

Technostress, Techno-Exhaustion, and Digital Mindfulness Among College Student

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Abstract—OnmentsThe increasing integration of digital technology into higher education has transformed learning activities and communication processes among students. While digital technologies provide numerous benefits, excessive reliance on technology may generate psychological challenges, particularly technostress and techno-exhaustion. Technostress refers to the stress experienced due to the increasing demands of technology use, whereas techno-exhaustion describes emotional, cognitive, and physical fatigue resulting from prolonged exposure to digital technologies. In this context, digital mindfulness has emerged as an important factor that may help students regulate their technology use and manage technology-related stress more effectively. Therefore, this study aims to examine the effects of technostress and digital mindfulness on techno-exhaustion among college students. This study employed a quantitative research design using a survey method. Data were collected from 104 undergraduate students through an online questionnaire. The collected data were analyzed using Structural Equation Modeling–Partial Least Squares (SEM-PLS). The results indicate that technostress has a positive and significant effect on techno-exhaustion ($\beta = 0.527$, $t = 5.812$, $p < 0.001$). Furthermore, digital mindfulness also significantly influences techno-exhaustion ($\beta = 0.686$, $t = 7.806$, $p < 0.001$). The coefficient of determination ($R^2 = 0.471$) indicates that the proposed model explains 47.1% of the variance in techno-exhaustion. The findings highlight the importance of managing technology-related stress and promoting mindful technology use among students. Higher education institutions are encouraged to develop strategies that foster digital well-being and support students in adapting to increasingly technology-dependent learning environment.

Keywords: Technostress; Digital Mindfulness; Techno-Exhaustion; College Students; SEM-PLS

1. INTRODUCTION

The rapid advancement of digital technology has significantly transformed various aspects of human life, including the educational sector. In recent years, higher education institutions have increasingly adopted digital technologies to facilitate teaching, learning, communication, and administrative activities. The integration of learning management systems, online collaboration platforms, video conferencing applications, cloud-based services, and social media has enabled students to access educational resources more efficiently and flexibly. These technological developments have become even more prominent following the widespread implementation of online and hybrid learning models. As a result, digital technology has become an indispensable component of students' academic experiences.

Despite the numerous benefits offered by digital technologies, their extensive use has also generated various psychological challenges among students. Continuous exposure to digital devices, information overload, frequent online communication, and the pressure to remain constantly connected can contribute to adverse psychological outcomes. Students are often required to manage multiple digital platforms simultaneously while coping with academic demands, deadlines, and social expectations. Such conditions may increase stress levels and negatively affect students' well-being. Consequently, researchers have become increasingly interested in understanding the psychological consequences associated with intensive technology use in educational environments.

One of the most serious consequences of prolonged technostress is techno-exhaustion. Techno-exhaustion refers to a state of physical, emotional, and cognitive fatigue resulting from excessive interaction with digital technologies. Individuals experiencing techno-exhaustion often report feelings of mental depletion, reduced concentration, lower motivation, and difficulty maintaining productivity. In educational contexts, techno-exhaustion may hinder students' learning engagement and overall academic performance. As students spend increasing amounts of time interacting with digital devices and online learning systems, the risk of experiencing techno-exhaustion becomes more pronounced.

Previous research suggests that technostress significantly contributes to the development of techno-exhaustion. Continuous exposure to technological demands can drain individuals' psychological resources, making it more difficult to cope with academic and personal responsibilities. The Conservation of Resources Theory explains that stress occurs when individuals perceive a threat to their available resources or experience resource depletion. In the context of technology use, excessive technological demands may consume cognitive and emotional resources, eventually leading to exhaustion. Therefore, examining the relationship between technostress and techno-exhaustion is essential for understanding students' experiences in technology-mediated learning environments.

While technology-related stress presents significant challenges, recent studies have identified several protective factors that may help individuals cope with digital demands more effectively. One of these factors is digital mindfulness. Digital mindfulness refers to the conscious, intentional, and balanced use of digital technologies. It involves maintaining awareness of one's digital behaviors, regulating technology use, minimizing distractions, and engaging with digital tools in a purposeful manner. Individuals who practice digital mindfulness are generally more capable of managing their interactions with technology and avoiding excessive dependence on digital devices.

