Research Square

Preprints are preliminary reports that have not undergone peer review.
They should not be considered conclusive, used to inform clinical practice,
or referenced by the media as validated information.

Technostress, facilitating conditions, and work engagement in AI-integrated language teaching: The mediating role of psychological resilience

mei chen

mchen0203@gxufe.edu.cn

Guangxi University of Finance and Economics

Research Article

Keywords: technostress, psychological resilience, facilitating conditions, work engagement, job demands-resources model, mediation analysis

Posted Date: February 27th, 2026

DOI: https://doi.org/10.21203/rs.3.rs-8721158/v1

License: This work is licensed under a Creative Commons Attribution 4.0 International License.
Read Full License

Additional Declarations: No competing interests reported.

Abstract

Foreign language teachers in resource-constrained universities face unprecedented challenges navigating simultaneous national AI adoption mandates and institutional resource limitations. This cross-sectional study (N = 515) examines how technostress creators and facilitating conditions jointly shape work engagement through psychological resilience among multilingual educators. Drawing on the Job Demands-Resources (JD-R) theoretical framework and Conservation of Resources (COR) theory, structural equation modeling tested seven integrated hypotheses. Results revealed technostress creators negatively predicted psychological resilience ($\beta = -0.233$, $p < 0.001$) and work engagement ($\beta = -0.198$, $p < 0.001$). Facilitating conditions positively predicted resilience ($\beta = 0.329$, $p < 0.001$) and engagement ($\beta = 0.263$, $p < 0.001$). Psychological resilience significantly predicted engagement ($\beta = 0.531$, $p < 0.001$). Bootstrap analysis confirmed resilience partially mediated both technostress-engagement (indirect effect = -0.124, 95% CI [-0.175, -0.079]) and facilitating conditions-engagement relationships (indirect effect = 0.175, 95% CI [0.127, 0.231]). Findings validate integrated JD-R applicability in technology-intensive, resource-constrained educational contexts, providing evidence-based foundations for designing targeted resilience-building interventions and enhanced institutional support systems.

1. Introduction

1.1 The Digital Transformation of Higher Education and Technology-Related Stress

The integration of artificial intelligence (AI) and information and communication technologies (ICT) into higher education has accelerated substantially. Generative AI systems such as ChatGPT and Claude reshape pedagogical practices across lesson planning, assessment design, personalized feedback, and content creation [1, 2].

For foreign language educators, AI integration introduces distinctive complexities including language-specific tool limitations, concerns regarding machine translation reliability, and tensions between authentic human communication and technology-mediated instruction [3–5].

Despite technology's transformative potential, widespread ICT integration generates significant psychological strain termed technostress, characterized by perpetual connectivity pressures, information overload, rapid technological obsolescence, and skill deficit concerns [6, 7]. Meta-analytic evidence demonstrates that educators report elevated technostress levels, with substantial negative associations with job satisfaction, organizational commitment, and instructional performance [8]. Foreign language educators encounter distinctive stressors including rapid AI tool advancement creating uncertainty, inadequate training generating perceived system complexity, skill deficit anxiety, and amplified workload from managing both traditional and technology-mediated instruction simultaneously [9].

1.2 Work Engagement as a Critical Outcome in Digital Environments

The Job Demands-Resources (JD-R) model, originally proposed by Demerouti et al. [10], has evolved substantially over the past two decades and now provides a comprehensive framework for understanding work engagement. Within this framework, work engagement—comprising vigor, dedication, and absorption [11]—is viewed as a critical indicator of teacher well-being and instructional effectiveness, with job demands depleting psychological resources through a health-impairment process and job resources fostering engagement through a motivational process [12].

Psychological resilience, defined as the capacity to adapt successfully and maintain well-being under stress [13], represents a fundamental personal resource consistently predicting work engagement across occupational contexts. In AI-mediated teaching environments, psychological resilience assumes particular importance as teachers navigate continuous technological change, algorithmic uncertainty, and intensified digital workloads. Whether psychological resilience mediates relationships between technology-specific demands (technostress) and organizational resources (facilitating conditions) in predicting work engagement remains underexamined, particularly in resource-constrained contexts.

1.3 Research Context and Contextual Gaps

Despite extensive research on educator technostress, empirical investigations concentrate predominantly on K-12 contexts and Western educational systems [14, 15], with limited attention to university-level foreign language teachers in resource-constrained border regions. Such contexts—characterized by simultaneous pressures for rapid technology adoption, severe resource limitations, and strategic international cooperation responsibilities—represent critical yet understudied environments.

China-ASEAN educational cooperation provides an informative research context. Border region universities serve strategic bridging functions between domestic and international higher education systems while training multilingual professionals in less commonly taught languages. Simultaneously, these institutions confront resource constraints (uneven ICT infrastructure, limited professional development access) while managing national AI adoption mandates and international partnership obligations. This distinctive context creates competing demands on foreign language faculty: maintaining instructional quality despite resource limitations, adopting emerging technologies without adequate training or support, and sustaining work engagement amid uncertainty.

1.4 Research Objectives and Theoretical Contributions

This research addresses these gaps by examining how technostress creators and facilitating conditions jointly shape work engagement through psychological resilience among foreign language teachers in border region gateway universities. This study advances beyond prior resilience research through three contributions: (1) examining resilience as a mediating mechanism linking technology-related demands and resources to engagement, rather than as a direct predictor; (2) testing dual mediation pathways

simultaneously; and (3) validating these mechanisms in resource-constrained border region contexts where technology transformation pressures intersect with severe resource limitations.

Theoretically, this study extends JD-R theory by demonstrating whether psychological resilience—a general personal resource—operates effectively as a mediating mechanism when job demands and resources are technology-specific. Methodologically, this study employs validated general resilience measures in technology-intensive contexts. Practically, findings inform evidence-based strategies for resource-constrained institutions undertaking digital transformation.

