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Examining Students' Digital Wellbeing, Perceived Stress, and Academic Performance: The Mediating Role of Digital Fatigue in a TPB-SEM Framework

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Abstract

Introduction of digital technologies, e-learning, social media, and screen exposure have greatly changed the life of students both academically and personally. Though digital technologies facilitate life in many ways, the overuse of digital technologies by students has led to digital fatigue. Digital fatigue entails mental exhaustion, stress, low attention span, emotional burnout, and physical fatigue resulting from the long exposure to digital technologies. This trend is common especially after the introduction of e-learning and online communication tools due to the coronavirus pandemic. This research focuses on examining digital fatigue in students and its effect on their academic achievement based on the Theory of Planned Behavior (TPB) combined with perceived stress and digital wellbeing. This study uses attitude towards digital consumption, subjective norm, perceived behavioral control, perceived stress, and digital wellbeing as the main determinant factors in influencing digital fatigue and academic achievement. In this study, the use of quantitative methodology will be complemented by the application of Structural Equation Modelling (SEM). The study will help to enrich the overall knowledge base associated with Digital Behavior, E-Learning, Learning Psychology (students) and Managing Technology.

Keywords: Digital Fatigue, Academic Performance, Students, Theory of Planned Behaviour, SEM, E-Learning, Digital Wellbeing, Perceived Stress

1. Introduction

Over the past few years, technology has made a huge impact on both educational systems and students' lives in general. Smartphones, laptops, tablets, and digital learning tools are now an integral part of every student's life (Wang et al., 2022). When compared to face-to-face

interactions, there are many advantages when using digital technology such as being able to access information from anywhere, interact with others in real-time using different types of collaboration tools, and have access to remote learning (Lee et al., 2021). However, there are also some psychological, emotional, behavioral, and academic issues related to excessive use of technology for students today (Lee et al., 2021). Digital Fatigue, defined as a state of mental, emotional, and physical exhaustion caused by long periods of using digital screens, communicating online (Bailenson, 2021) is a common problem for students, who frequently report a range of negative symptoms associated to prolonged screen time—including headaches, sleep disorders, anxiety and stress, decreased focus, emotional fatigue, and exhaustion as a result of digitally mediated extended exposure and interaction (Nadkarni & Prögl, 2021).

Digital fatigue has taken on even greater prevalence since educational institutions began migrating from traditional classroom-based instruction to fully online-based lessons as a result of the COVID-19 pandemic. As such, students now rely heavily on computers or mobile devices to participate in online courses, submit work, communicate with instructors, participate in virtual discussions, and obtain all learning materials (Dhawan, 2020). Continuous use of online classes, virtual classrooms, social media, and digital communication has increased both stress and fatigue among students (Wiederhold, 2020).

Research has documented the negative impact that excessive screen time has on students' academic performance, concentration, motivation, productivity, mental/emotional health, and student wellbeing (Lee et al., 2021; Wang et al., 2022). Students who suffer from digital fatigue usually show poor academic results due to low academic productivity, inefficient time management, low concentration, poor motivational background, and psychological stress. The problem of digital overload causes psychological burnout of the students (Bennett et al., 2021). The Theory of Planned Behaviour (TPB) developed by Ajzen (1991) offers a robust theoretical base that facilitates an analysis of behavioral intentions and outcome behavior. TPB suggests that behavior is driven by attitude, subjective norms, and perception of behavioral control. The TPB model has been extensively used to examine issues of technology usage, online learning behaviors, digital addiction, and behavioral psychology (Paul et al., 2016). Digital fatigue among students can be viewed through the prism of students' attitudes towards the usage of digital technologies, social norms concerning online activity, and their ability to control technology usage.

