CR: Composite Reliability; AVE: Average Variance Extracted; MSV: Maximum Shared Variance; MaxR(H): Maximum Reliability (H)
*** It is significant at .000 level

Table 2 provides the reliability and validity analysis for the key variables in the study. Positive relationships exist between Digital Efficacy, Engagement, and Motivation, suggesting that efficacy facilitates engagement and motivation. Technology-Enhanced Anxiety is negatively correlated with other variables, indicating its detrimental effects on engagement and motivation. The results confirm the reliability and validity of the measurement model. The constructs are internally consistent, demonstrate both convergent and discriminant validity, and exhibit meaningful relationships. Digital Efficacy emerges as a central positive factor, while Technology-Enhanced Anxiety poses challenges to engagement and motivation, highlighting the importance of mitigating anxiety in technology-enhanced environments.

Table 3. *Standardized Regression Weights of the Variables*

			STANDARDIZED REGRESSION WEIGHTS	S.E.	C.R.	P
Digital Efficacy	↔	Technology-Enhanced Motivation	.791	.252	.545	.002
Technology-Enhanced Anxiety	↔	Digital Efficacy	-.782	.141	.351	.001
Technology-Enhanced Engagement	↔	Digital Efficacy	.784	.151	.342	.002
Technology-Enhanced Motivation	↔	Technology-Enhanced Anxiety	-.893	.152	.345	.001
Technology-Enhanced Engagement	↔	Technology-Enhanced Anxiety	-.884	.341	.551	.002
Technology-Enhanced Motivation	↔	Technology-Enhanced Engagement	.841	.351	.587	.002

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

Table 3 presents the standardized regression weights, their corresponding standard errors (S.E.), critical ratios (C.R.), and p-values for the relationships between key variables. Digital Efficacy has significant positive effects on Technology-Enhanced Motivation (β = 0.791, *P* = 0.002) and Technology-Enhanced Engagement (β = 0.784, p = 0.002), highlighting its importance as a driver of both motivation and engagement. Technology-Enhanced Anxiety negatively impacts Digital Efficacy (β = -0.782, *P* = 0.001), Motivation (β = -0.893, *P* = 0.001), and Engagement (β = -0.884, *P* = 0.002), suggesting it is a major barrier to effective participation in technology-enhanced environments. The strong positive relationship between Technology-Enhanced Motivation and Engagement (β = 0.841, *P* = 0.002) indicates that motivation plays a key role in fostering active participation. The findings underscore the pivotal role of Digital Efficacy in promoting Motivation and Engagement while highlighting the detrimental effects of Technology-Enhanced Anxiety. Strategies aimed at reducing anxiety and improving digital efficacy could significantly enhance motivation and engagement in technology-enhanced environments.

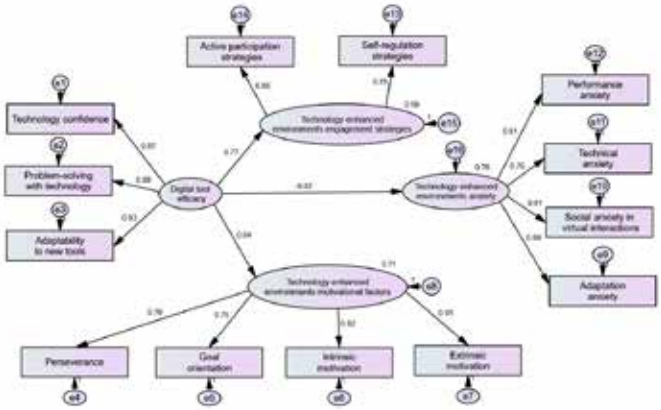

Figure 2. *The Final Measurement Model*

Figure 2 represents a structural equation model (SEM) illustrating the relationships among the variables. Digital Tool Efficacy demonstrates strong, positive contributions to Technology-Enhanced Engagement Strategies (β = 0.77) and Motivational Factors (β = 0.84). It also significantly reduces Technology-Enhanced Anxiety (β = -0.87), highlighting its central role in technology-enhanced environments. Technology-Enhanced Anxiety emerges as a critical barrier, negatively impacting Engagement Strategies (β = -0.59) and Motivational Factors (β = -0.71). Motivational Factors are strongly characterized by Intrinsic Motivation (loading = 0.82) and Extrinsic Motivation (loading = 0.91), suggesting that both play a significant role in sustaining engagement in technology-enhanced contexts. The model highlights the need for interventions aimed at bolstering Digital Tool Efficacy while addressing the sources of Anxiety to foster greater Engagement and Motivation.

