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# How Technostress Shapes Anxiety Levels in Learning Four Language Skills? Evidence from Thai Students

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**ABSTRACT**

The rapid integration of digital technology in education has introduced new challenges, particularly for junior high school students learning English. Technostress, defined as the stress caused by difficulties in adapting to new technologies, has emerged as a significant factor affecting students' emotional responses in digital learning environments. This study aims to explore the relationship between technostress and language learning anxiety, focusing on Thai junior high school students. The research employs a quantitative explanatory design using Partial Least Squares Path Modeling (PLS-PM) to analyze how various dimensions of technostress, such as techno-anxiety, techno-overload, and techno-uncertainty, contribute to anxiety in learning English across four skills: speaking, listening, reading, and writing. The findings indicate a significant positive relationship between technostress and language learning anxiety, with techno-uncertainty and techno-anxiety identified as the most impactful stressors. The study highlights the need for educators to minimize platform switching, create error-friendly learning environments, and maintain consistent digital routines to reduce anxiety. The results provide practical insights for developing more emotionally supportive digital learning designs, ensuring that technology-based education is both effective and psychologically sustainable for young learners.

**Keywords:** technostress, language learning anxiety, EFL students, digital learning, PLS-SEM



## INTRODUCTION

The rapid development of digital technology has significantly transformed the landscape of education, including English language learning at the junior high school level (Khan & Ahmad, 2024; Le et al., 2025; Nasution, 2024; Nunan, 2022; Timotheou et al., 2023). Digital platforms, online learning systems, and interactive multimedia are increasingly integrated into classroom practices to support flexibility, accessibility, and skill development. However, alongside these benefits, digitalization has also introduced new psychological demands for students, particularly children who are still developing emotional regulation and cognitive control. These pressures are commonly conceptualized as technostress, defined as stress arising from the demands of adapting to continuously evolving technology (Tarafdar et al., 2007).

In junior high school English learning, technology plays a central role in facilitating the acquisition of the four primary language skills: speaking, listening, reading, and writing. Students are required to interact with digital platforms to complete online exercises, submit assignments, participate in virtual discussions, and perform language tasks through audio or video recordings. While these activities are designed to enhance engagement, students often experience difficulties related to complex interfaces, inconsistent instructions, technical errors, and frequent system changes. For children whose digital literacy and emotional regulation are still developing, such conditions can generate feelings of confusion, pressure, and

psychological discomfort (Freel et al., 2022; Jarar & Salim, 2024; Keating, 2025; Scott et al., 2024).

These technological pressures are closely related to the emergence of language learning anxiety, a construct characterized by fear of making mistakes, lack of confidence, and tension during language performance (Horwitz, Horwitz, & Cope, 1986). In digital learning contexts, anxiety may be intensified when students are required to demonstrate language competence through unfamiliar technological media. Previous studies have shown that anxiety can inhibit cognitive processing in second or foreign language learning, reducing students' ability to comprehend input and produce language effectively (MacIntyre & Gardner, 1994). When combined with technological pressure, this anxiety may become more pronounced, particularly in speaking, listening, reading, and writing activities mediated by digital platforms.

Existing research on technostress has primarily focused on teachers and adult learners in higher education contexts (Shaukat et al., 2022; Estrada Araoz et al., 2023; Wang & Yao, 2025), while studies on language learning anxiety have largely examined adolescent and adult learners (MacIntyre & Gardner, 1994; Liu, 2023). Empirical research that simultaneously examines technostress and language learning anxiety among junior high school students remains limited. This gap is significant, given that children are more vulnerable to technological pressure due to their developing emotional control and adaptation capacity. Moreover, few studies have explored how different dimensions of technostress such as techno-complexity, techno-anxiety, and techno-uncertainty relate to anxiety across the four language skills in technology-based English learning.

Several previous studies have examined either technostress or foreign language anxiety, but mostly in separate contexts. Shaukat et al. (2022), for example, found that technostress had significant consequences for teacher educators' work-related well-being in remote teaching environments, indicating that digital demands can meaningfully shape psychological outcomes. Similarly, Liu (2023) showed that English classroom anxiety remains an important predictor of learning experiences and outcomes among Chinese university EFL students. These studies are important because they confirm that both technostress and language anxiety are empirically significant constructs. Nevertheless, they focus largely on adults or university-level learners, leaving younger student populations underexamined.

