# NEEDS ANALYSIS ON TECHNOSTRESS COPING STRATEGIES AMONG STUDENTS IN E-LEARNING ENVIRONMENTS

RAGHINEY A/P VENUGOPAL

FACULTY OF EDUCATION
UNIVERSITY OF MALAYA
KUALA LUMPUR

2025

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RAGHINEY A/P VENUGOPAL

DISSERTATION SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF INSTRUCTIONAL TECHNOLOGY (INSTRUCTIONAL DESIGN)

FACULTY OF EDUCATION
UNIVERSITY OF MALAYA
KUALA LUMPUR

2025

# UNIVERSITI MALAYA

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Registration/Matric No: s2021146/1

Name of Degree: Master of Instructional Technology (Instructional Design)

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## ABSTRACT

## NEEDS ANALYSIS ON TECHNOSTRESS COPING STRATEGIES AMONG STUDENTS IN E-LEARNING ENVIRONMENTS

This study was conducted to investigate the technostressors faced by students in e-learning environments. Besides that, this study investigated the coping strategies (specifically the problem- and emotion-focused coping strategies) used by students to cope with technostress in e-learning environments. This study employed two systematic literature reviews guided by the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) 2020 statement. Articles were searched in four databases, namely Education Resources Information Center, Web of Science, Scopus and Science Direct from January 2000 to June 2023. The first systematic review investigating the technostressors faced by students in e-learning environments comprised 26 articles, while the second systematic review investigating students' coping strategies comprised four articles. Based on a thematic analysis of the findings in the first review, 12 themes emerged which are: - Techno-overload, Techno-complexity, Techno-invasion, Structure of lessons and assessments, instructor and administrative factors, Social factors, Techno-uncertainty, Techno-unreliability, Accessibility to ICT and suitable learning space, Techno-insecurity, Physical and psychological strain, Addiction and compulsive use and Privacy invasion. Upon conducting a thematic analysis of the findings in the second review, four problem-focused coping strategies emerged which are: - Academic planning, Problem-solving, The use of digital collaboration tools and Seeking instrumental help to overcome problems; and four emotion-focused coping strategies emerged which are: - Emotional expression or venting, Cognitive reinterpretation, Disengagement and Seeking emotional support. To conclude, this study identified several technostressors students experience in e-learning environments as well as the problem- and emotion-focused coping strategies they use to cope with them. Future studies should investigate

technostress and coping in primary and secondary students, the root causes of technostress, how certain technostressors are coped with (that were not identified in this study) and the short- and long-term outcomes of coping strategies.

## ABSTRAK

## ANALISIS KEPERLUAN STRATEGI MENGATASI TEKNOSTRES DALAM KALANGAN PELAJAR DALAM PERSEKITARAN E-PEMBELAJARAN

Kajian ini dijalankan untuk mengkaji teknostres yang dihadapi oleh pelajar dalam persekitaran e-pembelajaran. Selain itu, kajian ini menyiasat strategi mengatasi teknostres (khususnya strategi yang berfokuskan masalah dan emosi) yang digunakan oleh pelajar untuk menghadapi teknostres dalam persekitaran e-pembelajaran. Kajian ini menggunakan dua analisis literatur sistematik berpandukan *Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) 2020 statement*. Artikel telah dicari dalam empat pangkalan data, iaitu Education Resources Information Center, Web of Science, Scopus dan Science Direct dari Januari 2000 hingga Jun 2023. Analisis sistematik pertama yang menyiasat teknostres yang dihadapi oleh pelajar dalam persekitaran e-pembelajaran terdiri daripada 26 artikel, manakala analisis sistematik kedua menyiasat strategi mengatasi teknostres pelajar terdiri daripada empat artikel. Berdasarkan analisis tematik terhadap penemuan dalam ulasan pertama, 12 tema muncul iaitu: - Keterlebihan teknologi, Kekompleksan teknologi, Invasi teknologi, Struktur pelajaran dan penilaian, faktor pengajar dan pentadbiran, Faktor sosial, Ketidakpastian dalam teknologi, Ketidakstabilan teknologi, Aksesibiliti kepada ICT dan ruang pembelajaran yang sesuai, Ketidakyakinan dalam teknologi, Ketegangan fizikal dan psikologi, Ketagihan dan penggunaan kompulsif dan Invasi privasi. Setelah menjalankan analisis tematik terhadap penemuan dalam ulasan kedua, empat strategi menangani teknostres berfokuskan masalah muncul iaitu: - Perancangan akademik, Penyelesaian masalah, Penggunaan alat kolaborasi digital dan Mencari bantuan *instrumental* untuk mengatasi teknostres; dan empat strategi mengatasi teknostres yang berfokuskan emosi telah muncul iaitu: - Ekspresi atau melepaskan emosi, Penafsiran semula kognitif, Pengasingan diri dan Mencari sokongan emosi. Sebagai kesimpulan, kajian ini mengenal

pasti teknostres yang dialami oleh pelajar dalam persekitaran e-pembelajaran serta strategi mengatasi teknostres yang berfokuskan masalah dan emosi. Kajian yang akan datang harus mengkaji teknostres dan strategi mengatasi teknostres dalam kalangan pelajar sekolah rendah dan menengah, analisis punca akar teknostres, cara segelintir teknostres diatasi (yang tidak ditemui oleh kajian ini) dan kesan jangka pendek dan jangka panjang penggunaan strategi mengatasi teknostres.