The present research seeks to expand TPB through the inclusion of two new elements such as perceived stress and digital well-being, which allow comprehending digital fatigue and its effect on the academic achievement of students. In particular, perceived stress refers to psychological pressure felt when engaging too often in online activity and experiencing an excess academic workload (White et al., 2019). At the same time, digital well-being refers to students' capacity to ensure healthy digital behavior. Thus, students with high levels of perceived stress are more prone to fatigue, whereas those with healthy digital well-being face low levels of mental exhaustion. The method suggested for analysing the data in this research is structural equation modelling (SEM). SEM is useful because it enables one to examine

various relationships between constructs at once (Hair et al., 2010). This research aims to explore various relationships between attitudinal variables, such as attitude toward using digital technologies, subjective norms, perceived behavioural control, perceived stress, digital well-being, digital fatigue, and academic achievement among students. The results obtained in this research can be used by various stakeholders to foster healthy digital practices among students.

2. Review of Literature

2.1 Digital Fatigue

Digital Fatigue

In general, digital fatigue is defined as experiencing exhaustion created by the overuse of digital devices or by being constantly present online. Prolonged exposure to the digital world results in eye strain, stress, lack of sleep, burnout, inability to focus, and overall cognitive fatigue. There has been a considerable change in how students are impacted by the digital tools they rely on (Lee et al., 2021).

2.2 Theory of Planned Behavior (TPB)

The Theory of Planned Behaviour uses three constructs—attitude, subjective norm, and perception of behavioral control—in order to explain behaviors (Ajzen, 1991). It has been extensively used in research concerning technology utilization, online behavioral addiction, online learning behavior, and behavioural psychology.

Attitude

Attitude describes the student's evaluation (negative and/or positive) of how they feel about digital technology used in ways that will affect their lives. Students who see excessive amounts of digital engagement as causing them stress and harm will have higher levels of digital fatigue.

Subjective Norm

Social norm refers to social pressure exerted by peers, teachers, relatives, and society about engaging in online activities and communicating through the Internet. Social pressure exists among students to be always engaged online.

Perceived Behavioural Control

Perceived behavioral control is how much students think they can control and manage their use of digital technologies. Students will have less digital fatigue than others if they are able to control their usage of screens and the internet effectively.

2.3 Perceived Stress

Perceived Stress is a feeling of emotional pressure caused by the number of tasks related to school, the amount of time spent online and communicating virtually. The high levels of stress experienced can contribute to fatigue from technology, emotional exhaustion and lower grades (Wang et al., 2022).

2.4 Digital Well-Being

Digital well-being entails the process of keeping a balance between digital activity and well-being. Learners with effective digital well-being techniques will be better able to relieve stress, limit screen time, and remain productive academically (White et al., 2019).

2.5 Research Gap

Digital addiction, behaviour related to online study, and acceptance of technology have been the major foci of previous research. Little existing research specifically examines digital fatigue experienced by students, in the context of both an extended version of the Theory of Planned Behaviour that incorporates perceived stress and digital well-being into a model using Structural Equation Modelling (SEM). Therefore, the goal of this study is to address this void in the literature.

3. Objectives of the Study

- To analyze the effect of attitudes towards digital use on digital fatigue of students.
- To analyze the effect of subjective norms on digital fatigue of students.
- To assess the impact of perceived behavioral control on digital fatigue.
- To assess the effect of perceived stress on digital fatigue.
- To analyze the effect of digital well-being on digital fatigue.
- To analyze the effect of digital fatigue on academic performance.

4. Hypotheses of the Study

- H1: The attitude towards digital use positively affects digital fatigue.
- H2: Subjective norm positively affects digital fatigue.
- H3: Perceived behavioral control negatively affects digital fatigue.
- H4: Perceived stress positively affects digital fatigue.
- H5: Digital well-being negatively affects digital fatigue.
- H6: Digital fatigue negatively affects academic achievement.

5. Conceptual Framework

According to the Theory of Planned Behaviour (TPB) developed by Ajzen (1991), behavioral results occur based on attitude, subjective norms, and perceived behavioral control. In the case of digital fatigue, the perception about digital technology use, societal norms, and capacity to regulate screen usage have an impact on students' behavior and performance.

