The International Journal of Technologies in Learning
ISSN: 2327-0144 (Print), ISSN: 2327-2686 (Online)
Volume 31, Issue 2, 2024
https://doi.org/10.18848/2327-0144/CGP/v31i02/83-110

Original Research

The Influence of Introversion and Extroversion Personality Traits on Student Technostress, Satisfaction, and Performance Expectancy: A Multigroup Analysis

Nurul Nadia Abd Aziz, Universiti Teknologi MARA Pahang, Malaysia
Mohd Amar Aziz, Universiti Teknologi MARA Pahang, Malaysia
Noor Amira Syazwani Abd Rahman, Universiti Teknologi MARA Pahang, Malaysia
Norazlina Mohd Yasin, Universiti Teknologi Malaysia, Malaysia
Noor Hadzlida Ayob, Universiti Pendidikan Sultan Idris, Malaysia

Received: 08/26/2023; ***Accepted:*** 01/24/2024; ***Published:*** 03/27/2024

Abstract: This study aims to examine the influence of personality traits, specifically introversion and extroversion, on the relationship between technostress, satisfaction, and performance expectancy of students. Data from 234 university students were collected and analyzed using the partial least square structural equation modeling approach. The findings reveal no significant difference between introverted and extroverted students in terms of techno-overload and techno-insecurity. However, a notable difference is observed in the context of techno-complexity, where introverted students are more affected by it compared with extroverted students. This could be attributed to introverted students who tend to face challenges alone and find it difficult to ask for help, whereas the extroverted ones are more inclined to ask for assistance when facing technological challenges. Consequently, it is recommended that instructors provide clear explanations on how to use learning technology applications before commencing lessons, aiming to alleviate techno-complexity issues among students. Despite being considered digital natives, the current generation still requires guidance on the use of learning technology. The provision of user-friendly applications is essential to ensure the effectiveness of learning technology for both personality types.

Keywords: *Introversion, Extroversion, Personality Traits, Technostress, Satisfaction, Performance Expectancy, Multigroup Analysis*

Introduction

The COVID-19 pandemic, which has affected all countries, has now surpassed three years, leading to the widespread adoption of technology in various employment sectors, including education. Since the outbreak in late 2019, most universities have shifted to online learning activities using diverse applications and technologies (Aziz and Yazid 2021; Christian, Purwanto, and Wibowo 2020). Consequently, students had to unexpectedly alter their learning patterns and adapt to the use of technology. The lack of face-to-face classes, physical distance from peers and lecturers, increased responsibility for individual assignments, and

the complexity of online learning technologies and applications have placed significant pressure on students. Failure to effectively address these challenges can result in university students experiencing technostress.

Technostress refers to a psychological state of stress linked to the use of information technology (IT), encompassing the challenges posed by IT usage that can impact an employee's effectiveness at work (Gaudioso, Turel, and Galimberti 2017). Reports indicate heightened levels of technostress among workers in rapidly growing economies, suggesting frequent and potentially excessive technology use (Tu, Wang, and Shu 2005; Suharti and Susanto 2014). Given that most university students belong to Generation Z, there are high expectations for their proficiency in online learning. However, it may go unnoticed that students might experience stress related to technology during their learning process (Aziz and Yazid 2021). Consequently, if left unaddressed, technostress could potentially influence their overall satisfaction (Hsiao 2017).

Despite the widespread adoption of digital devices in the academic world, there is a notable scarcity of studies investigating the occurrence of technostress and its impact on students' academic performance (Upadhyaya and Vrinda 2020). While most technostress-related research has focused on workers, limited attention has been given to studying students (Wang, Tan, and Li 2020). In particular, Dunn and Kennedy (2019) highlight the minimal exploration of technostress among university students, revealing a significant gap in the existing literature concerning this specific group. Firstly, research on technostress in the context of university students is still relatively limited (Upadhyaya and Vrinda 2020). Although technostress has been found to be associated with satisfaction levels (Al-Ansari and Alshare 2019), little is known about its effect on students' performance expectations. Secondly, previous research has not adequately considered the role of personality traits, such as introversion and extroversion, in moderating the relationship between student satisfaction and performance expectancy.

Personality traits are enduring attributes that shape an individual's identity. Researchers suggest that different personality traits can lead to diverse outcomes, and some traits exert a stronger impact on academic performance than others (McCabe et al. 2013). Consequently, students' confidence levels in managing technology-related stress may vary based on their individual personality traits. Previous studies have proposed that introverted students may exhibit reluctance to engage in verbal interactions, discussions, or asking questions in a traditional face-to-face classroom setting. However, they may become more expressive and participative in an online learning environment (Yasin, Ong, and Aziz 2020).

In contrast, extrovert students tend to employ fewer learning strategies; however, their engagement in a variety of stimulating activities in a traditional face-to-face classroom setting can enhance their learning effectiveness. Nevertheless, replicating such an environment in online learning becomes challenging due to limitations faced by lecturers in providing interactive and engaging activities, leading to reduced opportunities for extroverted students to interact with their peers and instructors. Consequently, this study aims to examine

potential differences in the effects of technostress on student satisfaction and performance expectancy, considering the influence of different personality traits. Specifically, we believe that student's personality traits, particularly introversion and extroversion, may significantly moderate their satisfaction with online learning and performance expectancy. Therefore, this study will investigate personality traits as possible moderators in the anticipated relationship between student satisfaction and performance expectancy.

Literature Review

Theoretical Underpinnings

This study employs the Person-Environment (P-E) fit theory (Edwards, Caplan, and Harrison 1998) and Jung's theory of personality (Jung 2014) to explore the interplay between personality traits, technostress, and performance expectancy. The P-E fit theory posits that individuals need a suitable environment to achieve life satisfaction and well-being. When there is a misfit between the person and the environment, individuals experience stress and a decline in their quality of life. Considering this, personality traits are considered as one of the factors that influence how individuals fit into a technology-based learning environment.

In this study, Jung's theory of personality, which focuses on introversion and extroversion as dominant traits, is used to explore the role of personality in technology-based remote learning. An incompatible personality in a technology-based learning environment is observed to contribute to technostress, thereby affecting students' satisfaction and performance expectations. Therefore, this study seeks to examine the effects of the personality traits of introversion and extroversion in a remote learning environment by combining the insights from the P-E fit theory and Jung's personality theory. This exploration aims to identify the impact of these personality traits on technostress and performance expectancy in the context of technology-based learning.

Technostress

Technostress, coined by Brod in 1984, is the term used to describe a condition in which individuals experience stress due to constant exposure to an overwhelming amount of information while utilizing digital devices. Stress is a fundamental aspect elucidated in the P-E fit theory, which posits that when an individual cannot effectively adapt to their environment, it leads to feelings of discomfort and heightened stress over prolonged exposure to that environment (Edwards, Caplan, and Harrison 1998). In modern times, people's daily lives are increasingly intertwined with information and communication technologies (Riva et al. 2012).

Consequently, this exposure can lead to either stress or atypical reactions, manifested through indications at the cardiocirculatory, psychological, and neurological levels (Brod 1984). Brod further posits technostress as a contemporary ailment affecting adolescents,

resulting from an inability to cope healthily with new technologies. Technostress, as described by Tarafdar, Cooper, and Stich (2019), refers to the stress individuals experience due to their use of information technologies. When faced with technostress, individuals may either try to accept or overly rely on technology. In the explanation of technostress, numerous scholars dissect it into several elements: techno-overload, techno-complexity, and techno-insecurity (Tarafdar, Tu, and Raju-Nathan 2010; Tu, Wang, and Shu 2005; Wang, Shu, and Tu 2008). These elements are believed to induce stress, leading to an uncomfortable and dissatisfying experience for individuals when using technology (Jena 2015).

Techno-overload

One category of technostress is techno-overload, which occurs when individuals feel compelled to exert more effort under the mistaken belief that technology will aid them in completing their tasks. In the context of students, Upadhyaya and Vrinda (2020) observed that technology-induced techno-overload leads students to work harder and longer hours than before. In simpler terms, techno-overload describes the feelings experienced when technology demands that individuals accomplish more challenging tasks in a shorter period. This increased workload arises from the necessity to process a surplus of information within limited time frames, forcing people to multitask and utilize technological tools to expedite their activities. Consequently, individuals may perceive that they are wasting time as they sift through vast amounts of data amid the techno-overload.