## ACKNOWLEDGEMENT

First and foremost, I would like to express my gratitude to my supervisor, Associate Professor Dr. Rafiza binti Abdul Razak for her dedication and patience in guiding me in completing this dissertation. Her guidance has been vital in shaping the quality of my work.

Next, I thank my family for their endless support throughout this journey. Their words of encouragement were an invaluable resource that enabled me to write this dissertation to completion. I am eternally grateful for their motivation and belief in me.

Finally, I thank my best friend and biggest cheerleader, Ashveenk for encouraging me to persevere in completing this dissertation. I am forever grateful for the encouragement, company and constant reminder that I can accomplish anything I set my mind to.

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| | |
|---|---|
| ICT | : Information and communication technology |
| LMS | : Learning management system |
| IT | : Information technology |
| DELIMa | : Digital Educational Learning Initiative Malaysia |
| MCO | : Movement control order |
| ESL | : English as a Second Language |
| PRISMA | : Preferred Reporting Items for Systematic Reviews and Meta-Analysis |
| ERIC | : Education Resources Information Center |
| WoS | : Web of Science |
| JBI | : Joanna Briggs Institute |
| AMCIS | : Americas Conference on Information Systems |
| SIGMIS-CPR | : Special Interest Group on Management Information Systems-Computers and People Research |
| ESCI | : Emerging Sources Citation Index |
| GRADE | : Grades of Recommendation, Assessment, Development and Evaluation |
| VLE | : Virtual learning environment |
| PLS-SEM | : Partial Least Squares Structural Equation Modeling |

# CHAPTER 1

# INTRODUCTION

## 1.0 Introduction

Information and communication technology (ICT) has become a major part of our personal and professional lives in the 21st century (Ayyagari et al., 2011). The use of ICT is known to bring many benefits to organizations such as increased productivity (Rodríguez-Moreno & Rochina-Barrachina, 2019), profitability (Huang et al., 2022), enhanced collaboration (Nawinna & Venable, 2019) and improved efficiency through cost-reduction and resource optimization (Singh & Maiti, 2020). However, ICTs also alter organizational frameworks, operations and interactions between people within and outside the establishment. To that end, workers need to continually upskill themselves, get acclimated to new work procedures and the enhanced ability of ICTs in carrying out complex functions. This could cause workers to feel uncertain about their capabilities to adapt to growing job demands via ICT as well as feel concerned about being substituted in the future (Goetz & Boehm, 2020).

The progressively extensive use of ICT has led to the rise of phenomena damaging to users like technostress (Abilleira et al., 2020). Technostress is defined as "a modern disease of adaptation caused by an inability to cope with new computer technologies in a healthy manner" or a "state of mental and physiological arousal observed in certain employees who are heavily dependent on computers in their work" (Ragu-Nathan et al., 2008, as cited in Brod, 1984, p. 16 and Arnetz & Wiholm, 1997, p. 36). Tarafdar et al. (2007) described technostress as stress caused by the use of ICT. Tarafdar et al. (2015) and Tarafdar et al. (2019) later refined the definition as stress experienced as an outcome

of information system usage. Meanwhile, Salanova et al. (2014) defined technostress at work as "a negative psychological state associated with the use (and abuse) of technology as well as the threat of technology use in the future" (Salanova et al., 2014, p. 88).

According to Bondanini et al. (2020), technostress studies have centred around the mandatory use of technology in business. However, studies have also shown the adverse effects caused by the permeation of personal technology (e.g., social media) in the workplace. Stressors in the work environment contribute to strain in individuals and has an impact on organizational outcomes (Ragu-Nathan et al., 2008, Ayyagari et al., 2011). Technostress creators (e.g., techno-overload, techno-invasion) reduce job satisfaction, lower commitment to the organization and reduce work performance (Tarafdar et al., 2010; Kumar et al., 2013; Khan et al., 2013; Jena, 2015a; Park & Cho, 2016; Suh & Lee, 2017; Umair et al., 2019; Pullins et al., 2020; Cahapay & Bangoc II, 2021). On the other hand, technostress inhibitors (e.g., literacy facilitation, technical support) moderate the relationship between stress and strain (Ragu-Nathan et al., 2008; Nisafani et al., 2020). Technostress inhibitors contribute to higher job satisfaction, higher organizational commitment and better performance among employees (Tarafdar et al., 2011; Fuglseth & Sørebø, 2014; Jena, 2015b, Al-Ansari & Alshare, 2019, Mustika et al., 2021). Deviating from the popularly studied technostress inhibitor, a recent concept paper by Yasin et al. (2022) called for the examination of the role of leadership as a moderator between technostress and strain. Moreover, workplace studies have explored technostress in the context of specific fields such as library science (Yuvaraj & Singh, 2015; Laspinas, 2015), sales (Tarafdar et al., 2014; Tarafdar et al., 2015; Pullins et al., 2020), engineering (Suharti & Susanto, 2014), and has called for more in-depth studies in fields like nursing (Abuatiq, 2015; Califf et al. 2020) and accounting (Boyer-Davis, 2019; Talib et al., 2022).