Research in Thailand also suggests that anxiety remains a persistent issue in English learning, especially when students must perform orally in different instructional settings. Poolperm (2024) found that Thai students experienced different levels of speaking anxiety in onsite and online classrooms, with nervousness, limited vocabulary, and difficulty recalling vocabulary emerging as contributing factors. This finding is highly relevant because it shows that the learning mode itself can shape emotional responses in Thai EFL contexts. However, such studies have largely concentrated on speaking anxiety or mode comparison rather than on a broader structural relationship between technostress and anxiety across all four language skills. As a result, the current body of evidence still provides only a partial understanding of how digital learning environments affect Thai learners' emotional experiences in English classes.

The main research gap, therefore, lies in the limited integration of technostress theory with foreign language anxiety theory in school-aged EFL settings. Existing technostress studies are dominated by teachers, employees, and higher education students, whereas language anxiety

studies commonly examine adolescents or university learners without systematically modeling technological stressors as antecedents. Furthermore, only a small number of studies explore how specific dimensions of technostress—such as techno-anxiety, techno-complexity, techno-overload, techno-uncertainty, and techno-invasion—may shape anxiety in speaking, listening, reading, and writing. This gap is theoretically important because younger learners may experience digital pressure differently from adults, and practically important because schools increasingly implement technology-rich learning without always understanding its emotional consequences for children.

This gap creates a clear research urgency. If digital learning continues to expand without adequate understanding of its psychological side effects, schools risk designing English instruction that is technically modern but emotionally unsupportive. For young learners, repeated exposure to technological confusion, system changes, task overload, or fear of making technical mistakes may reduce confidence, increase avoidance, and weaken engagement in language tasks. Over time, this may undermine the very goals of technology-enhanced language learning. Therefore, investigating how technostress shapes language learning anxiety is not merely an academic exercise; it is necessary for creating digital learning environments that are pedagogically effective, developmentally appropriate, and emotionally sustainable for Thai junior high school students.

The novelty of this study lies in its attempt to connect two strands of literature that are usually treated separately: technostress in digital education and anxiety in foreign language learning. Unlike previous studies that focus on adult educators, university students, or only one language skill, this research examines Thai junior high school learners and analyzes the relationship between technostress and anxiety across the four core English language skills. In addition, by operationalizing technostress through multiple dimensions and modeling its influence using Partial Least Squares Path Modeling, the study offers a more comprehensive and developmentally sensitive explanation of how technological pressure is translated into language-related anxiety. This approach provides a more integrative framework for understanding the emotional costs of digital learning in EFL classrooms.

Based on that rationale, this study aims to analyze the effect of technostress on language learning anxiety among Thai junior high school students in technology-based English learning. More specifically, the study seeks to identify which dimensions of technostress are most salient in students' learning experiences, to examine how these pressures are associated with anxiety in speaking, listening, reading, and writing, and to generate evidence that can guide more child-friendly digital learning design. The expected contribution of this research is threefold: theoretically, it extends technostress and foreign language anxiety literature into a younger EFL population; empirically, it provides evidence from the Thai educational context; and practically, it offers insights for teachers, schools, and curriculum designers to reduce anxiety while maintaining the benefits of digital learning. In this sense, the study is expected to benefit both scholarship and educational practice by supporting more inclusive, psychologically aware, and sustainable English language instruction.

## METHOD

### Research Design

This study employed a quantitative explanatory research design using the Partial Least Squares–Path Modeling (PLS–PM) approach to examine the structural relationship between technostress and English learning anxiety among junior high school students in Thailand. The explanatory design is selected because the objective of this research is not merely to describe students' experiences, but to test the structural relationship between latent constructs, namely technostress and language learning anxiety. Quantitative explanatory research is appropriate for testing theoretical models and examining causal relationships among variables through statistical analysis (Creswell, 2014).