2. Literature Review and Theoretical Framework

2.1 Literature Review

2.1.1 Work Engagement in Technology-Intensive Educational Contexts

Work engagement comprises vigor (high energy and mental resilience), dedication (strong involvement and significance), and absorption (full concentration and immersion) [11]. In educational settings, teacher engagement proves particularly consequential: engaged teachers demonstrate superior instructional quality, enhanced student outcomes, and reduced burnout risk [16].

The rapid digital transformation of higher education, however, introduces considerable challenges to sustaining engagement. For foreign language educators, AI integration creates distinctive complexities: language-specific tool limitations, concerns regarding machine translation reliability, and tensions surrounding authentic human communication preservation amid technology-mediated instruction expansion [4, 5].

2.1.2 Technostress Creators and Their Impact on Resilience and Engagement

Technostress, defined as stress experienced from ICT use, represents a substantial occupational stressor in digitally transformed educational environments [6, 7]. The construct encompasses four dimensions: techno-overload (increased workload from technology use), techno-complexity (perceived difficulty using systems), techno-insecurity (concerns about professional competence), and techno-uncertainty (ongoing technological evolution) [17]. Foreign language educators encounter distinctive stressors including rapid AI advancement, insufficient training, skill deficit anxiety, and amplified instructional workload.

Technostress and Psychological Resilience

Psychological resilience captures individuals' capacity to adapt successfully, preserve well-being, and recover from adversity [13]. Recent scholarship emphasizes resilience as a dynamic personal resource

rather than a fixed trait [18]. Within the JD-R framework, job demands such as technostress constitute factors requiring sustained effort, thereby depleting personal resources [12].

Prolonged technostress exposure diminishes psychological resilience. Teachers facing elevated work demands report substantially lower resilience profiles [19, 20]. This pattern aligns with Conservation of Resources (COR) theory's loss spiral concept, wherein initial resource depletion undermines subsequent coping capacity, further eroding resilience through escalating vicious cycles [21].

H1

Technostress creators will be negatively associated with foreign language teachers' psychological resilience.

Technostress and Work Engagement

The JD-R model's health impairment process posits that excessive job demands deplete psychological resources, producing strain and reduced work engagement [12]. Meta-analytic evidence confirms that technostress substantially predicts reduced job satisfaction and diminished organizational commitment [22]. Teachers experiencing high technostress report lower vigor, dedication, and absorption [9, 17].

H2

Technostress creators will be negatively associated with foreign language teachers' work engagement.

2.1.3 Facilitating Conditions and Their Impact on Resilience and Engagement

Facilitating conditions—organizational factors that remove obstacles and provide support for technology use—constitute critical job resources [23]. Dimensions include technology infrastructure, professional development, technical support, and decision participation [24].

Facilitating Conditions and Psychological Resilience

The JD-R model posits that job resources foster personal growth and development [12]. Organizational support networks strengthen teachers' adaptive capacity and resilience [25, 26]. This reflects COR theory's gain spiral concept, wherein initial resource investment yields returns enabling further resource acquisition in virtuous cycles [21]. Teachers perceiving adequate facilitating conditions—including reliable technological infrastructure, accessible professional development, responsive technical assistance, and meaningful decision-making participation—experience enhanced capacity to manage technology-related challenges effectively.

H3

Facilitating conditions will be positively associated with foreign language teachers' psychological resilience.

Facilitating Conditions and Work Engagement

The JD-R model's motivational process suggests that adequate job resources foster work engagement [12]. Meta-analytic evidence demonstrates that job resources represent significant predictors of work engagement [27]. Teachers perceiving adequate organizational support report higher engagement levels and lower burnout incidence [28].

H4

Facilitating conditions will be positively associated with foreign language teachers' work engagement.

2.1.4 Psychological Resilience as a Mediating Mechanism

Resilience and Work Engagement

Within the JD-R framework, psychological resilience functions as a personal resource enabling individuals to buffer job demands and activate motivational processes [12]. Personal resources represent positive self-evaluations enabling individuals to control and influence their environment successfully [29, 30]. Resilience consistently predicts work engagement across occupational contexts.

Resilient individuals maintain positive attitudes, recover rapidly from setbacks, and sustain effort despite challenges, characteristics directly enhancing engagement dimensions [30]. Research demonstrates that resilience substantially enhances work engagement among teachers, contributing substantially to engagement variance [31, 32].

H5

Psychological resilience will be positively associated with foreign language teachers' work engagement.

The Mediating Role of Resilience in the Technostress-Engagement Relationship

Contemporary JD-R theory identifies personal resources as central mediating mechanisms linking job demands to well-being outcomes [12]. This mediation operates through the health impairment process, wherein excessive job demands deplete personal resources, subsequently producing strain and reduced engagement.

COR theory's loss spiral concept suggests that technostress initiates a vicious cycle: initial exposure to technology-related demands depletes psychological resilience, which subsequently reduces capacity to manage ongoing demands, ultimately manifesting as reduced work engagement.

H6

Psychological resilience will mediate the negative relationship between technostress creators and work engagement (health impairment pathway).

The Mediating Role of Resilience in the Facilitating Conditions-Engagement Relationship

The JD-R model proposes a motivational process wherein job resources cultivate personal resources, which subsequently foster engagement [12]. COR theory's gain spiral concept suggests that facilitating conditions initiate a virtuous cycle: organizational support provides initial resources, which cultivate psychological resilience, enabling teachers to invest these resources in their work, ultimately manifesting as enhanced engagement.