Himma (2017) highlights a significant increase in the amount of available information over the past four decades, making it challenging to limit exposure to such information. Individuals who experience technology overload may encounter various physical and psychological symptoms, including headaches, musculoskeletal anxiety, fatigue, and computer anxiety. The higher education sector has witnessed a surge in technology usage, leading students to rely on technology for all their academic assignments (Upadhyaya and Vrinda 2020). Technology has transformed their work and study patterns, enabling constant connectivity. For instance, students are continually bombarded with information through emails, phone calls, text messages, and other communication channels. This constant alertness reduces their resting time significantly.

Techno-overload can result in students multitasking and working quickly for prolonged periods (Sethi, Pereira, and Arya 2021). These demands impose an additional workload and may lead to technological interruptions even during family days or vacations. A study by Upadhyaya and Vrinda (2020) reveals a link between technostress and academic productivity. For instance, Qi (2019) found that technological stress has a comparatively lesser impact on the academic performance of male students than on female students. However, this study primarily focuses on personality traits rather than examining technostress from a gender perspective, an area that remains relatively underexplored in scholarly research.

Techno-complexity

Tarafdar, Cooper, and Stich (2019) define techno-complexity as a situation where the intricacy associated with technology leads users to feel inadequate in their abilities and compels them to invest time and effort in comprehending and recognizing the various components of technology. In the context of higher education, techno-complexity refers to students' perception of being unable to use new and complex technology due to their unfamiliarity with it (Sethi, Pereira, and Arya 2021). Technostress of this nature could adversely affect productivity. Research by D'Arcy et al. (2014) suggests that technology's intricate and disruptive nature may have detrimental effects on companies and individuals' social lives. Additionally, Tarafdar, Pullins, and Raju-Nathan (2015) found a negative correlation between productivity and techno-complexity. This negative relationship arises when users experience stress while trying to manage multiple competing responsibilities or grappling with the intricacies and complexities of their tasks (Tarafdar, Cooper, and Stich 2019).

At the university level, techno-complexity can be best understood as the situation where intricate technology systems prompt students to invest more time in studying and learning how to use new technology and enhance their technological skills. The current generation of students is commonly referred to as digital natives in the academic sphere, as they are well-versed in the latest technology and can adeptly navigate its use. As a result, students may not experience techno-complexity as technology is an integral part of their education. They have already mastered technology and incorporate it seamlessly into their daily lives, making it an inherent aspect of their existence.

Schwieger and Ladwig (2018) further highlight that the present generation has effectively developed productive learning processes, multitasking abilities, and cooperative skills, making them proficient in adapting to technological advancements (Joo, Lim, and Kim 2016). Despite being considered digital natives who readily grasp the latest applications and technologies, the current generation may still experience pressure when faced with new applications in the learning process. The adverse impacts of techno-complexity necessitate the provision of literacy facilitation to counteract its negative effects (Califf and Brooks 2020; Li and Wang 2021). To gain a different perspective on this matter, the influence of personality traits is also deemed significant in shedding light on how personality relates to aspects of techno-complexity.

Techno-insecurity

Techno-insecurity represents another form of technostress, arising from situations where technology users fear losing their positions to individuals with greater proficiency in modern technological tools (Tarafdar, Cooper, and Stich 2019). As technology continues to expand, companies tend to prioritize hiring individuals who possess effective technology skills, often favoring the younger generation due to their familiarity and high level of technical expertise. However, such preferences may lead to insecurity among employees, contributing to stress

and anxiety. As technology evolves, users must continuously acquire new skills and adapt to new systems (Ayyagari, Grover, and Purvis 2011). Some users may find themselves being apprehensive about this situation and experience stress as they fear losing their jobs, either due to the belief that technology will replace them or the concern that someone with better technology utilization abilities will replace them.

In the academic realm, techno-complexity refers to a student's perception that they lack familiarity with new and intricate technology, hindering their effective use of it (Sethi, Pereira, and Arya 2021). Presently, universities are increasingly incorporating electronic items as teaching aids with the belief that it enhances the learning environment for students and helps them improve their abilities. A key objective of universities is to prepare students for future employment, where technological competence is crucial to secure jobs (Sousa and Wilks 2018). If students cannot cope with the latest technologies, they may become dissatisfied and feel uneasy, especially when their peers demonstrate better technological skills. This comparison can exacerbate the problem, leading to feelings of inferiority. Li (2022) stated that today's graduate students entering the workforce are significantly impacted by the constant growth of technological innovation, with employers increasingly seeking technically skilled employees. If students are unprepared and unable to cope with technology, they may struggle in the future working environment. In this context, exploring the role of personality traits concerning techno-insecurity becomes intriguing as it can contribute valuable information to the body of knowledge pertaining to technostress in the learning environment.

Student Satisfaction and Performance Expectancy

According to the P-E fit theory, an uncomfortable environment that does not align with an individual's needs can lead to dissatisfaction, consequently affecting their performance and productivity (Edwards, Caplan, and Harrison 1998). From an academic and learning perspective, various factors can contribute to student dissatisfaction, and effectively addressing these factors can lead to increased student satisfaction and performance expectancy. In this context, the environment is viewed in terms of the use of technology in learning. Njoroge et al. (2012) have defined satisfaction in terms of technology, often linked to the acceptance or rejection of technology in a field. Martirosyan, Hwang, and Wanjohi (2015) found that student satisfaction positively impacts academic performance and outcomes, while Hung, Chen, and Huang (2017) discovered that it also enhances academic achievement and retention. However, Tang and Austin (2009) identified that although technology can serve as an effective teaching tool, its use in the classroom does not guarantee improved student happiness or performance. Consequently, these findings emphasize the significance of student satisfaction, calling for special attention to performance-related concerns.

According to Gopal, Singh, and Aggarwal (2021), student satisfaction is a crucial outcome of the learning process and a prerequisite for successful tertiary education.

When students are satisfied, their academic performance improves, as they are more likely to work harder and achieve higher grades. Thus, high levels of student satisfaction indicate that appropriately challenging instructional strategies are aiding students in their thinking and learning. Therefore, the assessment of student satisfaction becomes crucial in ensuring their academic success. In this study, the focus on student satisfaction and performance expectancy is examined through the lens of the technological environment, specifically considering the level of technostress experienced by students. Additionally, to gain deeper insights into technostress, the influence of personality traits is also considered, aiming to understand how personality differences may impact the suitability of the learning technology environment.

Introversion and Extroversion Personality Traits

Since the early 1990s, there has been increasing interest in the impact of personality traits on academic performance (Lestari, Sada, and Suhartono 2015). Academic performance is reflected in students' success in completing tasks, as evident from their scores. The relationship between personality traits and academic performance highlights the role of character in classroom achievement. Hence, students' personality traits should be highlighted, as they are a significant factor influencing academic achievement. From the perspective of personality traits, this study centers on two specific forms of traits, namely introversion and extroversion.

Jung (2014) posits that each individual possesses their own energy and interest tendencies. Introverts tend to direct their interests inwardly, while extroverts tend to direct their interests outwardly. This distinction is considered relevant to the student's learning environment, particularly in the context of using learning technology. Depending on the task or exam, extroverts and introverts may perform differently due to their distinct personalities (Smiderle et al. 2020). Performance variations can be observed based on the specific assignment or exam. For instance, Trendak (2015) discovered that extroverts exhibited better split attention, short-term memory, and speech production fluency. On the other hand, introverts excelled in long-term memory and problem-solving abilities.

Septianah, Susilawati, and Supardi (2019) found that students with an introverted personality, who demonstrated the ability to analyze and express knowledge through mathematical symbols, scored 90 percent in the high-performance group. Consequently, introverts may outperform extroverts in academic settings due to their higher likelihood of integrating learning abilities, being less easily distracted, and having strong study habits. In contrast, extroverts face disadvantages in higher education as evaluations often involve more formal, complex, and sophisticated tasks that require specific preparation (Yu 2021). Another systematic research supported the notion that introverts who are serious and well-organized were considered better learners (Septianah, Susilawati, and Supardi 2019). Drawing on previous research, introverts are perceived as better suited for technology-based learning due to their preference for internal learning processes.

On the other hand, extroverted students tend to enjoy dynamic events, such as role-playing, theater, debates, or activities that require them to be outspoken and talkative. They prefer participating in activities with background noise rather than sitting silently and writing. Due to their cooperative learning style, extroverts perform better in group settings compared with introverts (Petric 2022). Numerous language acquisition theories suggest that extroverts excel in language skills. They are more talkative, inclined to form teams, and eager to engage in conversations both inside and outside the classroom (Lestari, Sada, and Suhartono 2015). Therefore, the literature discussion indicates that an extroverted personality is more inclined to thrive in a social learning environment and may experience increased pressure and dissatisfaction when exposed to technology-based learning. However, there is a lack of extensive research on the role of personality in technology-based learning environments.