PLS–PM is used as the main analytical technique because it enables simultaneous assessment of the measurement model and the structural model, and is suitable for studies involving complex latent constructs, relatively small sample sizes, and data that may not meet multivariate normality assumptions (Hair et al., 2021). In this study, technostress is modeled as an exogenous latent construct reflected by five dimensions, while language learning anxiety is modeled as an endogenous latent construct reflected by four language skill–related dimensions.

Although the model specifies a directional path from technostress to language learning anxiety, the present study does not aim to establish definitive causal effects. The analysis focuses on examining the strength and direction of structural relationships between latent constructs based on theoretical assumptions.

### Location of the Study

This research was conducted at Anuban Taphea Satun School, Thailand, a junior high school that implements technology-supported English learning using platforms such as Google Classroom, Zoom, and basic language learning applications.

The research site was selected purposively because the school has integrated digital technology into English learning activities on a regular basis, making it a relevant context for examining technostress among young learners. Data collection was carried out during August–September 2025, encompassing the stages of instrument preparation, pilot testing, questionnaire administration, and data analysis.

### Population of the Study

The population of this study consists of junior high school students (Rooms 1–6) at Anuban Taphea Satun School who participate in technology-based English learning.

A purposive sampling technique was employed to select participants who had used digital learning platforms in English classes for at least one semester. A total of 60 students were included as research respondents. This sample size satisfies the recommended minimum requirement of 10–20 observations per parameter for PLS–PM analysis, making it adequate for structural model estimation (Hair et al., 2021).

### Variables and Operational Definitions

This study involves two main variables: an independent variable and a dependent variable. The variables are determined based on the technostress framework proposed by Tarafdar et al. (2007) and the foreign language anxiety theory developed by Horwitz, Horwitz, and Cope (1986) as well as MacIntyre and Gardner (1994).

**Independent Variable (X): Technostress**

Technostress is defined as a psychological stress condition experienced by individuals due to difficulties in adapting to the demands of continuously evolving technology (Tarafdar et al., 2007). In this study, technostress refers to the pressure experienced by junior high school students when using digital technology in English learning activities. Based on Tarafdar et al. (2007), technostress is operationalized into five dimensions:

**Table 1. Dimensions of Technostress in Learning**

| No. | Dimension | Description |
|---|---|---|
| 1. | Techno Anxiety | Feelings of fear or nervousness experienced by students when using learning technology. |
| 2. | Techno Overload | Students' perceptions of being burdened by excessive technology-based learning tasks. |
| 3. | Techno Complexity | Difficulties experienced by students in understanding and operating digital learning systems. |
| 4. | Techno Uncertainty | Confusion and stress caused by frequent changes in learning platforms, applications, or systems. |
| 5. | Techno Invasion | Perceived disruption of students' personal time and boundaries due to continuous technology use. |

All five dimensions are analyzed to determine their contribution to the technostress construct.

**Dependent Variable (Y): Language Learning Anxiety**

Language learning anxiety is defined as a form of situational anxiety related to learning and using a foreign language, characterized by fear of making mistakes, lack of confidence, and tension during language performance (Horwitz et al., 1986). In this study, language learning anxiety refers to the anxiety experienced by junior high school students when learning English through technology-based activities. Based on Horwitz et al. (1986) and MacIntyre and Gardner (1994), language learning anxiety is operationalized through four language skills:

1. Speaking anxiety
2. Listening anxiety
3. Reading anxiety
4. Writing anxiety

These dimensions reflect students' emotional responses during technology-mediated English learning tasks.

**Research Instrument**

The research instrument used in this study is a structured questionnaire designed to measure technostress and language learning anxiety among junior high school students. A questionnaire is considered appropriate because both variables involve psychological perceptions and emotional experiences that can be effectively captured through self-reported measures.

The questionnaire items were adapted from established instruments developed by Tarafdar et al. (2007) and Wang et al. (2020) for technostress, as well as Horwitz et al. (1986) and MacIntyre and Gardner (1994) for language learning anxiety. The wording of the items was adjusted to suit the cognitive and emotional development level of young learners.