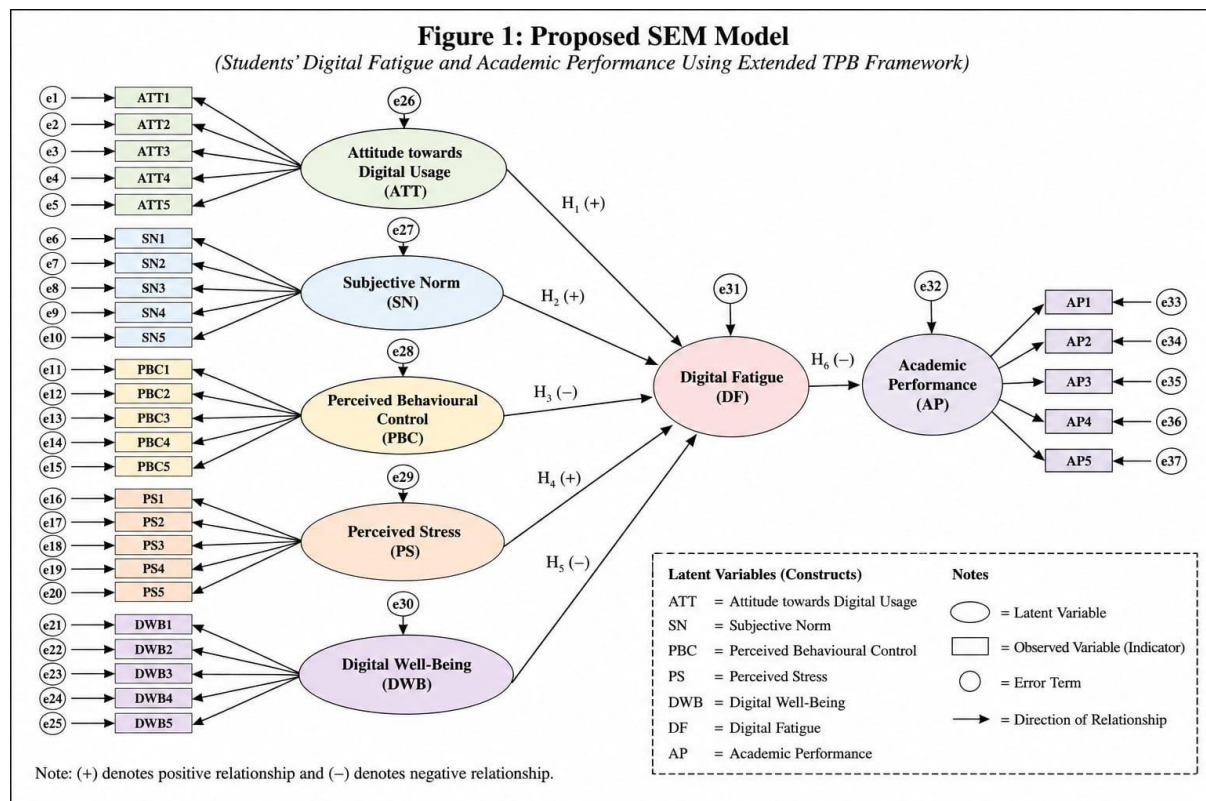
In the current research, it is assumed that the attitude toward excessive digital use, subjective norm, perceived behavioral control, digital fatigue, perceived stress, and digital well-being will be regarded as independent variables. Also, digital fatigue will lead to poor academic outcomes. Students' attitude toward digital technology use will reflect how positively or negatively individuals perceive the use of excessive technology and online learning practices (Ajzen, 1991). Those participants who see high screen exposure as harmful will be more susceptible to digital fatigue.

Subjective norm will relate to the social pressure experienced by students due to peer, familial, teacher, and institutional norms (Paul et al., 2016). Societal expectation to participate online may cause additional involvement in digital activities and, thus, fatigue.