The concept of digital mindfulness has gained increasing attention in the literature on digital well-being. Researchers argue that mindful technology use can help individuals maintain healthier relationships with digital technologies and reduce the negative psychological consequences associated with excessive technology use. Through increased self-awareness and self-regulation, digital mindfulness enables users to recognize unhealthy digital habits and implement strategies to improve their technology use behaviors. As a result, digital mindfulness may serve as an important psychological resource for reducing technology-related stress and fatigue.

In the context of higher education, digital mindfulness may play a crucial role in helping students navigate increasingly complex digital learning environments. Students who are mindful of their technology use may be better equipped to manage academic demands, regulate screen time, and avoid information overload. Consequently, they may experience lower levels of techno-exhaustion and maintain higher levels of psychological well-being. Given the growing importance of digital technologies in education, investigating the role of digital mindfulness in students' academic experiences is both timely and relevant.

Although previous studies have extensively examined technostress and its consequences, empirical research investigating the combined effects of technostress In the context of higher education, digital mindfulness may play a crucial role in helping students navigate increasingly complex digital learning environments. Students who are mindful of their technology use may be better equipped to manage academic demands, regulate screen time, and avoid information overload. Consequently, they may experience lower levels of techno-exhaustion and maintain higher levels of psychological well-being. Given the growing importance of digital technologies in education, investigating the role of digital mindfulness in students' academic experiences is both timely and relevant.

Although previous studies have extensively examined technostress and its consequences, empirical research investigating the combined effects of technostress ac Least Squares (SEM-PLS), this study seeks to provide empirical evidence regarding the relationships among these variables and contribute to the growing literature on digital well-being in higher education. The findings are expected to offer practical insights for educational institutions in developing strategies that promote healthier technology use and support students' psychological well-being.

Based on the literature review and research objectives, the following hypotheses are proposed:

H1: Technostress has a positive and significant effect on techno-exhaustion among college students.

H2: Digital mindfulness has a significant effect on techno-exhaustion among college students.

2. RESEARCH METHOD

This study employed a quantitative research approach using a cross-sectional survey design to examine the effects of technostress and digital mindfulness on techno-exhaustion among college students. A quantitative approach was considered appropriate because it enables researchers to investigate the relationships among variables objectively and test hypotheses through statistical analysis. The study focused on understanding how students' experiences with technology-related stress and their awareness of digital technology use influence the occurrence of techno-exhaustion in higher education settings.

2.1 Research Design

The research adopted an explanatory design aimed at examining the causal relationships among the proposed variables. The conceptual framework consisted of two independent variables, namely Technostress (X) and Digital Mindfulness (Z), and one dependent variable, namely Techno-Exhaustion (Y). The study hypothesized that Technostress and Digital Mindfulness significantly influence Techno-Exhaustion among college students.

Data were collected through a structured questionnaire and analyzed using Structural Equation Modeling–Partial Least Squares (SEM-PLS). SEM-PLS was selected because it is suitable for predictive research models, can handle relatively small sample sizes, and allows simultaneous examination of measurement and structural models.

2.2 Population and Sample

The population of this study consisted of undergraduate students enrolled in higher education institutions who actively utilized digital technologies for academic purposes. These technologies included online learning platforms, video conferencing applications, social media, cloud-based learning systems, and other digital tools used to support educational activities.

A total of 104 students participated in this study. The respondents were selected using a convenience sampling technique because the questionnaire was distributed online and participation was voluntary. This sampling method enabled researchers to obtain data efficiently from students who met the research criteria, namely active use of digital technology in learning activities.

The sample size of 104 respondents is considered adequate for SEM-PLS analysis. According to Hair et al. (2022), PLS-SEM can be effectively applied with relatively small to moderate sample sizes, provided that the model complexity remains manageable. Therefore, the number of respondents in this study satisfies the minimum requirements for conducting structural model analysis.

2.3 Research Instrument

Data were collected using a self-administered questionnaire distributed through Google Forms. The questionnaire consisted of three constructs measured using multiple indicators. All items were assessed using a five-point Likert scale ranging from 1 (Strongly Disagree) to 5 (Strongly Agree). The measurement constructs used in this study are presented in Table 1.

Table 1. Research Variables and Indicators

Variable	Code	Number of Indicators
Technostress	TC	5
Digital Mindfulness	DM	5
Techno-Exhaustion	TE	5

Technostress was measured through five indicators (TC1–TC5) representing students’ perceptions of stress associated with technology use, information overload, technological complexity, and continuous digital connectivity.

Digital Mindfulness was measured through five indicators (DM1–DM5) reflecting students’ awareness, self-regulation, intentional technology use, and ability to manage digital distractions.