Hypotheses and Research Model

This section comprehensively synthesizes all the concepts of technostress, satisfaction, performance expectancy, and personality traits to develop research hypotheses and research models. While the existing literature predominantly focuses on the impact of technostress on satisfaction levels, most studies center around job and customer satisfaction. For instance, Christ-Brendemühl and Schaarschmidt (2020) found that techno-overload leads to technostress and affects customer satisfaction. Aktan and Toraman (2022) explored gender differences in technostress and teacher satisfaction levels, revealing distinct gender-related aspects of technostress and satisfaction. Similarly, Suh and Lee (2017) demonstrated that job characteristics influence the level of technostress and job satisfaction. These studies emphasize that various characteristics and demographics result in diverse effects when individuals confront technostress and strive for satisfaction.

However, due to the scarcity of research on personality traits, particularly introversion and extroversion, it is anticipated that the role of personality will also exhibit differences in technostress and satisfaction levels. For instance, Blevins, Stackhouse, and Dionne (2022) conducted research without considering the aspect of technostress and found that extroversion is generally perceived positively in the workplace, whereas introversion is often viewed more negatively. This perception is attributed to the friendly and sociable nature of extroverts, which contributes to a positive work environment, whereas introverts may feel awkward in socializing and have lower social self-esteem.

When examining this aspect in the context of students and their use of technology, especially when physical contact is not involved, it raises the question of whether introverts may feel more comfortable in such situations and, conversely, whether technostress may increase in extroverted individuals. As a result, the study formulates hypotheses to explore the differences between introversion and extroversion in terms of their effects on technostress, satisfaction, and performance expectancy among students. The study measures

three elements of technostress, namely techno-overload, techno-complexity, and techno-insecurity, which form the basis for the three proposed hypotheses.

- H1. The effect of techno-overload on student satisfaction differs significantly based on the personality traits of introversion and extroversion.
- H2. The effect of techno-complexity on student satisfaction differs significantly based on the personality traits of introversion and extroversion.
- H3. The effect of techno-insecurity on student satisfaction differs significantly based on the personality traits of introversion and extroversion.

Arising from the impact of technostress, it is discerned that varying levels of satisfaction can be engendered, and this satisfaction seems to play a role in shaping performance expectancy. The research of Christ-Brendemühl and Schaarschmidt (2020) substantiates the influence of technostress on customer satisfaction, yet it also propels us to probe whether the satisfaction born from technostress influences performance expectancy, particularly among students. This inquiry draws relevance from Felszeghy et al. (2019), whose findings illuminate the role of gamification in technology-enhanced learning; they observed that the incorporation of gaming elements can elevate satisfaction levels in the learning milieu, subsequently fostering improved performance expectations among students. Although their study illuminates the relationship between satisfaction levels and student performance, it stops short of exploring variations in personality traits.

To augment this discussion, Alamri (2019) underscores that technology-based learning, inclusive of online formats, is engaging and may be further enriched with gaming elements. Yet, a lack of student competence in utilizing technology can lead to stress, subsequently diminishing their satisfaction with the learning experience. Aligning this with Felszeghy et al. (2019) findings, it becomes evident that the impact is subject to variation, shifting from dissatisfaction due to technostress to altered performance expectations among students. Thus, the exploration into how satisfaction, as influenced by technostress, impacts performance expectancy becomes a compelling area of study, particularly when examined through the lens of differing personality traits, such as introversion and extroversion. Hence, based on the aforementioned discourse, we propose the following hypothesis:

- H4. In the context of technology-based learning, there is a significant difference in the effect of student satisfaction on performance expectancy based on their personality traits of introversion and extroversion.

Based on the literature and P-E fit theory, it is evident that the satisfaction factor plays a crucial role in balancing the learning environment and academic performance. She et al. (2021) conducted a study indicating that the level of student satisfaction significantly influences their learning performance, suggesting the need for conducive learning

environments to enhance satisfaction. Similarly, Ennen, Stark, and Lassiter (2015) found that face-to-face group learning leads to higher satisfaction compared with technology-based online group learning, possibly favoring extroverted individuals in face-to-face settings. On the other hand, Wei and Chou (2020) discovered that strong computer or internet self-efficacy positively impacts learning satisfaction and student performance. However, none of these studies considered the role of personality traits in learning satisfaction and aspects of the learning environment. Consequently, in this study, satisfaction is proposed to serve as a mediator between technostress in technology-based learning and its impact on learning performance, with a specific comparison based on introversion and extroversion personalities. Several hypotheses are thereby formulated to investigate these relationships.

- H5. The level of satisfaction acts as a mediator between techno-overload and performance expectancy, and it varies significantly based on the personality traits of introversion and extroversion.
- H6. The level of satisfaction acts as a mediator between techno-complexity and performance expectancy, and it varies significantly based on the personality traits of introversion and extroversion.
- H7. The level of satisfaction acts as a mediator between techno-insecurity and performance expectancy, and it varies significantly based on the personality traits of introversion and extroversion.

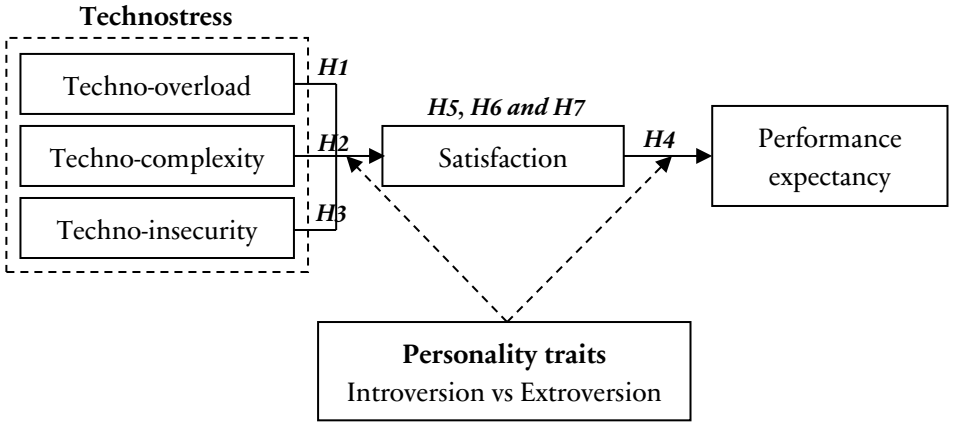


Figure 1: Research Model

Methodology

Research Design

This study adopts a quantitative cross-sectional research design to collect data. While there has been debate regarding the appropriateness of this method for studying causal relationships (e.g., Katz 2001), conducting cross-sectional data analysis with a focus on specific criteria is crucial to understand the causal effects of technostress on student satisfaction and performance expectations, considering their personality traits. Thus, the suitability of the cross-sectional design method is assessed based on the criteria proposed by Wunsch, Russo, and Mouchart (2010) and Spector (2019). Spector (2019) suggests the following criteria: (1) the study should be exploratory research, (2) uncertainty about the exact time frame, and (3) examination of natural effects on students. As these criteria are taken into account in this study, the cross-sectional study design is considered appropriate for the data collection process.

Instrument

The instrument used in this study was a questionnaire adapted from previous studies (Aziz, Aziz, and Rahman 2023; Li and Wang 2020). The questionnaire comprised fifty-nine items, measuring six variables, and included ten demographic questions. Among these items, seventeen were used to measure three dimensions of technostress—techno-overload, techno-complexity, and techno-insecurity. Additionally, seven items were used to assess student satisfaction, and another seven items measured performance expectancy. All variables were measured on a ten-point scale. In addition to these, the questionnaire included a section with personality-related questions to determine whether participants were introverts or extroverts. The participants' personality category was established using eighteen items from the McCroskey (1997) introversion scale. Individuals scoring thirty-five or lower were classified as extroverts, while those scoring thirty-six or higher were classified as introverts.

A total of 400 online questionnaires were distributed via Google Forms to Universiti Teknologi MARA (UiTM) students who were undergoing online learning. The participants were selected through systematic random sampling from the university's list to ensure equal representation. Out of the 400 questionnaires, 245 students responded, but only 234 of them were suitable for analysis. Among these, 127 students identified themselves as introverts, while 107 considered themselves extroverts. Both samples of introverts and extroverts were deemed sufficient for Partial Least Squares Structural Equation Modeling (PLS-SEM) based on the "ten-times" sampling rule of thumb (Hair et al. 2017). Furthermore, the two groups of students with different personality traits were reasonably balanced, with only a 15 percent difference in size. As a result, the data could be effectively analyzed using the Partial Least Squares Multigroup Analysis (PLS-MGA) and permutation approach.