Xanthopoulou et al. [30, 33] demonstrated that personal resources mediate the relationship between job resources and work engagement. Teachers perceiving adequate facilitating conditions develop enhanced capacity to manage technology-related challenges through multiple mechanisms: reliable infrastructure reduces technical obstacles, professional development enhances perceived competence, technical support provides safety nets for troubleshooting, and decision participation fosters autonomy [25].

H7

Psychological resilience will mediate the positive relationship between facilitating conditions and work engagement (motivational pathway).

2.2 Theoretical Framework

2.2.1 Theoretical Integration

This study integrates the Job Demands-Resources (JD-R) model [12] and Conservation of Resources (COR) theory [21, 34] to explain mechanisms driving teacher engagement in technology-intensive educational contexts. The JD-R model conceptualizes work environments through job demands (e.g., technostress creators) and job resources (e.g., facilitating conditions), which interact through two distinct processes: the health impairment process (where demands deplete resources producing strain) and the motivational process (where resources foster engagement) [12]. Personal resources (e.g., psychological resilience) act as mediators transforming external work conditions into internal motivational states [30].

COR theory complements this framework by clarifying resource dynamics through loss spirals (initial resource depletion produces further stress amplification through vicious cycles) and gain spirals (resource investment produces further acquisition through virtuous cycles) [21]. By synthesizing these frameworks, this study positions technostress creators as technology-specific job demands, facilitating conditions as technology-specific job resources, and psychological resilience as the personal resource mediating their effects on work engagement.

2.2.2 Hypothetical Model

Building upon the integrated theoretical framework and literature review, this study proposes a dual-process model (Fig. 1) illustrating two concurrent cycles: (1) a vicious cycle (loss spiral) where technostress creators deplete psychological resilience leading to reduced work engagement (H1, H2, H6: health impairment pathway), and (2) a virtuous cycle (gain spiral) where facilitating conditions cultivate psychological resilience leading to enhanced work engagement (H3, H4, H5, H7: motivational pathway). The model tests seven hypotheses examining direct effects (H1–H5) and indirect effects through resilience mediation (H6–H7).

[Figure 1 **should be placed here: Conceptual model showing the relationships between Technostress Creators, Facilitating Conditions, Psychological Resilience, and Work Engagement with hypothesis paths labeled]**

3. Method

3.1 Research Design and Ethical Approval

This research employs a cross-sectional survey design to examine relationships among technostress creators, facilitating conditions, psychological resilience, and work engagement among university foreign language teachers in China. Cross-sectional designs enable efficient theoretical model testing in emerging research domains [35].

Ethical review and approval were waived by the Research Ethics Committee of Guangxi University of Finance and Economics (full name: Institutional Review Board for Human Subjects Research, Guangxi University of Finance and Economics), as the anonymous questionnaire study posed no risk to participants and complied with institutional ethical guidelines and Chinese national regulations for low-risk social science research. No formal reference number was issued for the waiver. All participants provided informed consent with assurance of anonymity, voluntary participation, and the option to withdraw without consequence. The study adhered to the Declaration of Helsinki (https://www.wma.net/policies-post/wma-declaration-of-helsinki/).

3.2 Participants

A total of 600 invitations were distributed to full-time foreign language teachers across China's border region universities using stratified sampling, yielding 515 valid responses (85.8% response rate). The sample included 61.9% females and 38.1% males (M = 38.73, SD = 6.86). The majority held master's degrees or above (73.4%) and specialized in English instruction (81.0%), with the remainder teaching other languages (19.0%). Participants represented comprehensive (51.5%), teacher education (35.1%), and vocational/applied universities (13.4%). On average, teachers possessed 10.65 years of experience (SD = 6.16). Notably, 70.9% reported receiving formal training in digital teaching tools within the past two years.

3.3 Measurement Instruments

All constructs were assessed using validated instruments translated into Simplified Chinese following rigorous back-translation procedures [36]. Two bilingual educational experts independently translated English items; discrepancies were resolved through consultation with education specialists and practicing foreign language teachers. All items were rated on 5-point Likert scales (1 = strongly disagree; 5 = strongly agree). Data quality was ensured through embedded instructional manipulation checks.

3.3.1 Technostress Creators

Technostress creators were measured using a 23-item scale adapted from Ragu-Nathan et al. [6]. The scale assessed five dimensions: techno-overload (5 items, α = 0.889), techno-invasion (4 items, α = 0.874), techno-complexity (5 items, α = 0.898), techno-insecurity (5 items, α = 0.881), and techno-uncertainty (4 items, α = 0.857). All items were rated on 5-point Likert scales (1 = strongly disagree, 5 = strongly agree). Cronbach's α for the total scale was 0.938. This published scale was used as originally validated [6].

3.3.2 Facilitating Conditions

Facilitating conditions were assessed using a 4-item scale adapted from the UTAUT framework [23, 24], contextualized for technology-integrated teaching environments. All items were rated on 5-point Likert scales (1 = strongly disagree, 5 = strongly agree). Cronbach's α was 0.825. This published scale was used as originally validated [23, 24].

3.3.3 Psychological Resilience

Psychological resilience was measured using a 10-item instrument assessing capacity to recover from stress [13]. Following established contextualization procedures [37], items incorporated phrases specifying technology-related teaching challenges to enhance measurement relevance. All items were rated on 5-point Likert scales (1 = strongly disagree, 5 = strongly agree). Cronbach's α = 0.918. This adaptation followed published contextualization procedures [13, 37].

3.3.4 Work Engagement

Work engagement was measured using the Utrecht Work Engagement Scale-9 (UWES-9) [11], validated in Chinese educational contexts [38]. The scale assesses three dimensions—vigor (3 items, α = 0.882), dedication (3 items, α = 0.837), and absorption (3 items, α = 0.822)—with 3 items each. All items were rated on 5-point Likert scales (1 = strongly disagree, 5 = strongly agree). Cronbach's α for the total scale was 0.882. This published scale was used as originally validated [11, 38].