Table 4. *Structural Model Assessment*

PARAMETER	ESTIMATE	LOWER	UPPER	P
Technology-Enhanced Environments Anxiety Levels	.761	.259	.556	.002
Technology-Enhanced Environments Engagement Strategies	.593	.364	.632	.001
Technology-Enhanced Environments Motivational Factors	.714	.156	.378	.002

Table 4 presents the results of the structural model assessment, showing the parameter estimates, their 95% confidence intervals (Lower and Upper bounds), and significance levels (P-values) for three key constructs. The structural model assessment highlights that Technology-Enhanced Anxiety Levels exert a significant and substantial effect (Estimate = 0.761, *P* = 0.002) within the model, with a narrow confidence interval indicating reliability. It means that approximately 76% of the variations observed in students' Technology-Enhanced Anxiety Levels can be attributed to the effect of digital tool efficacy. Engagement Strategies are moderately influenced (Estimate = 0.593, *P* = 0.001), confirming their importance as a mediator or outcome variable in technology-enhanced environments. In other words, approximately 59% of the variations observed in students' Technology-Enhanced Environments Engagement Strategies can be attributed to the effect of digital tool efficacy. Motivational Factors exhibit a strong and significant impact (Estimate = 0.714, *P* = 0.002), reinforcing their critical role in sustaining participation and effort in such contexts. It means that approximately 71% of the variations observed in students' Technology-Enhanced Environments Motivational Factors can be attributed to the effect of digital tool efficacy.

4.1 Discussion

The study's main objectives are to examine the relationships between EFL students' digital tool efficacy, anxiety, motivation, and engagement in technology-enhanced environments. This objective aims to identify if and how these variables are interconnected, helping to establish whether there are significant associations between students' perceived efficacy with digital tools and their emotional and behavioral responses (anxiety, motivation, engagement) in a digital learning context. in addition, it investigated the predictive power of digital tool efficacy on EFL students' anxiety, motivation, and engagement. This objective seeks to ex-

plore whether students' digital tool efficacy can be a significant predictor of their levels of anxiety, motivation, and engagement in technology-enhanced learning environments, thereby providing insight into how students' self-perceived abilities with digital tools may influence their emotional and motivational states, as well as their engagement in the learning process. These objectives collectively aim to deepen the understanding of how digital tool efficacy impacts EFL students' psychological experiences and engagement in technology-mediated learning environments.

The findings of this study underscore the intricate relationships between EFL students' digital tool efficacy, anxiety, motivation, and engagement in technology-enhanced environments. By demonstrating significant correlations and predictive relationships among these variables, the research highlights the vital role of digital tool efficacy in shaping learners' experiences and outcomes in language learning contexts that incorporate technology. The data reveal a crucial insight: higher digital tool efficacy among EFL learners is associated with lower levels of anxiety. This finding aligns with existing literature that links students' confidence in their technological skills to reduced anxiety (Blackmon & Major, 2023). When students feel capable of utilizing digital tools effectively, they are less likely to experience apprehension related to technology, which can often serve as a source of stress in language learning environments. This reduction in anxiety is significant, as anxiety is known to be a substantial barrier to language acquisition and participation in language activities (Novak et al., 2023). Furthermore, the study's observations that digital tool efficacy is positively correlated with motivation suggest that students who possess confidence in their technological skills are more likely to demonstrate an intrinsic desire to engage in their learning tasks. This finding resonates with SDT, which posits that competence—feeling effective in one's activities—enhances intrinsic motivation. Therefore, fostering an environment where EFL learners can build their digital tool efficacy may not only alleviate anxiety but also enhance their motivation to engage in learning.