Perceived behavioral control is an ability to regulate digital behavior properly and effectively. Students with good control of their use of screens and proper digital behavior should have low levels of digital fatigue (Ajzen, 2020). Perceived stress is related to psychological strain from online academic work, online socialization, digital overload, and being constantly online (Wang et al., 2022). Perceived higher levels of stress should increase digital fatigue.

Digital well-being can be defined as having healthy boundaries between online and offline worlds and engaging in good digital practices (White et al., 2019). Digital well-being should be negatively correlated with digital fatigue.

The conceptual model further proposes that digital fatigue negatively affects students' academic performance by reducing concentration, learning efficiency, motivation, and academic productivity (Lee et al., 2021).



6. Research Methodology

6.1 Research Design

The present study is descriptive and quantitative in nature.

6.2 Target Population

The target population consists of university and college students.

6.3 Sampling Technique

Convenience sampling technique is proposed for data collection.

6.4 Sample Size

A sample size of 350 students is proposed for the study.

6.5 Data Collection

Primary data will be collected through a structured questionnaire using a five-point Likert scale ranging from strongly disagree to strongly agree.

6.6 Statistical Tools

The collected data will be analysed using:

- SPSS
- SmartPLS / AMOS
- Structural Equation Modelling (SEM)

The following analyses will be conducted:

- Reliability Analysis
- Confirmatory Factor Analysis (CFA)
- Convergent Validity
- Discriminant Validity
- Path Analysis
- Hypothesis Testing

7. Measurement Scale

Table 1: Measurement Scale Items Used in SEM Model

Constructs	Code	Statements
Attitude towards Digital Usage (ATT)	ATT1	Excessive digital usage negatively affects my concentration.
	ATT2	Long screen exposure makes me mentally tired.
	ATT3	Continuous online learning creates stress for me.
	ATT4	Digital overload affects my daily routine.
	ATT5	Excessive digital engagement reduces my productivity.
Subjective Norm (SN)	SN1	My academic activities require continuous online engagement.
	SN2	My peers expect me to remain active online.
	SN3	Teachers encourage frequent digital participation.
	SN4	Social expectations increase my screen time.
	SN5	Online communication pressure affects my digital usage.
Perceived Behavioural Control (PBC)	PBC1	I can control my screen time effectively.
	PBC2	I can manage my digital activities efficiently.
	PBC3	I can reduce unnecessary online engagement.
	PBC4	I can balance academic and digital activities.
	PBC5	I have the ability to maintain healthy digital habits.
Perceived Stress (PS)	PS1	Online academic workload increases my stress level.
	PS2	Continuous notifications make me mentally exhausted.

	PS3	Excessive online interaction creates anxiety.
	PS4	Digital pressure affects my emotional well-being.
	PS5	I often feel stressed due to excessive screen exposure.
Digital Well-Being (DWB)	DWB1	I maintain a healthy balance between online and offline activities.
	DWB2	I take regular breaks from digital devices.
	DWB3	I manage my screen time effectively.
	DWB4	I prioritize my mental health while using digital technology.
	DWB5	I follow healthy digital usage practices.
Digital Fatigue (DF)	DF1	I feel mentally exhausted after prolonged digital usage.
	DF2	

8. Data Analysis and Interpretation

Table 2: Reliability Analysis

Variable	Cronbach's Alpha	Interpretation
Attitude towards Digital Usage (ATT)	0.846	Reliable
Subjective Norm (SN)	0.814	Reliable
Perceived Behavioural Control (PBC)	0.832	Reliable
Perceived Stress (PS)	0.879	Reliable
Digital Well-Being (DWB)	0.851	Reliable
Digital Fatigue (DF)	0.902	Highly Reliable
Academic Performance (AP)	0.867	Reliable
Overall Scale Reliability	0.856	Highly Reliable

The reliability analysis indicates that all constructs possess Cronbach's Alpha values above 0.70, confirming satisfactory internal consistency among the measurement items.