3.4 Data Collection and Data Analysis

Data collection was conducted through online survey administration, allowing anonymous responses. Informed consent was obtained from all participants, ensuring they understood the purpose, their voluntary participation, and their right to withdraw. The survey was completely anonymous; no personal

identifiers were collected. Participants were assured that their responses would not affect professional evaluations.

Data were analyzed using structural equation modeling (SEM) with IBM SPSS Statistics 27.0 and IBM AMOS 26.0. The analytical procedure followed a two-step approach. First, a measurement model tested construct validity and reliability; item parceling [39] optimized model fit for multi-dimensional constructs. Second, the structural model examined hypothesized relationships, with mediation effects evaluated using bias-corrected percentile bootstrapping (5,000 resamples).

4. Results

4.1 Descriptive Statistics and Reliability

Descriptive statistics and reliability coefficients for all study variables are presented in Table 1. The final sample consisted of 515 foreign language teachers, corresponding to an effective response rate of 85.83%. All constructs demonstrated acceptable to excellent internal consistency, with Cronbach's α values ranging from 0.825 to 0.938, exceeding the commonly recommended threshold of 0.70. Mean scores ranged from 3.465 to 3.733 on a five-point Likert scale, indicating moderate levels of technostress creators and facilitating conditions, with relatively higher levels of psychological resilience and work engagement. Composite reliability (CR = 0.765–0.918) and average variance extracted (AVE = 0.507–0.546) for all constructs also met recommended cutoffs, providing strong evidence of convergent validity at the construct level.

Table 1
Descriptive statistics and reliability coefficients

Construct	M	SD	Cronbach's α	CR	AVE
Technostress Creators (TS)	3.465	0.711	0.938	0.837	0.507
Facilitating Conditions (FC)	3.568	0.854	0.825	0.827	0.546
Psychological Resilience (PR)	3.733	0.805	0.918	0.918	0.530
Work Engagement (WE)	3.715	0.750	0.882	0.765	0.523

4.2 Measurement Model: Confirmatory Factor Analysis

Confirmatory factor analysis evaluated the measurement model. The four-factor model demonstrated excellent fit across all indices. Standardized factor loadings ranged from 0.630 to 0.803, exceeding the 0.50 threshold. Average variance extracted exceeded 0.50 for all constructs. Discriminant validity was supported: for each construct, the square root of average variance extracted exceeded correlations with other constructs.

4.3 Correlation Analysis

Table 2 displays the Pearson correlations among the study variables. Technostress creators were negatively correlated with psychological resilience ($r = -0.291$, $p < 0.001$) and work engagement ($r = -0.399$, $p < 0.001$), whereas facilitating conditions were positively correlated with resilience ($r = 0.371$, $p < 0.001$) and engagement ($r = 0.495$, $p < 0.001$). Psychological resilience showed a strong positive correlation with work engagement ($r = 0.687$, $p < 0.001$), providing preliminary support for the hypothesized mediating role of resilience between job demands/resources and engagement.

Table 2
Correlation matrix

Variable	TS	FC	PR	WE
TS	(0.712)			
FC	-0.178***	(0.739)		
PR	-0.291***	0.371***	(0.728)	
WE	-0.399***	0.495***	0.687***	(0.723)

Note. Diagonal values in parentheses represent the square root of AVE. ***p < 0.001.

4.4 Results of the Structural Model

Structural equation modeling tested hypothesized direct relationships (H1–H5). All five direct paths attained statistical significance ($p < 0.001$). Technostress creators negatively predicted psychological resilience and work engagement, supporting H1 and H2. Facilitating conditions positively predicted resilience and engagement, supporting H3 and H4. Psychological resilience demonstrated substantial direct effects on work engagement, supporting H5. The model explained approximately 25% of resilience variance and 60% of engagement variance. Figure 2 visually depicts the structural relationships and standardized path coefficients.

Note

TS = technostress creators; FC = facilitating conditions; PR = psychological resilience; WE = work engagement. Psychological resilience partially mediates relationships between technostress/facilitating conditions and work engagement. ***p < 0.001.

As shown in Table 3, all five hypothesized direct paths were statistically significant at $p < 0.001$. Technostress creators negatively predicted psychological resilience ($\beta = -0.233$, $SE = 0.063$, $t = -4.748$, $p < 0.001$) and work engagement ($\beta = -0.198$, $SE = 0.051$, $t = -4.326$, $p < 0.001$), supporting H1 and H2. Facilitating conditions positively predicted resilience ($\beta = 0.329$, $SE = 0.058$, $t = 6.460$, $p < 0.001$) and engagement ($\beta = 0.263$, $SE = 0.049$, $t = 5.406$, $p < 0.001$), supporting H3 and H4. Psychological resilience had the strongest direct effect on work engagement ($\beta = 0.531$, $SE = 0.047$, $t = 9.922$, $p < 0.001$), supporting H5 and highlighting resilience as a core personal resource driving engagement. The model

accounted for approximately 25% of the variance in resilience ($R^2 = 0.25$) and 60% of the variance in work engagement ($R^2 = 0.60$).