An essential aspect of the findings is the identification of motivation as a mediating factor between digital tool efficacy and engagement. This relationship emphasizes the importance of motivation in facilitating active participation in technology-enhanced environments. The results suggest that while high digital tool efficacy can directly lead to increased engagement, it is through heightened motivation that this engagement is realized. This mediating effect raises implications for instructional design and pedagogical approaches in technology-enhanced language learning. Educators should aim to cultivate a motivating atmosphere that encourages the exploration and use of digital tools. Such environments may include providing clear instructions, constructive feedback, and opportunities for collaborative learning that allow students to utilize digital tools in meaningful ways. Encouraging students to set personal learning goals and reflect on their progress can further strengthen their motivation and enhance their engagement.

The strong predictive relationship between digital tool efficacy and engagement offered significant insights into how EFL students interact in technology-enhanced settings. Students who feel adept at navigating digital tools are more inclined to actively participate in discussions, complete assignments, and engage collaboratively with peers. This finding mirrors the importance of engagement in effective learning outcomes and indicates that increasing students' comfort with technology is not only important for their emotional well-being but

also vital for their active involvement in language learning (Su & Zou, 2022). Moreover, promoting digital tool efficacy is particularly relevant given the increasing reliance on technology in education—a trend that has only accelerated due to the COVID-19 pandemic. As educational institutions increasingly adopt blended and online learning models, ensuring students possess the necessary skills to utilize digital tools effectively becomes paramount for optimizing their learning experiences.

The current study indicates a significant negative correlation between digital tool efficacy and learner anxiety, suggesting that students who feel proficient with digital tools experience less anxiety. This aligns with findings from Tang and Tang (2024), which demonstrated that increased self-efficacy in technology use reduces anxiety levels among language learners. Similarly, Yuan and Liu (2025) found that learners who are confident in their technological skills are less likely to experience anxiety in language learning situations, supporting the assertion that digital tool efficacy can mitigate anxiety. Additionally, Zhang et al. (2024) reveal that anxiety significantly affects learners' language performance. This study builds on that foundation by directly linking digital tool efficacy, indicating that addressing self-efficacy in tech use could be an effective strategy for minimizing anxiety in language learners. The findings that higher digital tool efficacy positively correlate with greater motivation align with the perspective presented by Zhong et al. (2024) and Qu and Wu (2024), who emphasize the integral role of perceived competence in motivation. Moreover, the assertion that motivation mediates the relationship between digital tool efficacy and engagement corroborates findings from Abu Arqub et al. (2024), who found that learners' motivation significantly influences their ability to engage with technology in educational settings. This connection suggests that fostering digital tool efficacy could leverage motivation to enhance engagement, reinforcing the importance of motivational strategies in educational practice.

The study's conclusion that digital tool efficacy predicts engagement mirrors existing research that underscores the role of technology in promoting active participation among learners. Cao and Yu (2023) and Naeem et al. (2023) have shown that engagement in learning is closely tied to students' confidence and comfort with the tools they are using. The current findings suggest that when EFL learners feel adept at utilizing digital tools, they are more likely to participate actively in class discussions and collaborative activities, akin to conclusions drawn by Blackmon and Major (2023), who emphasized the crucial role of digital literacy in fostering engagement. Furthermore, Revishvili and Tsereteli (2024) highlighted that effective technology integration can significantly enhance students' engagement levels, particularly when learners are familiar with and confident in their technological abilities. This connection provides a supportive backdrop for the study's findings that proficient use of digital tools directly impacts learner engagement. The current findings highlight the mediating role of motivation, a perspective supported by Staddon (2020) and others who argue that motivation serves as a crucial factor influencing student engagement and achievement. Previous studies have recognized the multifaceted nature of motivation, with Sui et al. (2024) exploring how intrinsic motivation stemming from a sense of competence and confidence enhances engagement in language tasks. The present study's findings compound this understanding by revealing that motivation not only mediates the relationship between digital tool efficacy and engagement but also functions as a dynamic driver of learner behavior in technology-enhanced environments.