**Technostress Instrument**

Based on the theory of Tarafdar et al. (2007), technostress consists of five main dimensions, namely techno-overload, techno-invasion, techno-complexity, techno-uncertainty, and techno-anxiety. All these dimensions are measured in this study to obtain a comprehensive picture of the technological pressure experienced by junior high school students in technology-based English learning.

1. Techno-Overload refers to a condition when students feel burdened by the many tasks or technology-based learning activities that must be completed in a limited time. In junior high school students, this condition can appear when they have to work on various online tasks simultaneously through several digital platforms.
2. Techno-Invasion refers to the feeling of disturbed personal time of students due to the use of learning technology that extends to outside school hours. In junior high school students, this dimension can be seen when technology-based learning activities reduce rest time, play, or direct interaction with the surrounding environment.
3. Techno-Complexity describes the level of difficulty students have in understanding and operating learning technology, including the complexity of menus, features, or digital instructions that require certain technical skills. In junior high school students, technological complexity can cause feelings of incapacity and dependence on the help of others.
4. Techno-Uncertainty relates to the uncertainty felt by students due to changes in the system, features, or appearance of learning applications that often occur. Such changes can make junior high school students feel confused and less confident in using technology when following English learning.
5. Techno-Anxiety refers to the feeling of fear, nervousness, or anxiety experienced by students when using learning technology. In junior high school students, this anxiety can arise due to worries about making technical mistakes, being left behind in assignments, or being unable to follow digital instructions well.

Each dimension of technostress is measured through several statement items in the questionnaire that are adapted to the experiences of junior high school students in technology-based English learning.

**Language Learning Anxiety Instrument**

The language learning anxiety instrument is used to measure the level of anxiety of junior high school students in learning English through technological media. The preparation of this instrument refers to the theory of foreign language learning anxiety from Horwitz et al. (1986) as well as MacIntyre & Gardner (1994).

The statements in the instrument reflect the fear of making mistakes, shame when using English, tension when speaking or listening to English material, and anxiety when doing English assignments using digital platforms. This instrument covers anxiety related to the four language skills, namely listening, speaking, reading, and writing.

**Validity and Reliability of the Instrument**

Instrument validity and reliability were evaluated using the PLS–PM measurement model. Convergent validity was assessed through indicator loadings and Average Variance Extracted (AVE), while reliability was evaluated using Cronbach's Alpha and Composite Reliability (Dillon–Goldstein's rho). Indicators and constructs were considered acceptable if they met the recommended thresholds in PLS analysis (Hair et al., 2021).

In addition, PLS–PM is suitable for educational research contexts involving relatively small sample sizes and data that may not strictly follow normal distribution assumptions. Since this study focuses on junior high school students and examines perceptual and emotional responses toward technology-based English learning, PLS–PM provides the flexibility required to analyze complex relationships without imposing rigid statistical assumptions. Therefore, the use of PLS–PM aligns with both the characteristics of the data and the objectives of the study.

**Data Analysis Technique**

**Partial Least Squares (PLS)**

Partial Least Squares Path Modeling (PLS–PM) is employed in this study because the main variables under investigation technostress and language learning anxiety are abstract psychological constructs that cannot be measured directly. These constructs are represented by multiple observable indicators and dimensions, such as the five dimensions of technostress and the four-language skills-based anxiety components. PLS–PM is particularly appropriate for this type of research because it allows the simultaneous examination of relationships between latent variables and their indicators within a single analytical model.

In addition, PLS–PM is suitable for educational research contexts involving relatively small sample sizes and data that may not strictly follow normal distribution assumptions. Since this study focuses on junior high school students and examines perceptual and emotional responses toward technology-based English learning, PLS–PM provides the flexibility required to analyze complex relationships without imposing rigid statistical assumptions. Therefore, the use of PLS–PM aligns with both the characteristics of the data and the objectives of the study

The PLS–PM analysis in this study is conducted through several systematic stages. First, the measurement model is evaluated to ensure that all indicators reliably and validly represent their respective constructs. This stage focuses on examining the consistency and accuracy of the questionnaire items in measuring technostress and language learning anxiety. Once the measurement model is confirmed, the structural model is analyzed to examine the direction and strength of the relationship between technostress and language learning anxiety. Through this two-stage process, PLS–PM enables a comprehensive understanding of how technological pressure contributes to students' anxiety in learning English.