Table 3
Standardized path coefficients for the structural model

Path	β	SE	t	p
TS → PR	-0.233	0.063	-4.748	< 0.001
FC → PR	0.329	0.058	6.460	< 0.001
TS → WE	-0.198	0.051	-4.326	< 0.001
FC → WE	0.263	0.049	5.406	< 0.001
PR → WE	0.531	0.047	9.922	< 0.001

4.5 Mediation Analysis: Indirect Effects of Psychological Resilience

To test the mediating role of psychological resilience, a bias-corrected bootstrap procedure with 5,000 resamples was employed to estimate indirect effects and their 95% confidence intervals. As summarized in Table 4, the indirect effect of technostress creators on work engagement via resilience was significant (indirect effect = -0.124, SE = 0.024, 95% CI [-0.175, -0.079]), with the confidence interval excluding zero, thereby supporting H6. This pathway indicates that technostress undermines engagement in part by depleting teachers' psychological resilience. Similarly, the indirect effect of facilitating conditions on engagement through resilience was significant (indirect effect = 0.175, SE = 0.026, 95% CI [0.127, 0.231]), supporting H7. In both cases, psychological resilience operated as a partial mediator: the indirect effects accounted for approximately 39% of the total effect of technostress creators and 40% of the total effect of facilitating conditions on work engagement, respectively. These findings provide empirical support for concurrent health-impairment (loss spiral) and motivational (gain spiral) pathways.

Table 4
Bootstrap mediation analysis

Indirect path	Effect	SE	95% CI lower	95% CI upper
TS → PR → WE	-0.124	0.024	-0.175	-0.079
FC → PR → WE	0.175	0.026	0.127	0.231

Note. Indirect effects are based on bias-corrected 95% confidence intervals; intervals that do not include zero indicate significant mediation.

5. Discussion

This study investigated how technostress creators and facilitating conditions jointly influence work engagement through psychological resilience among foreign language teachers in border region universities. Drawing on the Job Demands-Resources model and Conservation of Resources theory, the findings validate a dual-process framework wherein technostress depletes resilience leading to reduced engagement (health impairment pathway), while facilitating conditions cultivate resilience leading to enhanced engagement (motivational pathway). Psychological resilience operated as a partial mediator explaining 40% of total effects in both pathways, supporting all seven hypotheses.

5.1 Technostress and the Depletion Pathway

The negative association between technostress creators and psychological resilience confirms that technology-related job demands progressively erode teachers' adaptive capacity [32]. This relationship reflects Conservation of Resources theory's loss spiral dynamics [21]. The direct negative effect of technostress on work engagement substantiates the JD-R model's health impairment process [12]. However, the smaller direct effect size relative to resilience's effect suggests that technostress operates primarily through resource depletion pathways.

5.2 Facilitating Conditions and the Motivational Pathway

The positive association between facilitating conditions and psychological resilience demonstrates that organizational support fosters personal growth and adaptive capacity [25, 26]. This reflects gain spiral dynamics wherein resource investment yields compounding returns [21]. The direct positive effect of facilitating conditions on work engagement aligns with empirical evidence identifying job resources as primary engagement predictors [27], operating through both direct motivational and indirect resilience cultivation pathways.

5.3 Psychological Resilience as Mediator

The substantial effect of psychological resilience on work engagement positions resilience as a central mechanism translating external work conditions into internal motivational states [12]. The partial mediation structure (40% indirect effects) indicates that contextual factors exert dual influences: symbolic signaling of organizational commitment and resource-building effects cultivating adaptive capacity. This dual-process framework extends JD-R theory with more nuanced architectures reflecting real-world organizational dynamics.

5.4 Theoretical and Practical Contributions

Theoretically, this research validates psychological resilience as a critical mediating mechanism in technology-specific JD-R models, demonstrating that general personal resources effectively mediate relationships when demands and resources are domain-specific [30, 33]. The simultaneous testing of loss and gain spirals provides empirical substantiation for COR theory's dynamic propositions [21].

Practically, findings position resilience-building interventions as high priorities, though sustainable engagement requires dual investments in cultivating teachers' adaptive capacities and enhancing

organizational support systems. Institutions should implement integrated programs addressing demand reduction (streamlining technology portfolios, establishing connectivity boundaries) and resource enhancement (infrastructure investment, culturally adapted professional development, responsive technical support).

5.5 Limitations and Future Directions

This study's contributions require interpretation within several limitations. The cross-sectional design precludes causal inferences, as reverse causation remains plausible. Common method variance poses potential bias despite acceptable statistical controls. Geographic specificity of the sample limits generalizability. The general resilience measure may not fully capture technology-specific adaptive responses. The model explained 60% of engagement variance, with 40% attributable to unmeasured factors including self-efficacy, leadership quality, and institutional culture.

Future research should employ longitudinal designs with cross-lagged panels to establish temporal precedence. Multi-site comparative studies would clarify whether mediation patterns vary across resource availability levels. Technology-specific resilience scale development and moderated mediation models examining potential moderators (cultural values, leadership styles) would advance theoretical understanding. Qualitative investigations would illuminate lived experiences complementing quantitative findings.

6. Conclusion

This study provides empirical evidence that psychological resilience operates as a critical mediating mechanism through which technostress creators and facilitating conditions influence work engagement among foreign language teachers in border region universities. Specifically, the findings confirm dual-process pathways: technostress depletes resilience leading to reduced engagement (health impairment pathway), while facilitating conditions cultivate resilience leading to enhanced engagement (motivational pathway). Psychological resilience partially mediated both relationships, explaining approximately 40% of total effects.

By validating the integrated Job Demands-Resources and Conservation of Resources framework within a technology-specific educational context characterized by resource constraints, this research advances theoretical understanding of how personal resources translate external work conditions into behavioral outcomes. It bridges individual-level (resilience depletion) and organizational-level (engagement outcomes) effects, reinforcing the urgency of designing policies and interventions that support teacher well-being during digital transformation. The findings underscore the need for dual investments: cultivating teachers' psychological resilience through targeted programs and enhancing organizational support through infrastructure improvement, culturally adapted professional development, and authentic participation in technology decision-making.