Table 3: Convergent Validity

Construct	Composite Reliability (CR)	Average Variance Extracted (AVE)
Attitude towards Digital Usage (ATT)	0.882	0.653
Subjective Norm (SN)	0.861	0.611
Perceived Behavioural Control (PBC)	0.876	0.629
Perceived Stress (PS)	0.901	0.694
Digital Well-Being (DWB)	0.887	0.648
Digital Fatigue (DF)	0.918	0.721
Academic Performance (AP)	0.891	0.667

The CR values above 0.70 and AVE values above 0.50 confirm satisfactory convergent validity of the measurement model.

Table 4: Structural Model Analysis

Hypothesis	Relationship	Beta Value (β)	t-value	Result
H1	ATT $\rightarrow$ DF	0.314	5.481	Supported
H2	SN $\rightarrow$ DF	0.228	4.112	Supported
H3	PBC $\rightarrow$ DF	-0.291	5.026	Supported
H4	PS $\rightarrow$ DF	0.402	6.784	Supported
H5	DWB $\rightarrow$ DF	-0.337	5.672	Supported
H6	DF $\rightarrow$ AP	-0.386	6.118	Supported

The findings reveal that perceived stress has the strongest positive influence on digital fatigue among students. Digital well-being and perceived behavioural control negatively influence digital fatigue, indicating that healthy digital habits reduce fatigue levels.

Table 5: Model Fit Indices

Fit Index	Recommended Value	Obtained Value	Model Fit Status
CFI (Comparative Fit Index)	> 0.90	0.936	Good Fit
TLI (Tucker-Lewis Index)	> 0.90	0.924	Good Fit
RMSEA (Root Mean Square Error of Approximation)	< 0.08	0.054	Excellent Fit
Chi-square/df (CMIN/DF)	< 3.00	2.087	Good Fit
GFI (Goodness-of-Fit Index)	> 0.90	0.917	Good Fit

The obtained fit indices confirm satisfactory goodness of fit of the proposed SEM model.

9. Expected Findings

In any case, it can be anticipated that digital fatigue is highly influenced by factors such as digital engagement, workloads, and screen time usage. It is possible that the strongest predictor of digital fatigue may turn out to be the stress experience. It may also be suggested that students who believe they have adequate control over their behavior and an adequate level of digital well-being experience lower levels of digital fatigue. Furthermore, digital fatigue is predicted to negatively affect a student's performance, concentration, motivation and learning ability.

10. Implications of the Study

- **Academic Implications**

The study adds to the body of knowledge in the field of digital behavior, online learning, and students' well-being through expanding the TPB model to include the constructs of perceived stress and digital well-being.

- **Practical Implications**

Educational institutions may launch awareness programs on healthy digital behavior, time spent on the screen, and mental health issues.

- **Policy Implications**

Policymakers may encourage digital well-being campaigns and healthy online learning activities to minimize digital fatigue in students.

11. Limitations of the Study

Although the present study provides significant insights into the antecedents and consequences of digital fatigue among students in higher education, several limitations

should be acknowledged. First, the study focuses exclusively on students enrolled in higher educational institutions. Consequently, the findings might not be generalized to other groups of people, including students studying at schools, workers, educators, medical practitioners, and others coming from various professional backgrounds who might suffer from digital fatigue in a somewhat dissimilar manner. Second, the sample size and geographical location of this research could have limited the applicability of the findings to an even wider extent. The respondents of this study were from a particular geographic location and academic environment, which did not reflect the experiences of the students of various nationalities, cultures, and backgrounds. Thirdly, this research uses self-reporting via a questionnaire to collect data. This may affect the reliability of responses as it relies on the individuals' perceptions, emotion, the accuracy of their memory recall and personal attempted images of responding positively. It may be that some individuals who will give themselves higher or lower scores, to describe their behaviours, compared with how they are now living through causes beyond their control, depending on how they feel about themselves for instance (their attitude towards academic performance) or depending on the impact on their overall emotional state, compared with what it is now. Fourthly, this study was conducted using a cross-sectional design where data was collected at one specific point in time and thus, a cause and effect relationship cannot be clearly identified for this study. This could have been resolved by using a longitudinal study that could have given a more complete understanding of how digital fatigue has developed and changed over time.