Techno-Exhaustion was measured through five indicators (TE1–TE5) representing emotional fatigue, mental exhaustion, reduced concentration, and psychological strain resulting from prolonged technology use.

Prior to data analysis, all questionnaire responses were screened to ensure completeness and consistency. Incomplete responses were excluded from the dataset to maintain data quality.

2.4 Data Collection Procedure

The data collection process was conducted online to facilitate wider participation and improve accessibility for respondents. The questionnaire link was distributed through various digital communication channels commonly used by students, including messaging applications and social media platforms.

Before completing the questionnaire, respondents were informed about the purpose of the study and assured that their participation was voluntary. Confidentiality and anonymity were maintained throughout the research process. Respondents were also informed that the collected data would be used solely for academic purposes.

The data collection period was conducted over several weeks until the targeted number of respondents was achieved. A total of 104 valid responses were obtained and included in the final analysis.

2.5 Data Analysis Technique

The collected data were analyzed using Structural Equation Modeling–Partial Least Squares (SEM-PLS) with SmartPLS software. The analysis consisted of two major stages: measurement model evaluation (outer model) and structural model evaluation (inner model).

2.5.1 Measurement Model Evaluation

The outer model was assessed through validity and reliability testing. Convergent validity was evaluated using outer loading values and Average Variance Extracted (AVE). According to Hair et al. (2022), outer loading values above 0.70 indicate strong indicator reliability, although values above 0.60 remain acceptable in exploratory studies. Meanwhile, AVE values greater than 0.50 indicate that a construct explains more than half of the variance of its indicators.

Reliability testing was conducted using Cronbach’s Alpha and Composite Reliability (CR). A value above 0.70 indicates satisfactory internal consistency and reliability.

2.5.2 Structural Model Evaluation

The inner model was evaluated through the coefficient of determination (R^2) and hypothesis testing. The R^2 value indicates the proportion of variance explained by the independent variables in the dependent variable. Higher R^2 values indicate greater predictive accuracy of the model.

Hypothesis testing was performed using the bootstrapping procedure in SmartPLS. The significance of the relationships among variables was assessed using path coefficients (β), t-statistics, and p-values. Following conventional statistical criteria, hypotheses were accepted when the t-statistic exceeded 1.96 and the p-value was less than 0.05.

Through these analytical procedures, the study aimed to provide empirical evidence regarding the effects of Technostress and Digital Mindfulness on Techno-Exhaustion among college students and contribute to the understanding of digital well-being in higher education environments.

3. RESULTS AND DISCUSSION

3.1 Respondent Profile

The study involved 104 undergraduate students who actively utilized digital technologies in their academic activities. All respondents were familiar with various digital learning platforms, including learning management systems, video conferencing applications, social media, cloud-based collaboration tools, and online communication platforms. The

increasing dependence on these technologies reflects the growing digitalization of higher education and provides an appropriate context for investigating technostress, digital mindfulness, and techno-exhaustion.

The respondents represented students who regularly engaged with digital technologies for attending classes, accessing learning materials, submitting assignments, and communicating with lecturers and peers. Consequently, the sample was considered suitable for examining the psychological consequences associated with technology use in educational settings.

3.2 Measurement Model Evaluation

The measurement model (outer model) was evaluated to assess the validity and reliability of the constructs used in this study. Convergent validity was examined through outer loading values and Average Variance Extracted (AVE), while reliability was assessed using Cronbach's Alpha and Composite Reliability (CR).

3.2.1 Convergent Validity

Convergent validity refers to the extent to which indicators of a construct share a high proportion of variance. According to Hair et al. (2022), indicators are considered acceptable when their outer loading values exceed 0.70. However, values above 0.60 may still be retained in exploratory research if other validity criteria are satisfied.

The results of the outer loading analysis are presented in Table 2.

Table 2. Outer Loading Values

Indicator	Loading
DM1	0.759
DM2	0.659
DM3	0.767
DM4	0.762
DM5	0.796
TC2	0.737
TC3	0.876
TC4	0.780
TC5	0.800
TE1	0.711
TE2	0.810

The results indicate that all indicators achieved loading values above the minimum acceptable threshold of 0.60. Although DM2 obtained a loading value of 0.659, it was retained because the construct demonstrated satisfactory reliability and AVE values. Therefore, all indicators were considered valid and suitable for measuring their respective constructs. The findings suggest that the indicators effectively represent the latent variables of Technostress, Digital Mindfulness, and Techno-Exhaustion.