In an era where educational digitalization accelerates globally, particularly in resource-constrained regions serving strategic international cooperation functions, this study offers timely, actionable insights for educators, administrators, and policymakers. Ensuring that technology integration enhances rather than impairs teacher well-being and performance remains not merely an ethical imperative but a strategic necessity for realizing digital transformation's pedagogical potential.

Declarations

Acknowledgements

I would like to express my sincere gratitude to the anonymous reviewers for their insightful and constructive comments, which have greatly improved the clarity and quality of this article. I am also grateful to the colleagues, teachers, and students who kindly assisted in distributing the questionnaires and collecting data for this study.

Authors' contributions

The author conceived and designed the study, collected and analyzed the data, interpreted the results, and drafted and revised the manuscript. The author has read and approved the final manuscript.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Data availability

No datasets were generated or analysed during the current study.

Ethics approval and consent to participate

All subjects gave their informed consent for inclusion before they participated in the study. The study was conducted in accordance with the Declaration of Helsinki, and the protocol was approved by Institutional Review Board of Guangxi University of Finance and Economics, China.

Consent for publication

Not applicable.

Competing interests

The author declares that there are no competing interests.

References

1. Rasul T, Nair S, Kalendra D, Robin M, de Oliveira Santini F, Ladeira WJ, et al. The role of ChatGPT in higher education: Benefits, challenges, and future research directions. J Appl Learn Teach. 2023;6(1):41–56. https://doi.org/10.37074/jalt.2023.6.1.29.
2. Storey VA, Wagner A. Integrating artificial intelligence (AI) into adult education: Opportunities, challenges, and future directions. Int J Adult Educ Technol. 2024;15(1):1–15.
3. Guan L, Zhang Y, Gu MM. Pre-service teachers' preparedness for AI-integrated education: An investigation from perceptions, capabilities, and teachers' identity changes. Comput Educ Artif Intell. 2025;8:100341. https://doi.org/10.1016/j.caeai.2024.100341.
4. Kovalenko I, Baranivska N. Integrating artificial intelligence in English language teaching: Exploring the potential and challenges of AI tools in enhancing language learning outcomes and personalized education. Eur Socio-Legal Humanit Stud. 2024;1:86–95.
5. Zhang L. Benefits and challenges in implementing artificial intelligence from Chinese EFL primary school teachers' attitude and perception. GLOKALde. 2024;10(2):48–67.
6. Ragu-Nathan TS, Tarafdar M, Ragu-Nathan BS, Tu Q. The consequences of technostress for end users in organizations: Conceptual development and empirical validation. Inf Syst Res. 2008;19(4):417–33. https://doi.org/10.1287/isre.1070.0165.
7. Tarafdar M, Tu Q, Ragu-Nathan BS, Ragu-Nathan TS. The impact of technostress on role stress and productivity. J Manage Inf Syst. 2007;24(1):301–28. https://doi.org/10.2753/MIS0742-1222240109.
8. Shi H, Saharia I. Evaluating the impact of technostress on teachers' well-being and academic productivity in technology-enhanced higher education. Malays J Soc Sci Humanit. 2025;10(9):e003543.
9. Su W, Fadzil HM, Rauf RAA. Moderated mediation of technostress, TPACK, and growth mindset on competency in interdisciplinary teaching among STEM lecturers. Sci Rep. 2025;15:37633.
10. Demerouti E, Bakker AB, Nachreiner F, Schaufeli WB. The job demands-resources model of burnout. J Appl Psychol. 2001;86(3):499–512. https://doi.org/10.1037/0021-9010.86.3.499.
11. Schaufeli WB, Bakker AB, Salanova M. The measurement of work engagement with a short questionnaire: A cross-national study. Educ Psychol Meas. 2006;66(4):701–16. https://doi.org/10.1177/0013164405282471.
12. Bakker AB, Demerouti E. Job demands-resources theory: Taking stock and looking forward. J Occup Health Psychol. 2017;22(3):273–85. https://doi.org/10.1037/ocp0000056.
13. Smith BW, Dalen J, Wiggins K, Tooley E, Christopher P, Bernard J. The Brief Resilience Scale: Assessing the ability to bounce back. Int J Behav Med. 2008;15(3):194–200.

https://doi.org/10.1080/10705500802222972.