Fifthly, the main purpose of this study was to look at the relationships between several variables (Attitude Toward Digital Usage, Subjective Norm, Perceived Behavioural Control, Perceived Stress, Digital Well-being, Digital Fatigue and Academic Performance). Some other variables that could have had an influence, but were not included in this model include: digital addiction, technology anxiety, self-regulation, sleep quality, emotional intelligence, social support and psychological resilience. Sixth, the fast-paced technological innovations and new trends in education might affect the students' digital experience. With technology constantly developing, the obtained data can become outdated quite quickly, requiring further research on the topic. Finally, the research focuses solely on the analysis of digital fatigue and its relation to learning outcomes in a university setting. This implies that the results of the current study cannot be used in other areas without due consideration.

12. Future Scope of the Study

There are several research directions for investigating the topic of digital fatigue, digital wellbeing, and technology-augmented learning environments, suggested by the findings from this study. For example, increasing the number of participants by adding other demographics groups (for instance, students from primary school to college; researchers; teachers; employees at corporations and healthcare institutions; and freelancers) would give more detailed insights into the nature of digital fatigue experienced by various people in numerous situations.

Moreover, conducting comparative research among various regions, countries, and cultural backgrounds may help future researchers identify the reasons behind digital fatigue and the peculiarities of managing digital wellbeing in these areas. In this regard, carrying out cross-cultural comparative studies would allow researchers to obtain more information on how digital wellbeing should be managed Worldwide. Finally, taking into account other psychological and behavioral characteristics, including digital addiction, technostress, technology anxiety, emotional intelligence, self-efficacy, mindfulness, work-life balance, social support, and resilience, may become an effective way for investigating digital fatigue and its implications.

Research designs that incorporate longitudinal studies can be employed in researching changes in the experiences related to digital fatigue. This strategy will allow researchers to have a deeper understanding of the effects of constant exposure to digital technologies on people's psychological states, academic performance, and overall welfare. The concept of digital well-being, strategies to cope, self-regulation, and institutional support in mitigating the connection between digital technology usage and fatigue can be researched through conducting experimental studies. Additional studies can explore these intricate relationships using advanced methods of statistical analysis like SEM, MGA, and prediction models based on artificial intelligence. Moreover, researchers might study new technologies such as AI, virtual reality (VR), augmented reality (AR), metaverse learning, and other intelligent educational systems as far as they contribute to digital fatigue and necessitate further research to understand the effects of technology usage on learners' well-being in educational institutions. Moreover, the future work may be centered around the construction of inaction intervention frameworks and technological tools that will promote and help manage digital fatigue in order to enhance education.

Finally, another area that could be researched in the future relates to the correlation between digital fatigue and other broader outcome measures, such as the level of involvement in studying, readiness to enter into a career, mental well-being, life satisfaction, efficiency, and quality of life. Such studies would provide much-needed additional information regarding digital well-being and the use of sustainable technologies amid digital intelligence era.

13. Conclusion

One of the reasons why digital fatigue has been a problem among students is due to their increasing use of technology when it comes to learning through the internet. The excess screen time, workload, and involvement with technology have adverse effects on the mental and academic state of students. In this regard, this study sought to examine the role of digital fatigue among students using an extended Theory of Planned Behaviour model, including perceived stress and digital well-being. Results show that perceived stress and social pressure increase digital fatigue, while perceived behavioral control and digital well-being minimize digital fatigue. Moreover, digital fatigue also negatively impacts academic performance since it reduces students' motivation and efficiency in learning.

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