1. Unidimensionality

$$\alpha = \frac{k-1}{k}\left(1 - \frac{\sigma_T^2}{\left(\sum_{\{i=1\}}^{k}\sigma_i^2\right)}\right) \;\&\; \rho_c = \frac{\left(\left(\sum_{\{i=1\}}^{k}\lambda_i\right)^2\right)}{\left(\left(\sum_{\{i=1\}}^{k}\lambda_i\right)^2 + \sum_{\{i=1\}}^{k}\left(1-\lambda_i^2\right)\right)}$$

This stage evaluated internal consistency of each block through Cronbach's α, Dillon–Goldstein's ρ, and eigenvalues. where k is the number of indicators, $\sigma i^2$ is indicator variance, and $\lambda_i$ denotes the standardized loading. A construct is deemed unidimensional when its first eigenvalue ($eig_{1st}$) is substantially greater than the second ($eig_{2nd} < 1$).

2. Outer Model

Each indicator's contribution to its latent variable was captured through outer weights ($w_i$), loadings ($\lambda_i$), communality, and redundancy:

$$\lambda_i = \mathrm{cor}(x_i, z_\eta),\ \mathrm{Community}_i = \lambda_i^2,\ \mathrm{Redundancy}_i = \lambda_i^2 x\, R_{LV}^2$$

Weights define how observed indicators combine into latent scores; communalities quantify variance explained by the construct; redundancies appear only for endogenous blocks (for exogenous, $R^2 = 0$)

3. Cross-Loadings

Discriminant validity was checked by comparing each indicator's correlation with its own construct and with others:

$$\text{CrossLoading}_{i\eta} = \text{cor}(x_i, z_\eta)$$

Ensuring that every item loads highest on its intended construct relative to other latent variables.

4. Inner Model

Structural relations were estimated via the following equation, which represents the directional association between latent constructs:

$$Y = \beta_{YX} X + \zeta,$$

Where $\beta_{XY}$ is the standardized path coefficient and $\zeta$ the residual. Significance testing employed the ratio. While the path coefficient represents the strength and direction of the relationship, it is interpreted as a structural association rather than as conclusive evidence of causality.

$$t = \frac{\beta_{XY}}{SE(\beta_{XY})} \;\&\; p = 2\left(1 - F_t(|t|)\right).$$

The algorithm internally computes the standard error and p-value without external bootstrapping.

5. Inner Summary

The model's explanatory power and convergent validity were assessed from the following metrics:

$$R^2 = 1 - \left(\frac{\sum\left(y_{obs} - y_{pred}\right)^2}{\sum(y_{obs} - y_{mean})^2}\right),$$

$$R^2_{adj} = 1 - (1 - R^2) * \frac{(n-1)}{(n-k-1)},$$

$$\text{Block Communality} = \text{AVE} = \left(\frac{1}{k}\right) \sum_{\{i=1\}}^{k} \lambda_i^2,$$

$$\text{Mean Redundancy} = \left(\frac{1}{k}\right) \sum_{\{i=1\}}^{k} (\lambda_i^2 R^2_{LV})$$

Block Communality reflects the average variance extracted (AVE) per block, while Mean Redundancy integrates indicator reliability and structural predictiveness.

6. Goodness-of-Fit (GoF)

Overall model adequacy was summarized using the index proposed by Wetzels et al. (2009):

$$GoF = \sqrt{\overline{communality} \times \overline{R^2}}$$

Where $\overline{Communality}$ is the mean AVE across constructs and $\overline{R^2}$ is the mean $R^2$ of endogenous constructs. A GoF >= 0.36 denotes a large, well-fitting PLS model. Visualization of the structural path and outer loadings was conducted with the networkx and matplotlib packages

## RESULTS AND DISCUSSION

This study employed Partial Least Squares–Path Modeling (PLS–PM) to examine the causal relationship between technostress (X) and language learning anxiety (Y) among Thai elementary school students. The analysis was conducted through two main stages: measurement model evaluation and structural model evaluation, the results of which are visually summarized in the PLS–PM model