14. Lin Y, Yu Z. An integrated bibliometric analysis and systematic review modelling students' technostress in higher education. Behav Inf Technol. 2025. Advance online publication.
15. Reeves JK. Technology's impact on K-12 educators: Correlations between technostress and burnout among rural high school teachers [dissertation]. Jonesboro (AR): Arkansas State University; 2023.
16. Rich BL, Lepine JA, Crawford ER. Job engagement: Antecedents and effects on job performance. Acad Manage J. 2010;53(3):617–35. https://doi.org/10.5465/amj.2010.51468988.
17. Li Y, Wang Z. Technostress in higher education: Measurement, antecedents, and consequences. Comput Educ. 2021;163:104091. https://doi.org/10.1016/j.compedu.2020.104091.
18. Ungar M. Multisystemic resilience: Adaptation and transformation in contexts of change. Oxford: Oxford University Press; 2021.
19. Daniilidou A, Platsidou M, Stafylidis A, Stafylidis S. Resilience profiles of teachers: Associations with psychological characteristics and demographic variables. Educ Sci. 2025;15(10):1358. https://doi.org/10.3390/educsci15101358.
20. Oksa R, Saari T, Kaakinen M, Savela N, Ellonen N, Oksanen A. Professional social media usage: Work engagement perspective. New Media Soc. 2021;23(8):2303–26. https://doi.org/10.1177/1461444820921938.
21. Hobfoll SE, Halbesleben JRB, Neveu JP, Westman M. Conservation of resources in the organizational context: The reality of resources and the theory of conservation of resources. J Organ Behav. 2018;39(2):155–67. https://doi.org/10.1002/job.2285.
22. Arici F, Yildirim P, Caliklar S, Yilmaz RM. A meta-analysis of technostress in educational contexts. Educ Inf Technol. 2025;30:1–31.
23. Venkatesh V, Morris MG, Davis GB, Davis FD. User acceptance of information technology: Toward a unified view. MIS Q. 2003;27(3):425–78. https://doi.org/10.2307/30036540.
24. Venkatesh V, Thong JY, Xu X. Consumer acceptance and use of information technology: Extending the unified theory of acceptance and use of technology. MIS Q. 2012;36(1):157–78. https://doi.org/10.2307/41410412.
25. Journell L. The relationships among organizational support, teacher well-being, and teacher resilience in secondary school teachers [dissertation]. Dayton (OH): Wright State University; 2023.
26. Salvo-Garrido S, Cisternas-Salcedo P, Polanco-Levicán K. Understanding teacher resilience: Keys to well-being and performance in Chilean elementary education. Behav Sci. 2025;15(3):292.
27. Chen X, Smith D, Johnson A. Meta-analysis of job resources and work engagement. J Organ Psychol. 2024;45(2):201–25.
28. Chen M. Exploring the influencing effect of tertiary teachers' perceived organizational support and teacher self-efficacy on their job satisfaction: the mediating role of teacher work engagement. Front Psychol. 2025;16:1609824.

29. Mazzetti G, Robledo E, Vignoli M, Topa G, Guglielmi D, Schaufeli WB. Work engagement: A meta-analysis using the job demands-resources model. Psychol Rep. 2023;124(3):1069–107.
30. Xanthopoulou D, Bakker AB, Demerouti E, Schaufeli WB. The role of personal resources in the job demands-resources model. Int J Stress Manag. 2007;14(2):121–41. https://doi.org/10.1037/1072-5245.14.2.121.
31. Özdere M. The integration of artificial intelligence in English education: Opportunities and challenges. Lang Educ Technol. 2023;3(2):137–72.
32. Pöysä S, Pakarinen E, Lerkkanen MK. Patterns of teachers' occupational well-being during the first year of elementary teaching. Teach Teach Educ. 2025;136:104345.
33. Xanthopoulou D, Bakker AB, Demerouti E, Schaufeli WB. Work engagement and financial returns: A dynamic perspective on the consequences of engagement. J Organ Behav. 2009;30(1):154–71. https://doi.org/10.1002/job.584.
34. Hobfoll SE. Conservation of resources: A new attempt at conceptualizing stress. Am Psychol. 1989;44(3):513–. https://doi.org/10.1037/0003-066X.44.3.513. 24.
35. Kline RB. Principles and practice of structural equation modeling. 4th ed. New York: Guilford Press; 2016.
36. Brislin RW. Back-translation for cross-cultural research. J Cross Cult Psychol. 1970;1(3):185–216. https://doi.org/10.1177/135910457000100301.
37. Bandura A. Self-efficacy: The exercise of control. New York: W.H. Freeman; 1997.
38. Tian X, Fan J. Short-form Utrecht Work Engagement Scale in Chinese nursing context. J Adv Nurs. 2021;77(5):2455–63. https://doi.org/10.1111/jan.14774.
39. Little TD. Mean and covariance structures (MACS) analyses of cross-cultural data. Multivar Behav Res. 2002;37(1):53–76. https://doi.org/10.1207/S15327906MBR3701_02.