3.2.2 Reliability and Construct Validity

Reliability analysis was conducted using Cronbach's Alpha and Composite Reliability (CR). These measures evaluate the internal consistency of indicators within each construct.

Table 3. Reliability Test Results

Variable	Cronbach's Alpha	Composite Reliability
Technostress (X)	0.858	0.898
Techno-Exhaustion (Y)	0.822	0.865
Digital Mindfulness (Z)	0.873	0.909

The results demonstrate that all constructs exceeded the recommended threshold of 0.70 for both Cronbach's Alpha and Composite Reliability. Therefore, all constructs were considered highly reliable and internally consistent. Convergent validity was further assessed using Average Variance Extracted (AVE).

Table 4. Average Variance Extracted (AVE)

Variable	AVE
Technostress (X)	0.638
Techno-Exhaustion (Y)	0.563
Digital Mindfulness (Z)	0.667

The AVE values for all constructs exceeded the minimum requirement of 0.50. This indicates that each construct explains more than 50% of the variance in its indicators and confirms satisfactory convergent validity. Overall, the measurement model evaluation confirms that the constructs used in this study are both valid and reliable.

3.3 Structural Model Evaluation

The structural model (inner model) was evaluated to assess the explanatory power of the proposed research framework. This assessment was conducted using the coefficient of determination (R^2).

Table 5. Coefficient of Determination

Endogenous Variable	R^2	Adjusted R^2
Techno-Exhaustion	0.471	0.465

The R^2 value of 0.471 indicates that Technostress and Digital Mindfulness jointly explain 47.1% of the variance in Techno-Exhaustion. According to Hair et al. (2022), this value can be categorized as moderate explanatory power.

This finding suggests that while Technostress and Digital Mindfulness are important predictors of Techno-Exhaustion, other factors not included in this study may also contribute to students' experiences of technology-related fatigue.

3.4 Hypothesis Testing

Hypothesis testing was conducted using the bootstrapping procedure in SmartPLS. The significance of the proposed relationships was evaluated through path coefficients, t-statistics, and p-values.

Table 6. Hypothesis Testing Results

Relationship	β	T Statistics	P Values	Decision
Digital Mindfulness $\rightarrow$ Techno-Exhaustion	0.686	7.806	0.000	Supported
Technostress $\rightarrow$ Techno-Exhaustion	0.527	5.812	0.000	Supported

The results indicate that both hypotheses are supported. Digital Mindfulness significantly influences Techno-Exhaustion ($\beta = 0.686$, $t = 7.806$, $p < 0.001$), while Technostress also significantly influences Techno-Exhaustion ($\beta = 0.527$, $t = 5.812$, $p < 0.001$).

3.5 Discussion of Hypothesis 1: Effect of Technostress on Techno-Exhaustion

The findings reveal that Technostress has a positive and significant effect on Techno-Exhaustion among college students. This result indicates that students who experience higher levels of technology-related stress are more likely to experience emotional, cognitive, and psychological exhaustion associated with digital technology use.

The finding is consistent with previous studies suggesting that excessive technological demands contribute significantly to exhaustion and burnout. Students are increasingly required to interact with multiple digital platforms simultaneously, respond to continuous notifications, manage large volumes of information, and adapt to rapidly changing technological systems. These conditions create substantial psychological pressure that may eventually result in exhaustion.

The significant relationship between Technostress and Techno-Exhaustion can also be explained through the Conservation of Resources Theory. According to this theory, individuals experience stress when their psychological resources are threatened or depleted. In academic settings, continuous exposure to technological demands consumes students' cognitive and emotional resources. Over time, this resource depletion leads to fatigue, reduced concentration, and diminished academic engagement.

The findings also support previous research conducted by Tarafdar et al. (2019), who emphasized that information overload, technological complexity, and constant connectivity are major contributors to technology-related stress. Similarly, university students often face pressure to remain continuously available through digital communication channels, increasing their vulnerability to exhaustion.

Furthermore, the transition toward digital learning environments has intensified students' dependence on technology. While technology offers numerous educational benefits, excessive use may create unintended psychological consequences. Therefore, educational institutions should recognize the potential risks associated with intensive technology use and develop strategies to reduce unnecessary technological burdens on students.

3.6 Discussion of Hypothesis 2: Effect of Digital Mindfulness on Techno-Exhaustion

The results indicate that Digital Mindfulness significantly influences Techno-Exhaustion. This finding highlights the importance of conscious and intentional technology use in shaping students' experiences with digital technologies.