Participants

The sample for this study comprised 234 university students, with a higher representation of female respondents (53.4%) compared with male respondents (46.6%). These students were in their hometowns during the implementation of online learning due to the Malaysian government's Movement Control Order. In terms of location, 45 percent of the students were pursuing online learning from suburban areas, 41 percent from urban areas, and 14 percent from rural areas. The three most used online learning methods were the Learning Management System (e.g., Google Classroom, U-Future, Microsoft Team), video conference applications (e.g., Hangouts, Meet, Zoom, Webex, WhatsApp video, Microsoft Team), and social media/Web 2.0 technologies (e.g., Facebook, Instagram, YouTube, Twitter, WhatsApp, Telegram).

Data Analyses and Results

The SmartPLS application was utilized as the analytical tool to conduct the PLS-SEM assessment model, including the PLS-MGA analysis. PLS-SEM is considered a comprehensive multivariate approach for analyzing complex conceptual models, capable of performing nonparametric SEM techniques and supporting multigroup analysis (Hair et al. 2017; Henseler, Ringle, and Sarstedt 2014). The analysis process consisted of two assessments: the measurement model assessment and the structural model assessment. Prior to conducting the PLS-MGA analysis, the measurement invariance in SEM was assessed to ensure that both groups of personality traits demonstrated established measurement invariance.

Assessment of the Measurement Model and Measurement Invariance

The measurement model was conducted to assess the validity and reliability of the constructs in the model. The validity of the model was evaluated based on indicator loadings, internal consistency reliability, convergent validity, and discriminant validity. This evaluation was performed for two models of personality traits: introversion and extroversion. In the analysis process, the indicator loadings were examined. It is recommended that indicator loadings should be above 0.70 to be considered acceptable. As suggested by Hair et al. (2017), loadings between 0.40 and 0.70 may be removed only if it improves internal consistency or convergent and discriminant validity beyond the threshold value. Following these criteria, eight indicators (TC5, TIS5, TIS6, TIS7, TIS2, TIS4, TIS3, and TIS8) were omitted from the models as their loadings fell below the recommended threshold, negatively impacting internal consistency and reliability. However, the remaining indicators demonstrated loadings above the recommended threshold for both the introversion and extroversion models (see Table 1).

Table 1: Indicator Loadings

Constructs	*Items*	*Indicator Loadings*	
		Introversion	*Extroversion*
Techno-overload	TO1	0.848	0.841
	TO2	0.847	0.857
	TO3	0.805	0.810
	TO4	0.895	0.888
	TO5	0.763	0.825
	TO6	0.880	0.904
	TO7	0.867	0.856
	TO8	0.846	0.766
	TO9	0.834	0.800
Techno-complexity	TC1	0.934	0.871
	TC2	0.959	0.872
	TC3	0.931	0.916
	TC4	0.849	0.900
	TC6	0.878	0.815
Techno-insecurity	TIS1	0.836	0.680
	TIS9	0.902	0.889
	TIS10	0.849	0.887
Student Satisfaction	SS1	0.932	0.910
	SS2	0.893	0.894
	SS3	0.891	0.933
	SS4	0.910	0.921
	SS5	0.909	0.946
	SS6	0.926	0.823
	SS7	0.906	0.879
Performance Expectancy	PE1	0.932	0.910
	PE2	0.893	0.894
	PE3	0.891	0.933
	PE4	0.910	0.921
	PE5	0.909	0.946
	PE6	0.926	0.823
	PE7	0.906	0.879

Next, the reliability and convergent validity of both reflective models were assessed. Composite reliability (CR) and average variance extracted (AVE) were investigated to establish these criteria. The threshold value for CR is above 0.7, and for AVE, it should be above 0.5. The PLS algorithm results showed that both the introversion and extroversion models had CR values above 0.7, and the AVE values were above 0.5 for all the constructs. This indicates that both models have established consistency reliability and convergent validity. Table 2 shows the results of the assessment of composite reliability and convergent validity for both the introversion and extroversion models.

Table 2: Internal Consistency Reliability and Convergent Validity

Constructs	*Composite Reliability (CR)*		*Average Variance Extracted*	
	Introversion	*Extroversion*	*Introversion*	*Extroversion*
Techno-overload	0.947	0.945	0.712	0.705
Techno-complexity	0.951	0.942	0.830	0.766
Techno-insecurity	0.897	0.863	0.712	0.680
Satisfaction	0.961	0.958	0.828	0.813
Performance Expectancy	0.962	0.963	0.832	0.838

The subsequent step involved examining the discriminant validity using the Heterotrait-Monotrait ratio of correlations (HTMT). Compared to the Fornell-Larcker criterion and cross-loadings method, the HTMT is considered a more robust method for evaluating discriminant validity (Hair et al. 2017; Henseler, Ringle, and Sarstedt 2014). An acceptable HTMT discriminant validity threshold is achieved when the HTMT value is below 0.90 in a liberal HTMT approach (Henseler, Ringle, and Sarstedt 2014). As shown in Table 3, all the values for both the introversion and extroversion models are below 0.90 indexes, indicating that there are no issues with discriminant validity.

Table 3: Discriminant Validity Using HTMT Ratio of Correlations

Introversion					
Constructs	*TO*	*TC*	*TIS*	*SS*	*PE*
Techno-overload					
Techno-complexity	0.674				
Techno-insecurity	0.868	0.867			
Student Satisfaction	0.573	0.707	0.682		
Performance Expectancy	0.548	0.694	0.625	0.875	
Extroversion					
Constructs	*TO*	*TC*	*TIS*	*SS*	*PE*
Techno-overload					
Techno-complexity	0.715				
Techno-insecurity	0.763	0.759			
Student Satisfaction	0.581	0.479	0.617		
Performance Expectancy	0.525	0.457	0.502	0.891	

Before conducting PLS-MGA and permutation to compare the path coefficients between introvert and extrovert personality traits related to technostress and student performance expectancy, it is crucial to establish the acceptability of measurement invariance (Hair et al. 2017; Henseler, Ringle, and Sarstedt 2016). In PLS-SEM, measurement invariance is calculated based on the composite model algorithm. Thus, the study used the Measurement Invariance of Composites (MICOM) method for PLS-SEM (Hair et al. 2017; Henseler, Ringle, and Sarstedt 2016).

Table 4: Result of Measurement Invariance of Composites (MICOM)

MICOM Step 1				
Configural invariance established? Yes				
MICOM Step 2				
Composite	Correlation c	5% quantile of empirical distribution of c_u	p value	Comp. invariance established?
Techno-overload	0.999	0.998	.412	Yes
Techno-complexity	1.000	0.999	.575	Yes
Techno-insecurity	0.992	0.992	.055	Yes
Student Satisfaction	1.000	1.000	.207	Yes
Performance Expectancy	1.000	1.000	.617	Yes
MICOM Step 3				
Composite	Composite's mean value	95% confidence interval	p value	Equal mean values?
Techno-overload	−0.123	[−0.001; 0.255]	.354	Yes
Techno-complexity	−0.210	[−0.252; 0.259]	.108	Yes
Techno-insecurity	0.029	[−0.251; 0.255]	.826	Yes
Student Satisfaction	0.156	[−0.255; 0.261]	.237	Yes
Performance Expectancy	0.111	[−0.256; 0.260]	.403	Yes
Composite	Composite's variances ratio	95% confidence interval	p value	Equal variances?
Techno-overload	0.224	[−0.319; 0.315]	.173	Yes
Techno-complexity	0.282	[−0.329; 0.343]	.108	Yes
Techno-insecurity	−0.062	[−0.293; 0.301]	.684	Yes
Student Satisfaction	−0.062	[−0.320; 0.334]	.718	Yes
Performance Expectancy	−0.033	[−0.304; 0.308]	.829	Yes

The MICOM process involves three steps. The first step is the assessment of configural invariance, which ensures that the measurement model employs the same indicators, data treatment, and algorithm settings across the groups. This study successfully established configural invariance for this step. In steps 2 and 3, 5,000 permutations were used to assess compositional invariance and the equality of composite mean values and variances. To establish compositional invariance in step 2 of MICOM, the null hypothesis of c equal to 1 should not be rejected. Therefore, a p value larger than.05 is needed to accept the null hypothesis and establish compositional invariance. In this study, all the p values were above.05, indicating that compositional invariance is established (Hair et al. 2017). Table 4 shows the result of MICOM.