Figures

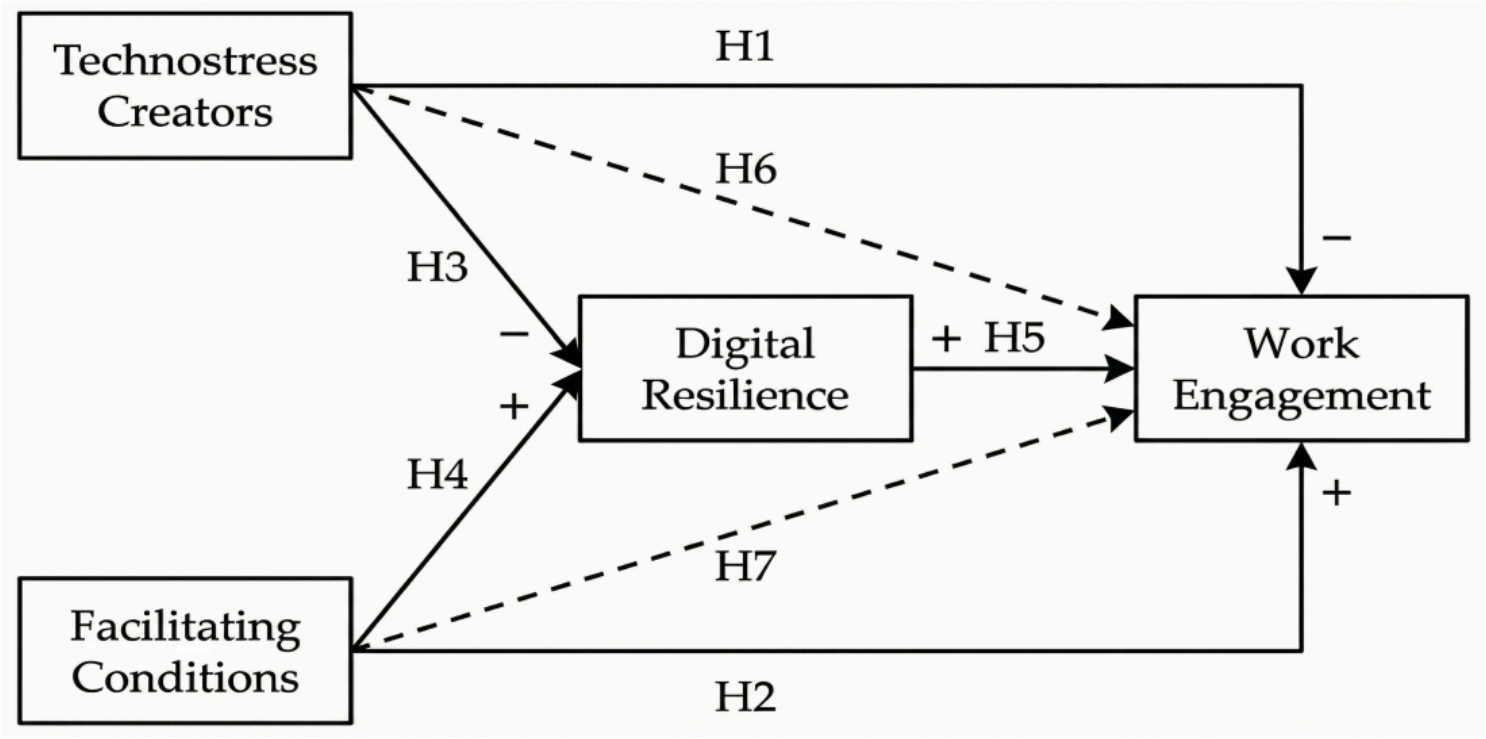


Figure 1

Conceptual model for this study.

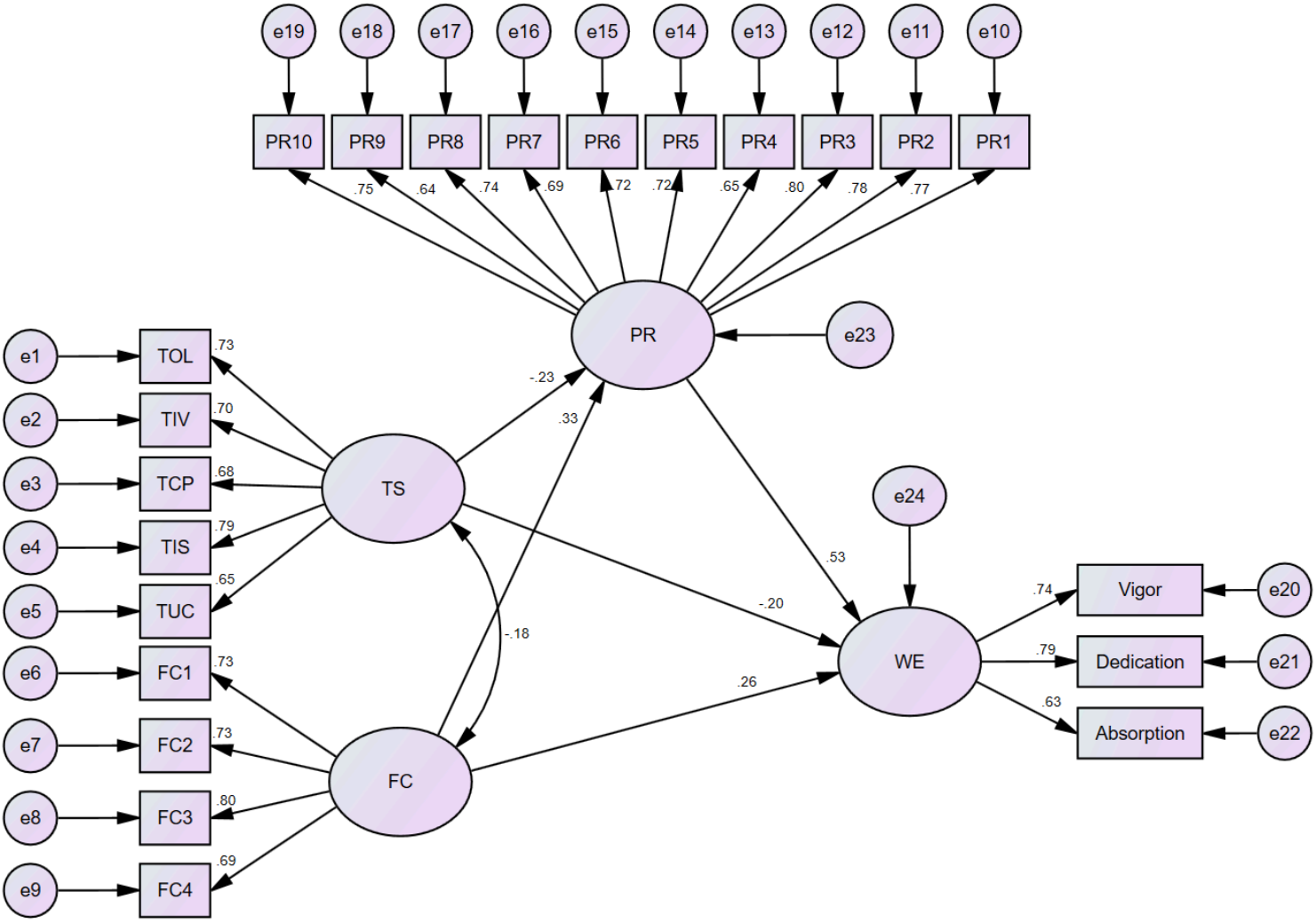


Figure 2

Structural equation model with standardized path coefficients.

Note. TS = technostress creators; FC = facilitating conditions; PR = psychological resilience; WE = work engagement. Psychological resilience partially mediates relationships between technostress/facilitating conditions and work engagement. ***p < 0.001.