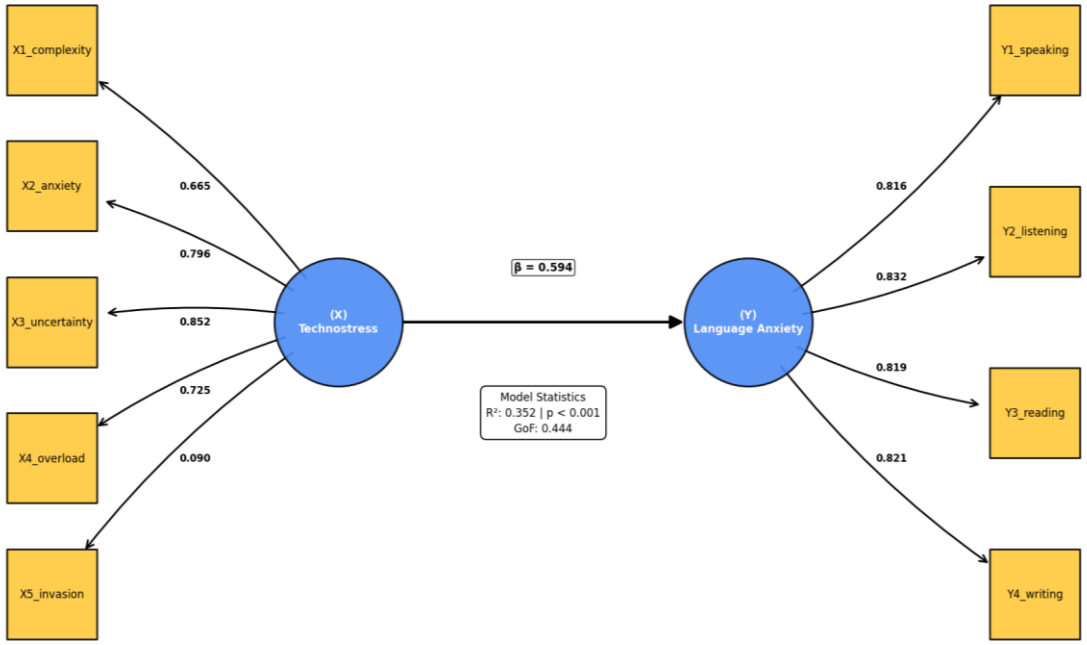


**Figure 1. PLS–PM Structural Model Technostress to Language Anxiety**

The first stage of analysis aimed to ensure the psychometric validity and reliability of the latent constructs. As presented in Table 2,

**Table 2. Unidimensionality of Latent Constructs**

| Construct | Mode | MVs | Cronbach's α | Dillon–Goldstein's ρ | 1st Eigenvalue | 2nd Eigenvalue |
|---|---|---|---|---|---|---|
| Technostress (X) | A | 5 | 0.671 | 0.794 | 2.344 | 1.070 |
| Language Anxiety (Y) | A | 4 | 0.840 | 0.893 | 2.703 | 0.531 |

Both constructs exhibited a clear single-factor structure, as the first eigenvalue was more than twice the second, confirming unidimensionality and internal coherence of indicators within each latent block. The results indicated that both constructs met acceptable criteria. The internal consistency for Technostress (X) was at the exploratory threshold with a Cronbach's α of 0.671 and a composite reliability (Dillon–Goldstein's ρ) of 0.794, exceeding the recommended threshold of 0.70 (Hair et al., 2021). Meanwhile, Language Anxiety (Y) demonstrated high internal consistency (α = 0.840; ρ = 0.893). The first-to-second eigenvalue ratio also confirmed unidimensionality, signifying that all indicators coherently measure their intended constructs. Subsequently, convergent validity was evaluated through indicator loadings and communalities. As shown in Table 3.