After confirming measurement invariance in step 2, the assessment proceeded to step 3, which involved evaluating the equality of composites' mean values and variances between the groups. This step aimed to determine whether there are any significant differences in mean values and variances across the groups. Full measurement invariance is achieved when no significant differences are found in mean values and variances between the groups (Hair et al. 2017). In this study, step 3 of MICOM did not reject the null hypothesis of the means and variances being equal to 0, indicating that full measurement invariance had been successfully established.

Assessment of the Structural Model and Multigroup Analysis

After conducting the measurement model assessment and establishing the MICOM, the second stage involved evaluating the structural models for the introversion and extroversion personality traits. Regarding *H1*, which tested the relationship between techno-overload and student satisfaction, no significant difference was found between introverts and extroverts in the PLS-MGA test ($\beta = 0.158$, $p > .05$), leading to the rejection of *H1*. However, for extroverts, techno-overload was found to have a significant and negative impact on student satisfaction, although the coefficient differences between both groups were not significant.

For H2, which examined the relationship between techno-complexity and student satisfaction, the results indicated significant differences between introverts and extroverts ($\beta = -0.452$, $p < .05$). Therefore, H2 is supported. Specifically, students with introverted personality traits were found to have a negative effect of techno-complexity on satisfaction. High techno-complexity significantly reduced student satisfaction for introverts compared with extroverts.

Regarding H3, which explored the relationship between techno-insecurity and student satisfaction, no significant difference was observed between both personality traits ($\beta = 0.210$, $p > .05$), leading to the rejection of the hypothesis. Similarly, H4, which compared student satisfaction and performance expectancy between both personality traits ($\beta = -0.118$, $p > .05$), indicated no significant difference and H4 is rejected.

Hypotheses 5, 6, and 7 were tested to determine the indirect effect for both introversion and extroversion personality trait models. The results showed that there were no significant differences between introverts and extroverts regarding the impact of techno-overload and techno-insecurity on performance expectancy via student satisfaction ($\beta = 0.182$, $p > .05$ and $\beta = 0.196$, $p > .05$). Consequently, H5 and H7 were rejected. However, there was a significant difference between introverts and extroverts in terms of the effect of techno-complexity on performance expectancy via student satisfaction ($\beta = -0.330$, $p < .05$), supporting H6.

Table 5: Result of Hypothesis Testing

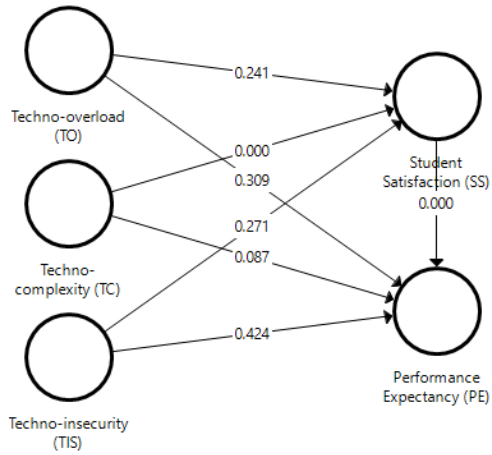
Hypo.	*Path*	*Path Coeff. (Intro)*	*Path Coeff. (Extro)*	*Path Coeff. Diff.*	*p Value MGA*	*Supp.?*
H1	TO → SS	−0.142	−0.299*	0.158	0.382	No
H2	TC → SS	−0.480*	−0.028	−0.452	0.004*	Yes
H3	TIS → SS	−0.140	−0.350*	0.210	0.252	No
H4	SS → PE	0.737*	0.855*	−0.118	0.245	No
H5	TO → SS → PE	−0.104	−0.256*	0.152	0.339	No
H6	TC → SS → PE	−0.354*	−0.024	−0.330	0.022*	Yes
H7	TIS → SS → PE	−0.103	−0.299*	0.196	0.201	No

Note(s): *$p < .05$

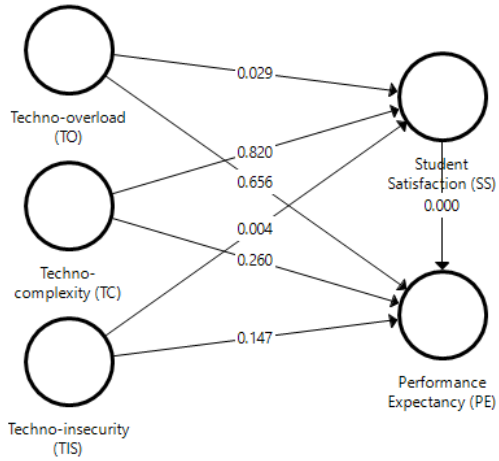
Specifically, techno-complexity affected introverts, influencing their satisfaction, and consequently affecting their performance expectancy. To address the issue of techno-complexity, it is recommended that software developers create user-friendly and easy-to-use learning applications.

Complex and difficult-to-access technology can adversely affect student satisfaction and performance, even though such technology might be advantageous in other ways. Figure 2 illustrates the results of the technostress personality traits models for introversion and extroversion.

Although techno-complexity has a greater impact on introverts compared with extroverts, based on the coefficient of determination (R^2), technostress variables were found to have a slightly stronger effect on performance expectancy for extroverted personalities (R^2 = 0.747) compared with introverted personalities (R^2 = 0.736). In terms of student satisfaction, technostress was found to have a greater impact on introverts (R^2 = 0.492) compared with extroverts (R^2 = 0.382). This finding may indicate that introverted personality students prefer to work alone, rather than socialize with others. Complicated technology causes more stress for introverted individuals and reduces their satisfaction compared with extroverted personalities.



Introversion



Extroversion

Figure 2: Technostress Models for Introversion and Extroversion Personality Traits

Discussion

According to the results, there is a significant and negative relationship between techno-overload and student satisfaction among extroverts, but this relationship is not significant among introverts. This suggests that extroverts experience higher levels of stress due to techno-overload, leading to a reduction in their satisfaction compared with introverts. However, when comparing the path coefficient values of introverts and extroverts, the difference is only marginal and does not show a significant distinction. One possible reason for this finding is that millennial students are well-acquainted with social and information technology, which has become essential for their academic success, communication structures, social relationships, and overall life satisfaction (Spiess et al. 2021). Although extroverts may experience more stress due to technological overload, which affects their level of satisfaction (Zeichner 2019), the overall comparison between introverts and extroverts on a broader scale does not reveal a significant difference. Both groups still encounter stress from various forms of technology, resulting in negative path coefficients for both personality types.

Regarding techno-complexity and student satisfaction, introverts appear to be more affected by techno-complexity, as indicated by a negative and statistically significant path coefficient value ($\beta = -0.480$, $p < .05$). In contrast, the value of the path coefficient for extroverts is small and not statistically significant ($\beta = -0.028$, $p > .05$). This demonstrates that introverts are more stressed by the complexity of technology when they attempt to comprehend it on their own. Extroverts, on the other hand, find it easier to ask others for assistance in using complex technology, thereby reducing their technological stress (Yasin, Ong, and Aziz 2020; Kader et al. 2022). A comparison of the value of the path coefficient between introverts and extroverts for the relationship between techno-complexity and student satisfaction reveals a clear distinction between the two personalities. Thus, to ensure that introverted students can successfully engage in the learning process, the application or learning software utilized must be intuitive and simple to comprehend (Lenz et al. 2015; Onaolapo and Oyewole 2018). In the modern era of education, students prefer online learning because it is more flexible (Crittenden, Biel, and Lovely III 2019; Koloseni and Mandari 2017). However, it is crucial for the application to be user-friendly and beneficial to use.

Extroverts exhibit a significant and negative relationship concerning the impact of techno-insecurity on student satisfaction, while introverts demonstrate a negative and insignificant relationship. This finding suggests that extroverts have lower confidence in their ability to cope with the growing technological digital system compared with introverts. However, when comparing the values of the path coefficients for both personality traits in relation to techno-insecurity and student satisfaction, the findings indicate that there is no significant difference between the two. This indicates that regardless of whether they are introverts or extroverts, students must acknowledge the importance of technology in the modern learning process, even though they may have concerns about the rapid development of these technologies, which can

sometimes make it challenging for them to adapt. Therefore, the difference between introverts and extroverts concerning technological insecurity is not significant.