Digital Mindfulness refers to an individual's ability to remain aware of their digital behaviors and regulate technology use effectively. Students who demonstrate greater digital mindfulness are generally more capable of managing screen time, controlling digital distractions, and maintaining healthy boundaries between academic and personal technology use.

The significant effect identified in this study suggests that digital mindfulness plays an important role in students' interactions with digital technologies. Mindful technology users tend to be more reflective regarding their online activities and are less likely to engage in excessive digital consumption. Consequently, they may experience lower levels of psychological strain associated with prolonged technology use.

This finding aligns with mindfulness theory, which emphasizes present-moment awareness and self-regulation as mechanisms for reducing stress and promoting psychological well-being. By cultivating greater awareness of technology use patterns, students can identify unhealthy behaviors and adopt more balanced digital habits.

Previous studies have also reported that mindfulness-based practices can improve emotional regulation, reduce stress, and enhance psychological resilience. In digital contexts, these benefits may help students cope more effectively with technological demands and minimize the risk of technology-related fatigue.

The findings suggest that digital mindfulness may serve as an important personal resource for promoting digital well-being among college students. Educational institutions should therefore consider integrating digital mindfulness training into student support programs and well-being initiatives.

3.7 Theoretical Implications

This study contributes to the growing literature on digital well-being by providing empirical evidence regarding the relationships among Technostress, Digital Mindfulness, and Techno-Exhaustion. The findings support theories emphasizing the role of psychological resources in managing technology-related stress.

The study also extends previous research by focusing specifically on college students, a population that has received relatively limited attention in technostress research compared to employees and organizational settings. As digital technologies become increasingly integrated into higher education, understanding students' experiences with technology-related stress becomes essential.

Furthermore, the results highlight the relevance of mindfulness concepts within digital environments. The findings suggest that digital mindfulness represents a meaningful construct for understanding how individuals interact with technology and manage its psychological consequences.

3.8 Practical Implications

The findings offer several practical implications for higher education institutions. First, universities should recognize technostress as a significant issue affecting students' well-being. Academic policies should be designed to minimize unnecessary technological complexity and reduce information overload.

Second, institutions should promote digital well-being initiatives that encourage healthy technology use. Workshops, seminars, and awareness campaigns can help students develop effective strategies for managing digital demands.

Third, digital mindfulness training programs may be incorporated into student development activities. Such programs can improve students' awareness of technology use and support healthier digital habits.

Finally, educators should consider balancing online and offline learning activities to reduce excessive screen exposure and prevent technology-related fatigue.

3.9 Research Limitations

Despite its contributions, this study has several limitations. First, the sample size was limited to 104 respondents, which may restrict the generalizability of the findings. Second, the study utilized a cross-sectional design, preventing causal conclusions from being established. Third, the model explained 47.1% of the variance in Techno-Exhaustion, indicating that additional factors may influence students' experiences of technology-related fatigue.

Future studies are encouraged to include larger and more diverse samples, employ longitudinal research designs, and investigate additional variables such as digital well-being, academic engagement, self-efficacy, and technology acceptance.

4. CONCLUSION

This study examined the effects of Technostress and Digital Mindfulness on Techno-Exhaustion among college students in the context of increasing digital technology use in higher education. The findings provide important insights into how students experience technology-related stress and how their awareness of digital technology use influences technology-induced exhaustion. The results indicate that Technostress has a positive and significant effect on Techno-Exhaustion. This finding suggests that students who experience higher levels of technological demands, information overload, constant connectivity, and technological complexity are more likely to experience emotional, cognitive, and psychological fatigue. As digital technologies become increasingly integrated into academic activities, students face greater challenges in managing technology-related stress, which may negatively affect their well-being and academic performance. The study also found that Digital Mindfulness significantly influences Techno-Exhaustion. This result highlights the importance of conscious and intentional technology use in helping students manage the psychological consequences associated with digital engagement. Students who demonstrate greater awareness and self-regulation in their technology use are better equipped to cope with digital demands and maintain healthier interactions with technology. Consequently, Digital Mindfulness can be considered an important personal resource for promoting digital well-being among college students. This study examined the effects of Technostress and Digital Mindfulness on Techno-Exhaustion among college students in the context of increasing digital technology use in higher education. The findings provide important insights into how students experience technology-related stress and how their awareness of digital technology use influences

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