**Table 3. Outer Model (Loadings and Communalities)**

| Indicator | Weight | Loading | Communality | Redundancy |
|---|---|---|---|---|
| $X_1$ – Techno-Complexity | 0.306 | 0.665 | 0.442 | 0.000 |
| $X_2$ – Techno-Anxiety | 0.339 | 0.796 | 0.633 | 0.000 |
| $X_3$ – Techno-Uncertainty | 0.366 | 0.852 | 0.725 | 0.000 |
| $X_4$ – Techno-Overload | 0.298 | 0.725 | 0.526 | 0.000 |
| $X_5$ – Techno-Invasion | −0.012 | 0.090 | 0.008 | 0.000 |
| $Y_1$ – Speaking | 0.282 | 0.816 | 0.666 | 0.234 |
| $Y_2$ – Listening | 0.316 | 0.832 | 0.691 | 0.244 |
| $Y_3$ – Reading | 0.303 | 0.819 | 0.671 | 0.237 |
| $Y_4$ – Writing | 0.315 | 0.821 | 0.673 | 0.237 |

Reveals that four of the five technostress indicators ($X_1 - X_4$) possessed strong loadings ($\geq 0.66$). Techno-Uncertainty ($\lambda = 0.852$) and Techno-Anxiety ($\lambda = 0.796$) emerged as the most influential components reflecting the technostress construct. Conversely, the Techno-Invasion indicator ($X_5$, $\lambda = 0.09$) failed to load significantly, indicating that "always-on" digital pressure is not a relevant stressor for young learners. For the Language Anxiety construct, all indicators ($Y_1 - Y_4$) showed very strong loadings (> 0.80), indicating solid convergent validity. Discriminant validity, which assesses whether a construct is distinct from others, was confirmed through cross-loading analysis. As shown in Table 4

**Table 4. Cross-Loadings**

| Indicator | on X | on Y |
|---|---|---|
| $X_1$ – Techno-Complexity | 0.665 | 0.421 |
| $X_2$ – Techno-Anxiety | 0.796 | 0.467 |
| $X_3$ – Techno-Uncertainty | 0.852 | 0.503 |
| $X_4$ – Techno-Overload | 0.725 | 0.409 |
| $X_5$ – Techno-Invasion | 0.090 | −0.016 |
| $Y_1$ – Speaking | 0.452 | 0.816 |
| $Y_2$ – Listening | 0.506 | 0.832 |
| $Y_3$ – Reading | 0.485 | 0.819 |
| $Y_4$ – Writing | 0.504 | 0.821 |

Each indicator loaded more highly on its intended construct than on others, thus satisfying the Fornell–Larcker criterion. The exception was again the $X_5$ (Invasion) indicator, reinforcing the conclusion that this dimension is not meaningful in the studied population. After establishing a valid measurement model, the analysis proceeded to the structural model to test the causal link. After establishing a valid measurement model, the analysis proceeded to the structural model to test the causal link.

**Table 5. Inner Model (Path Significance)**

| Path | β | SE | t | p |
|---|---|---|---|---|
| Technostress → Language Anxiety | 0.594 | 0.106 | 5.616 | < 0.001 |

Table 5 and Figure 1 reveal a significant positive relationship between technostress and language learning anxiety. The path coefficient (β = 0.594) with a t-value of 5.616 (p < 0.001) indicates that increased levels of technostress significantly predict higher anxiety in language learning. This finding aligns with the affective-cognitive model of language learning anxiety, where heightened digital stress can amplify fear of performance and reduce attentional control (Horwitz, Horwitz, & Cope, 1986; MacIntyre & Gardner, 1994).

The overall strength of the model was evaluated using the $R^2$ and Goodness-of-Fit (GoF) indices.

**Table 6. Model Summary and Fit Indices**

| Construct | Type | $R^2$ | $R^2$ Adj | Block Communality | Mean Redundancy | AVE |
|---|---|---|---|---|---|---|
| Technostress (X) | Exogenous | 0.000 | 0.000 | 0.467 | 0.000 | 0.467 |
| Language Anxiety (Y) | Endogenous | 0.352 | 0.341 | 0.675 | 0.238 | 0.675 |
| Model GoF | – | – | – | – | – | 0.444 |

Table 6 shows that technostress explains 35.2% of the variance in language learning anxiety ($R^2$ = 0.352), which is classified as a moderate effect (Chin, 1998). The GoF value of 0.444 surpasses the threshold of 0.36 (Wetzels, Odekerken-Schröder, & van Oppen, 2009), signifying that the proposed model has a good fit to the data and substantial explanatory power.