Next, both introverts and extroverts exhibit a positive and significant effect on the expectation of academic performance based on the level of student satisfaction. This result also conclusively demonstrates that there is no distinction between introverts and extroverts with regard to student satisfaction and performance expectations. Consequently, it is essential to increase student satisfaction to raise their performance expectations during the learning process (Alqurashi 2019). According to the findings, the three components of technostress cause a decrease in the level of student satisfaction. This clearly demonstrates that the technology aspect not only facilitates learning (Prasad and Srivastava 2021) but also affects the level of satisfaction and the learning process if it is poorly managed. Additionally, student satisfaction has been found to act as a mediator between technostress and student performance expectations. In this regard, the aspect of technological complexity reveals a substantial difference between introverts and extroverts. Therefore, addressing the issue of techno-complexity requires enhancing the instructor's skills in managing technology and designing courses that are suitable for technology, ensuring that it is easy to use and not overly complex (Gopal, Singh, and Aggarwal 2021).

Limitations of and Recommendations for Future Research

Though this study has established that the impact of techno-overload and techno-security on student satisfaction does not significantly differ between introverts and extroverts, it also reveals a noteworthy variance between these personality types concerning techno-complexity. However, a limitation of this research lies in its reliance on data solely sourced from a single institution. The application and effects of technology-based learning, as well as the technological learning environment, might vary across different institutions. Consequently, to bolster the findings of this study, a broader dataset encompassing various institutions is essential, serving either to reinforce or challenge these results.

Moreover, this study is limited in that it concentrates exclusively on the nuances of personality traits, namely introversion and extroversion. It does not delve into broader dimensions, such as gender, geographical location, or the specific programs or courses undertaken by students. Consequently, it is proposed that future research should encompass a more extensive dataset from diverse institutions, examining a wider array of demographic variables. Such an approach would significantly enrich the body of knowledge of technostress among students.

Implications and Conclusion

This study is seen to offer theoretical, managerial, and future implications. Theoretically, it extends the P-E fit theory by examining the impact of the technological environment on the emergence of a new form of stress known as technostress. The findings clearly demonstrate that

technostress affects both satisfaction levels and academic performance in a technological environment. Additionally, this study investigates the role of personality traits, namely introversion and extroversion, in how students adapt to technology in their learning process. While there are some differences between these two personality types in terms of technology use, the overall impact is deemed insignificant, except for techno-complexity. The current generation, being digital natives, is generally adept at using technology. However, when it comes to complex technology, introverts seem to be more affected. This is because they tend to prefer solving problems on their own and find it challenging to seek help, unlike extroverts who are more comfortable socializing and seeking assistance when dealing with complex technology.

From a management perspective, this study offers valuable insights for effectively managing technology-based learning. While the current generation is generally proficient in using technology, there are still complex applications or software in the context of learning technology. To address this issue, instructors should provide thorough explanations on how to use the applications and technology instead of assuming that students can figure it out on their own. This step is crucial to ensure that students fully understand how to utilize technology before incorporating it into the learning process, thereby enhancing learning efficiency. For students, especially those with introverted personalities, comprehending the use of complex technology is essential to prevent them from falling behind in technology-based learning. Unlike extroverts who may feel more comfortable seeking help or asking questions, introverts may hesitate to interrupt and seek assistance if they encounter difficulties in using technology. To mitigate this, instructors should consider providing user manuals and initial explanations about the technology before its implementation in the teaching process. These aspects can be integrated into the teaching plan prior to commencing technology-based teaching activities. By doing so, instructors can ensure that all students, regardless of their personality traits, are well-prepared to leverage technology effectively in their learning journey.

Following the discussion on theoretical and managerial implications, this study also anticipates leading to significant future implications, especially in the broad domain of technostress across diverse educational settings. Continual updates and an in-depth understanding of the effects of technostress on students are crucial, given the relentless progression of technology, which become increasingly integral in educational contexts. In response to this ever-evolving technological landscape, it is imperative for academics to engage in various experiments and new studies to keep pace with the latest impacts of technostress and to develop solutions for the newly emerging challenges. Insights from this study, particularly regarding the influence of techno-complexity on introverts, underscore the need for further research into the responsibilities of educators in moderating technological complexity, enhancing skill sets among both students and educators, and undertaking longitudinal studies for deeper insights. Future implications are expected to illuminate these areas, potentially revising and expanding upon current understandings.

In conclusion, the study finds that the technostress component has a significant impact on the level of learning satisfaction and student performance expectations, depending on the student's personality type. However, no significant difference has been observed between the personalities regarding the techno-overload and techno-insecurity components. Despite experiencing technostress, the current generation of students is generally well-exposed to technology and adapts to it easily. Nevertheless, it is crucial to highlight the issue of techno-complexity, which notably affects individuals with introverted personalities more than extroverts. Therefore, an effective method is required to simplify technology usage and enhance its efficiency in increasing the effectiveness of learning.

AI Acknowledgment

The authors declare that generative AI or AI-assisted technologies were not used in any way to prepare, write, or complete essential authoring tasks in this manuscript.

Informed Consent

The authors have obtained informed consent from all participants.

Conflict of Interest

The authors declare that there is no conflict of interest.

REFERENCES

Aktan, Osman, and Çetin Toraman. 2022. "The Relationship between Technostress Levels and Job Satisfaction of Teachers within the COVID-19 Period." *Education and Information Technologies* 27 (7): 10429–10453. https://doi.org/10.1007/s10639-022-11027-2.

Alamri, Mahdi M. 2019. "Students' Academic Achievement Performance and Satisfaction in a Flipped Classroom in Saudi Arabia." *International Journal of Technology Enhanced Learning* 11 (1): 103–119. https://doi.org/10.1504/IJTEL.2019.096786.

Al-Ansari, Muna A., and Khaled Alshare. 2019. "The Impact of Technostress Components on the Employees Satisfaction and Perceived Performance: The Case of Qatar." *Journal of Global Information Management* 27 (3): 65–86. https://doi.org/10.4018/JGIM.2019070104.

Alqurashi, Emtinan. 2019. "Predicting Student Satisfaction and Perceived Learning within Online Learning Environments." *Distance Education* 40 (1): 133–148. https://doi.org/10.1080/01587919.2018.1553562.

Ayyagari, Ramakrishna, Varun Grover, and Russell Purvis. 2011. "Technostress: Technological Antecedents and Implications." *MIS Quarterly: Management Information Systems* 35 (4): 831–858. https://doi.org/10.2307/41409963.

Aziz, Nurul Nadia Abd, and Zaidatul Nadiah Abu Yazid. 2021. "Exploratory Factor Analysis of Technostress among University Students." *International Journal of Academic Research in Progressive Education and Development* 10 (3): 161–175. https://doi.org/10.6007/IJARPED/v10-i3/10396.

Aziz, Nurul Nadia Abd, Mohd Amar Aziz, and Noor Amira Syazwani Abd Rahman. 2023. "The Mediating Effects of Student Satisfaction on Technostress–Performance Expectancy Relationship in University Students." *Journal of Applied Research in Higher Education* 15 (1): 113–129. https://doi.org/10.1108/JARHE-03-2021-0117.

Blevins, Dane P., Madelynn R. D. Stackhouse, and Shelley D. Dionne. 2022. "Righting the Balance: Understanding Introverts (and Extraverts) in the Workplace." *International Journal of Management Reviews* 24 (1): 78–98. https://doi.org/10.1111/ijmr.12268.

Brod, Craig. 1984. *Technostress: The Human Cost of the Computer Revolution.* Reading, MA: Addison Wesley Publishing.

Califf, Christopher B., and Stoney Brooks. 2020. "An Empirical Study of Techno-Stressors, Literacy Facilitation, Burnout, and Turnover Intention as Experienced by K-12 Teachers." *Computers & Education* 157:103971. https://doi.org/10.1016/j.compedu.2020.103971.

Christ-Brendemühl, Sonja, and Mario Schaarschmidt. 2020. "The Impact of Service Employees' Technostress on Customer Satisfaction and Delight: A Dyadic Analysis." *Journal of Business Research* 117:378–388. https://doi.org/10.1016/j.jbusres.2020.06.021.

Christian, Michael, Edi Purwanto, and Suryo Wibowo. 2020. "Technostress Creators on Teaching Performance of Private Universities in Jakarta during COVID-19 Pandemic." *Technology Reports of Kansai University* 62 (6): 2799–2809. https://www.kansaiuniversityreports.com/article/technostress-creators-on-teaching-performance-of-private-universities-in-jakarta-during-covid-19-pandemic.

Crittenden, William F., Isabella K. Biel, and William A. Lovely III. 2019. "Embracing Digitalization: Student Learning and New Technologies." *Journal of Marketing Education* 41 (1): 5–14. https://doi.org/10.1177/0273475318820895.