5. Conclusion

In conclusion, this study has provided valuable insights into the relationship between EFL students' digital tool efficacy and key psychological factors such as anxiety, motivation, and engagement in technology-enhanced learning environments. The findings suggest that there are significant associations between digital tool efficacy and these factors, with higher efficacy being linked to greater motivation and engagement, and lower levels of anxiety. Additionally, the study highlights the predictive role of digital tool efficacy in shaping students' emotional and behavioral responses, suggesting that fostering students' confidence in using digital tools could positively influence their engagement and motivation while mitigating anxiety. The results underscore the importance of enhancing students' digital tool efficacy as a key strategy in optimizing learning experiences in technology-rich environments. By focusing on improving students' skills and confidence with digital tools, educators and instructional designers can create more supportive and engaging learning environments that facilitate better academic outcomes. This study also contributes to the growing body of research on the intersection of technology, emotions, and motivation in language learning, offering practical implications for both educators and policymakers. Further research could explore the long-term effects of digital tool efficacy on student performance and explore additional factors that may mediate or moderate the relationships identified in this study.

The findings of this study contribute to a growing body of literature that emphasizes the importance of digital tool efficacy in shaping EFL students' experiences in technology-enhanced language learning environments. By aligning with previous research while also providing additional insights into the mediating role of motivation and mitigating effects on anxiety, this study reinforces the necessity of fostering digital confidence among learners. Enhanced digital tool efficacy is positioned as a pivotal factor that can lead to improved motivation and engagement, thus enriching the language learning experience in increasingly digital educational contexts. As technology continues to permeate language education, these findings underscore the need for targeted interventions aimed at bolstering learners' digital competencies to promote positive educational outcomes.

Educational programs and curricula should integrate specific training modules focused on building students' digital literacy skills. This could include practical workshops that help EFL learners become familiar with various digital tools and technologies, thereby improving their efficacy and reducing anxiety associated with their use. By strengthening these skills, educators can cultivate a more supportive and effective technology-enhanced learning environment. Curriculum designers should consider incorporating adaptive learning technologies that tailor instruction based on individual student needs. By leveraging AI-driven tools and resources, educators can provide personalized support that enhances students' confidence and engagement levels, ultimately fostering a more inclusive learning atmosphere. Educators must receive ongoing professional development focused on effectively integrating technology into language teaching. This training can equip instructors with the skills needed to guide students through the complexities of digital tools, demonstrating not only how to use them but how to leverage them for language learning. This empowerment can translate into greater student confidence and competence in using technology.

Educators should be encouraged to create classroom environments that prioritize psychological safety, encouraging students to view mistakes as learning opportunities rather than failures. This approach can help reduce anxiety and foster motivation, aligning with the study's findings regarding the importance of emotional factors in learning. To enhance engagement and reduce anxiety, educators can facilitate collaborative learning opportunities that allow students to work together on projects using digital tools. Group work can foster a social support system, enabling learners to share their digital skills and confidence, ultimately contributing to a collective sense of efficacy. Policymakers should prioritize investments in educational technology infrastructure to ensure that all learners have equal access to necessary digital tools and resources. This should include providing training and technical support to both students and educators to maximize the efficacy of technology in educational contexts. Educational institutions should implement systematic assessments to monitor students' digital tool efficacy and its impact on anxiety and motivation levels. Research initiatives and data analysis can help identify trends and gaps, allowing institutions to tailor support services and resources accordingly.

Future research can investigate the long-term effects of enhanced digital tool efficacy on EFL students' motivation, anxiety, and engagement. Future research can track these variables across multiple semesters or academic years to assess sustainability and changes over time. They can design and implement targeted interventions to improve EFL students' digital tool efficacy, such as workshops or training programs. Examine the impact of these interventions on reducing anxiety, increasing motivation, and improving engagement in technology-enhanced environments. In addition, they can explore how cultural and educational contexts influence the relationship between digital tool efficacy, anxiety, motivation, and engagement. Comparative studies across countries or education systems can provide deeper insights into the role of context. Future studies can incorporate additional variables, such as self-regulated learning strategies, digital literacy, or prior technology exposure, into predictive models. Analyze how these factors interact with digital tool efficacy to influence anxiety, motivation, and engagement. These directions can enrich the understanding of digital tool efficacy and its broader implications for EFL learners in increasingly digitalized educational environments.

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