The analysis confirms that technostress is a substantial predictor of language learning anxiety among Thai elementary students. This finding extends the application of technostress theory (Tarafdar et al., 2007) to the context of early childhood education while simultaneously reinforcing the cognitive-affective model of language anxiety.

At the dimensional level, the finding that Techno-Uncertainty (λ = 0.852) and Techno-Anxiety (λ = 0.796) are the dominant stressors is highly relevant. This suggests that rapid platform changes (e.g., switching assignments between Google Classroom, Zoom, and Duolingo) and the fear of making mistakes in digital environments are primary sources of cognitive tension. Mechanistically, uncertainty amplifies task demands and self-regulation load. Given children's still-developing metacognitive capacity, this burden can easily manifest as language anxiety, particularly in time-pressured speaking or listening tasks (MacIntyre &

Gardner, 1994). This pattern is consistent with prior research finding that digital uncertainty triggers performance-related stress (Wang et al., 2020).

Conversely, the non-significance of the Techno-Invasion dimension ($\lambda \approx 0.09$) is an intriguing finding that distinguishes this population from adolescents or adults. In older groups, "always-on" expectations (constant notifications, after-hours messaging) are significant stressors (Tarafdar et al., 2007; Ayyagari, Grover, & Purvis, 2011). However, for Thai elementary students, device access is closely supervised and learning schedules are structured. Consequently, the psychological pressure of constant connectivity is absent. This highlights the importance of a developmental boundary condition within the technostress framework: when digital boundaries are externally controlled, invasion loses its psychological salience (Chou & Chou, 2023).

Practically, these results suggest three key implications for educators: (1) minimize platform switching to reduce uncertainty, (2) provide scaffolding for oral and aural tasks through modeling and an error-friendly classroom climate to mitigate performance anxiety, and (3) train teachers to maintain simple, consistent digital routines to prevent cognitive overload. These recommendations align with literature on digital hygiene and predictable learning design (Tarafdar et al., 2007).

## CONCLUSION

This study set out to investigate the causal relationship between technostress and language learning anxiety among Thai elementary students. The results and discussion have conclusively demonstrated that a significant and positive relationship exists, as evidenced by a strong path coefficient ($\beta = 0.594$, $p < 0.001$). The findings confirm that heightened technostress, particularly driven by techno-uncertainty and techno-anxiety, is a substantial predictor of increased language anxiety. This successfully fulfills the research objective of empirically validating this link within a young learner context, thereby extending technostress theory into primary education. The primary advantage of this research lies in its practical application. By identifying techno-uncertainty and overlo ad as the dominant stressors, the study provides actionable insights for educators and curriculum designers. The findings suggest that minimizing platform switching, creating error-friendly learning environments, and maintaining consistent digital routines can effectively mitigate students' anxiety. These applications offer a direct pathway to improving the emotional well-being and learning outcomes of young students in technology-enhanced language classrooms. Despite its contributions, this study has several limitations. First, the model explains 35.2% of the variance in language anxiety, indicating that other significant factors (e.g., individual traits, teaching methods, or social pressure) remain unexplored. Second, the failure of the techno-invasion dimension to load significantly suggests that existing technostress scales may not be fully suitable for elementary-aged children and require contextual adaptation. Finally, the study was conducted within a specific cultural and educational context in Thailand, which may limit the generalizability of the findings to other populations. Based on these results and limitations, several suggestions for future research are proposed. Subsequent studies should aim to identify and integrate other predictors to build a more comprehensive model of language anxiety. A crucial next step is the development and validation of an age-appropriate technostress measurement instrument that captures stressors relevant to children, such as "difficulty

following multi-step digital instructions." Furthermore, longitudinal research is needed to track how the technostress-anxiety relationship evolves as students mature and their digital autonomy increases. Finally, experimental studies could test the efficacy of the proposed practical interventions (e.g., platform consistency) to directly measure their impact on reducing student anxiety.

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