D'Arcy, John, Ashish Gupta, Monideepa Tarafdar, and Ofir Turel. 2014. "Reflecting on the 'Dark Side' of Information Technology Use." *Communications of the Association for Information Systems* 35:109–118. https://doi.org/10.17705/1CAIS.03505.

Dunn, Thomas J., and Mark Kennedy. 2019. "Technology Enhanced Learning in Higher Education; Motivations, Engagement and Academic Achievement." *Computers & Education* 137:104–113. https://doi.org/10.1016/j.compedu.2019.04.004.

Edwards, Jeffrey R., Robert D. Caplan, and R. van Harrison. 1998. "Person-Environment Fit Theory." In *Theories of Organizational Stress*, edited by Cary L. Cooper, 28–67. Oxford: Oxford University Press.

Ennen, Nicole L., Emily Stark, and Andrea Lassiter. 2015. "The Importance of Trust for Satisfaction, Motivation, and Academic Performance in Student Learning Groups." *Social Psychology of Education* 18:615–633. https://doi.org/10.1007/s11218-015-9306-x.

Felszeghy, Szabolcs, Sanna Pasonen-Seppänen, Ali Koskela, Petteri Nieminen, Kai Härkönen, Kaisa M. A. Paldanius, Sami Gabbouj, et al. 2019. "Using Online Game-Based Platforms to Improve Student Performance and Engagement in Histology Teaching." *BMC Medical Education* 19 (1): 273. https://doi.org/10.1186/s12909-019-1701-0.

Gaudioso, Fulvio, Ofir Turel, and Carlo Galimberti. 2017. "The Mediating Roles of Strain Facets and Coping Strategies in Translating Techno-Stressors into Adverse Job Outcomes." *Computers in Human Behavior* 69:189–196. https://doi.org/10.1016/j.chb.2016.12.041.

Gopal, Ram, Varsha Singh, and Arun Aggarwal. 2021. "Impact of Online Classes on the Satisfaction and Performance of Students during the Pandemic Period of COVID 19." *Education and Information Technologies* 26 (6): 6923–6947. https://doi.org/10.1007/s10639-021-10523-1.

Hair, Joseph F., G. Tomas M. Hult, Christian M. Ringle, and Marko Sarstedt. 2017. *A Primer on Partial Least Squares Structural Equation Modeling (PLS-SEM)*. 2nd ed. Thousand Oaks, CA: Sage Publications.

Henseler, Jörg, Christian M. Ringle, and Marko Sarstedt. 2014. "A New Criterion for Assessing Discriminant Validity in Variance-Based Structural Equation Modeling." *Journal of the Academy of Marketing Science* 43 (1): 115–135. https://doi.org/10.1007/s11747-014-0403-8.

Henseler, Jörg, Christian M. Ringle, and Marko Sarstedt. 2016. "Testing Measurement Invariance of Composites Using Partial Least Squares." *International Marketing Review* 33 (3): 405–431. https://doi.org/10.1108/IMR-09-2014-0304.

Himma, Kenneth Einar. 2017. "The Concept of Information Overload: A Preliminary Step in Understanding the Nature of a Harmful Information-Related Condition." In *Ethics and Information Technology*, edited by Keith W. Miller and Mariarosaria Taddeo, 443–446. London: Routledge.

Hsiao, Kuo-Lun. 2017. "Compulsive Mobile Application Usage and Technostress: The Role of Personality Traits." *Online Information Review* 41 (2): 272–295. https://doi.org/10.1108/OIR-03-2016-0091.

Hung, Y. H., C. H. Chen, and S. W. Huang. 2017. "Applying Augmented Reality to Enhance Learning: A Study of Different Teaching Materials." *Journal of Computer Assisted Learning* 33 (3): 252–266. https://doi.org/10.1111/jcal.12173.

Jena, R. K. 2015. "Technostress in ICT Enabled Collaborative Learning Environment: An Empirical Study among Indian Academician." *Computers in Human Behavior* 51:1116–1123. https://doi.org/10.1016/j.chb.2015.03.020.

Joo, Young Ju, Kyu Yon Lim, and Nam Hee Kim. 2016. "The Effects of Secondary Teachers' Technostress on the Intention to Use Technology in South Korea." *Computers & Education* 95:114–122. https://doi.org/10.1016/j.compedu.2015.12.004.

Jung, Carl Gustav. 2014. *The Development of Personality*. London: Routledge.

Kader, Mohd Aidil Riduan Awang, Nurul Nadia Abd Aziz, Suhanom Mohd Zaki, Maisarah Ishak, and Siti Fahazarina Hazudin. 2022. "The Effect of Technostress on Online Learning Behaviour among Undergraduates." *Malaysian Journal of Learning and Instruction* 19 (1): 183–211. https://doi.org/10.32890/mjli2022.19.1.7.

Katz, David L. 2001. *Clinical Epidemiology & Evidence-Based Medicine: Fundamental Principles of Clinical Reasoning & Research*. Thousand Oaks, CA: Sage Publications.

Koloseni, Daniel, and Herman Mandari. 2017. "Why Mobile Money Users Keep Increasing? Investigating the Continuance Usage of Mobile Money Services in Tanzania." *Journal of International Technology and Information Management* 26 (2): 117–145. https://doi.org/10.58729/1941-6679.1312.

Lenz, Peter H., Jennifer W. McCallister, Andrew M. Luks, Tao T. Le, and Henry E. Fessler. 2015. "Practical Strategies for Effective Lectures." *Annals of the American Thoracic Society* 12 (4): 561–566. https://doi.org/10.1513/AnnalsATS.201501-024AR.

Lestari, Arie, Clarry Sada, and Luwandi Suhartono. 2015. "Analysis on the Relationship of Extrovert–Introvert Personality and Students' Speaking Performance." *Jurnal Pendidikan dan Pembelajaran Khatulistiwa* 4 (3): 1–14. https://jurnal.untan.ac.id/index.php/jpdpb/article/view/9232.

Li, Ling. 2022. "Reskilling and Upskilling the Future-Ready Workforce for Industry 4.0 and Beyond." *Information Systems Frontiers*, 1–16. https://doi.org/10.1007/s10796–10722-10308-y.

Li, Lu, and Xinghua Wang. 2021. "Technostress Inhibitors and Creators and Their Impacts on University Teachers' Work Performance in Higher Education." *Cognition, Technology & Work* 23:315–330. https://doi.org/10.1007/s10111-020-00625-0.

Martirosyan, Nara M., Eunjin Hwang, and Reubenson Wanjohi. 2015. "Impact of English Proficiency on Academic Performance of International Students." *Journal of International Students* 5 (1): 60–71. https://doi.org/10.32674/jis.v5i1.443.

McCabe, Kira O., Nico W. Van Yperen, Andrew J. Elliot, and Marc Verbraak. 2013. "Big Five Personality Profiles of Context-Specific Achievement Goals." *Journal of Research in Personality* 47 (6): 698–707. https://doi.org/10.1016/j.jrp.2013.06.003.

McCroskey, James C. 1997. "Self-Report Measurements." In *Avoiding Communication: Shyness, Reticence, and Communication Apprehension*, edited by John A. Daly, James C. McCroskey, Joe Ayres, Tim Hopf, Debbie M. Ayres Sonandre, and Tanichya K. Wongprasert, 191–216. Cresskill, NJ: Hampton Press.

Njoroge, Joyce, Andrew Norman, Diana Reed, and Inchul Suh. 2012. "Identifying Facets of Technology Satisfaction: Measure Development and Application." *Journal of Learning in Higher Education* 8 (2): 7–17. https://www.jwpress.com/Journals/JLHE/BackIssues/JLHE-Fall-2012.pdf#page=9.

Onaolapo, Sodiq, and Olawale Oyewole. 2018. "Performance Expectancy, Effort Expectancy, and Facilitating Conditions as Factors Influencing Smart Phones Use for Mobile Learning by Postgraduate Students of the University of Ibadan, Nigeria." *Interdisciplinary Journal of e-Skills and Lifelong Learning* 14 (1): 95–115. https://doi.org/10.28945/4085.

Petric, Domina. 2022. "The Introvert-Ambivert-Extrovert Spectrum." *Open Journal of Medical Psychology* 11 (3): 103–111. https://doi.org/10.4236/ojmp.2022.113008.

Prasad, Ram Komal, and Manish Kumar Srivastava. 2021. "Switching Behavior toward Online Shopping: Coercion or Choice during COVID-19 Pandemic." *Academy of Marketing Studies Journal* 25 (1S): 1–15. https://www.abacademies.org/articles/switching-behavior-toward-online-shopping-coercion-or-choice-during-covid19-pandemic-10037.html.

Qi, Cong. 2019. "A Double-Edged Sword? Exploring the Impact of Students' Academic Usage of Mobile Devices on Technostress and Academic Performance." *Behaviour & Information Technology* 38 (12): 1337–1354. https://doi.org/10.1080/0144929X.2019.1585476.

Riva, Giuseppe, Rosa M. Baños, Cristina Botella, Brenda K. Wiederhold, and Andrea Gaggioli. 2012. "Positive Technology: Using Interactive Technologies to Promote Positive Functioning." *Cyberpsychology, Behavior, and Social Networking* 15 (2): 69–77. https://doi.org/10.1089/cyber.2011.0139.

Schwieger, Dana, and Christine Ladwig. 2018. "Reaching and Retaining the Next Generation: Adapting to the Expectations of Gen Z in the Classroom." *Information Systems Education Journal* 16 (3): 45–54. https://isedj.org/2018-16/n3/ISEDJv16n3p45.html.

Septianah, Putri, Endang Susilawati, and Iwan Supardi. 2019. "Extrovert-Introvert Students and Their English Speaking Performance." *Jurnal Pendidikan dan Pembelajaran Khatulistiwa* 8 (6): 1–9. https://jurnal.untan.ac.id/index.php/jpdpb/article/view/33415.

Sethi, Deepa, Vijay Pereira, and Vikas Arya. 2021. "Effect of Technostress on Academic Productivity: E-engagement through Persuasive Communication." *Journal of Global Information Management* 30 (5): 1–19. https://doi.org/10.4018/JGIM.290365.

She, Long, Lan Ma, Anbareen Jan, Hamid Sharif Nia, and Pardis Rahmatpour. 2021. "Online Learning Satisfaction during COVID-19 Pandemic among Chinese University Students: The Serial Mediation Model." *Frontiers in Psychology* 12:743936. https://doi.org/10.3389/fpsyg.2021.743936.

Smiderle, Rodrigo, Sandro José Rigo, Leonardo B. Marques, Jorge Arthur Peçanha de Miranda Coelho, and Patricia A. Jaques. 2020. "The Impact of Gamification on Students' Learning, Engagement and Behavior Based on Their Personality Traits." *Smart Learning Environments* 7:3. https://doi.org/10.1186/s40561-019-0098-x.

Sousa, Maria José, and Daniela Wilks. 2018. "Sustainable Skills for the World of Work in the Digital Age." *Systems Research and Behavioral Science* 35 (4): 399–405. https://doi.org/10.1002/sres.2540.

Spector, Paul E. 2019. "Do Not Cross Me: Optimizing the Use of Cross-Sectional Designs." *Journal of Business and Psychology* 34 (2): 125–137. https://doi.org/10.1007/s10869-018-09613-8.

Spiess, Teresa, Christian Ploder, Reinhard Bernsteiner, and Thomas Dilger. 2021. "Techno-Stress in the Workplace: Triggers, Outcomes, and Coping Strategies with a Special Focus on Generational Differences." *International Journal of Web Engineering and Technology* 16 (3): 217–234. https://doi.org/10.1504/IJWET.2021.119875.

Suh, Ayoung, and Jumin Lee. 2017. "Understanding Teleworkers' Technostress and Its Influence on Job Satisfaction." *Internet Research* 27 (1): 140–159. https://doi.org/10.1108/IntR-06-2015-0181.

Suharti, Lieli, and Agung Susanto. 2014. "The Impact of Workload and Technology Competence on Technostress and Performance of Employees." *Indian Journal of Commerce and Management Studies* 5 (2): 1–7. https://www.ijcms.in/index.php/ijcms/article/view/403.

Tang, Thomas Li-Ping, and M. Jill Austin. 2009. "Students' Perceptions of Teaching Technologies, Application of Technologies, and Academic Performance." *Computers & Education* 53 (4): 1241–1255. https://doi.org/10.1016/j.compedu.2009.06.007.

Tarafdar, Monideepa, Cary L. Cooper, and Jean-François Stich. 2019. "The Technostress Trifecta-Techno Eustress, Techno Distress and Design: Theoretical Directions and an Agenda for Research." *Information Systems Journal* 29 (1): 6–42. https://doi.org/10.1111/isj.12169.

Tarafdar, Monideepa, Ellen Bolman Pullins, and T. S. Ragu-Nathan. 2015. "Technostress: Negative Effect on Performance and Possible Mitigations." *Information Systems Journal* 25 (2): 103–132. https://doi.org/10.1111/isj.12042.

Tarafdar, Monideepa, Qiang Tu, and T. S. Ragu-Nathan. 2010. "Impact of Technostress on End-User Satisfaction and Performance." *Journal of Management Information Systems* 27 (3): 303–334. https://doi.org/10.2753/MIS0742-1222270311.

Trendak, Olga. 2015. *Exploring the Role of Strategic Intervention in Form-Focused Instruction*. Cham, Switzerland: Springer International Publishing.

Tu, Qiang, Kanliang Wang, and Qin Shu. 2005. "Computer-Related Technostress in China." *Communications of the ACM* 48 (4): 77–81. https://doi.org/10.1145/1053291.1053323.

Upadhyaya, Pallavi, and Vrinda. 2020. "Impact of Technostress on Academic Productivity of University Students." *Education and Information Technologies* 26:1647–1664. https://doi.org/10.1007/s10639-020-10319-9.

Wang, Kanliang, Qin Shu, and Qiang Tu. 2008. "Technostress under Different Organizational Environments: An Empirical Investigation." *Computers in Human Behavior* 24 (6): 3002–3013. https://doi.org/10.1016/j.chb.2008.05.007.

Wang, Xinghua, Seng Chee Tan, and Lu Li. 2020. "Measuring University Students' Technostress in Technology-Enhanced Learning: Scale Development and Validation." *Australasian Journal of Educational Technology* 36 (4): 96–112. https://doi.org/10.14742/ajet.5329.

Wei, Huei-Chuan, and Chien Chou. 2020. "Online Learning Performance and Satisfaction: Do Perceptions and Readiness Matter?" *Distance Education* 41 (1): 48–69. https://doi.org/10.1080/01587919.2020.1724768.

Wunsch, Guillaume, Federica Russo, and Michel Mouchart. 2010. "Do We Necessarily Need Longitudinal Data to Infer Causal Relations?' *Bulletin de Méthodologie Sociologique* 106 (1): 5–18. https://doi.org/10.1177/0759106309360114.

Yasin, Norazlina Mohd, Mohd Hanafi Azman Ong, and Nurul Nadia Abd Aziz. 2020. "Assessment of the Blended Learning Implementation in Higher Education: Students' Readiness Perspective." *International Journal of Advanced Science and Technology* 29 (6s): 702–712. http://sersc.org/journals/index.php/IJAST/article/view/8893.

Yu, Zhonggen. 2021. "The Effects of Gender, Educational Level, and Personality on Online Learning Outcomes during the COVID-19 Pandemic." *International Journal of Educational Technology in Higher Education* 18 (1): 14. https://doi.org/10.1186/s41239-021-00252-3.

Zeichner, Orit. 2019. "The Relationship between Extrovert/Introvert Attributes and Feedback on Students' Achievements." *International Journal of Distance Education Technologies* 17 (2): 1–17. https://doi.org/10.4018/IJDET.2019040101.

ABOUT THE AUTHORS

Nurul Nadia Abd Aziz: Senior Lecturer, Faculty of Business and Management, Universiti Teknologi MARA Pahang, Raub Campus, Pahang, Malaysia
Email: nurul_nadia@uitm.edu.my

Mohd Amar Aziz: Senior Lecturer, Faculty of Administrative Science and Policy Studies, Universiti Teknologi MARA Pahang, Raub Campus, Pahang, Malaysia
Corresponding Author's Email: amaraziz@uitm.edu.my

Noor Amira Syazwani Abd Rahman: Lecturer, Faculty of Administrative Science and Policy Studies, Universiti Teknologi MARA Pahang, Raub Campus, Pahang, Malaysia
Email: amirarahman@uitm.edu.my

Norazlina Mohd Yasin: Senior Lecturer, School of Professional and Continuing Education (SPACE), Universiti Teknologi Malaysia, Skudai, Johor, Malaysia
Email: norazlina@utmspace.edu.my

Noor Hadzlida Ayob: Senior Lecturer, Department of Malaysian Studies, Faculty of Human Sciences, Universiti Pendidikan Sultan Idris, Tanjong Malim, Perak, Malaysia
Email: hadzlida@fsk.upsi.edu.my