The field of education is not exempt from progress in ICT (Daniela et al., 2018). Technology is widely utilized for automating processes in academia as well as advancing teaching and learning practices (Upadhyaya & Vrinda, 2020). Institution-administered tools such as learning management systems (LMS) (Holmes & Prieto-Rodriguez, 2018), e-libraries (Hwee et al., 2018), massive open online courseware (Dai et al., 2019), as well as third-party applications such as videoconferencing (Al-Samarraie, 2019) and instant messaging tools (Baguma et al., 2019) are extensively used in teaching and learning. During the recent COVID-19 outbreak, governments worldwide enforced school closures in an effort to safeguard learners. The adoption of ICT in education delivery was pivotal for assuring that learning continued during the health crisis (United Nations, 2020). Aside from schools, supplementary education such as private tuition which is typically conducted face-to-face also transitioned online in accordance with government health guidelines (Shaya et al., 2020; Pimlott-Wilson & Holloway, 2021). Besides that, the usage of social media platforms such as Facebook, WhatsApp and YouTube gained prominence for supporting learning during the global pandemic (Ghounane, 2020). Education providers predominantly used social media to carry out teaching and learning tasks, while learners tend to rely on social media for peer support and online community (Sobaih et al., 2020).

E-learning is known for its many benefits such as leveraging accessibility to quality learning resources, flexibility, convenience (Wang, Tan & Li, 2019), cost effectiveness as well as widened reach to more learners (Bali & Liu, 2018). While the advantages brought about by technology in education are significant, e-learning can lead to technostress among students (Aziz et al., 2021). This study aims to further our understanding of the causes of technostress and coping strategies employed by students in e-learning environments.

## 1.1 Background of Study

### 1.1.1 The Transactional Nature of Technostress and Coping

Technostress does not stem from the person nor their environment singularly, but from the interaction between them (Ayyagari et al., 2011). Based on the Transactional Theory of Stress and Coping by Lazarus and Folkman (1984), psychological stress is the relationship between an individual and their environment that is perceived by them as demanding or surpassing their resources and threatening their welfare. Two processes moderate the relationship between people and their environment, namely cognitive appraisal and coping. Cognitive appraisal is a person's assessment of the reasons why and degree to which a transaction between the person and environment is stress-inducing (Lazarus & Folkman, 1984). A person who believes that their ICT competence is sufficient to overcome potential threats caused by its use experiences lower anxiety than those who believe they are incompetent (Bandura, 1988). Another example is getting users involved in ICT implementation decisions increases the feeling of predictability, which in turn reduces the level of technostress experienced (Tarafdar et al., 2010).

Coping is the second moderator of the person-environment relationship proposed by Lazarus and Folkman (1984). Coping involves administering the demands of the person-environment relationship and the feelings they induce. Some resources of coping are good physiological health, constructive beliefs, ability to solve problems, social skills, social assistance and tangible material resources (Lazarus & Folkman, 1984). Employing suitable coping resources can effectively mitigate general stress, and its principles can be applied to technology-induced stress as well. For example, teachers cited insufficient social support from their environment contributed to feelings of stress when incorporating ICT into learning activities (Al-Fudail & Mellar, 2008). Teachers who had positive

attitudes and more support from their surrounding experiences lower levels of technostress (Syvänen et al., 2016).

### 1.1.2 Technostress Creators

Past research has used the terms "technostress creators" and "technostressors" interchangeably to describe the causes of technostress (Ahmad et al., 2012; Krishnan, 2017; Pflügner, 2022; Ramesh et al., 2022). Tarafdar et al. (2007) established a construct to evaluate the different technostressors i.e., techno-overload, techno-invasion, techno-complexity, techno-uncertainty and techno-insecurity. This conceptualization gained popularity in organizations (Wang et al., 2008; Fischer & Riedl, 2015; Kim & Lee, 2021; Zhang, Ye, Qiu, et al., 2022) and institutions of learning (Ahmad et al., 2012; Califf & Brooks, 2020; Lee & Lim, 2020). Techno-overload is the need to work faster and manage bigger workloads due to the use of ICT. Techno-invasion is the feeling that the use of ICT encroached upon users' personal lives. Techno-complexity relates to ICT being too complex to use given users' level of ICT competence. Techno-uncertainty is the inability to keep up with the frequent upgrades and changes in the technology used, and techno-insecurity is a feeling of incompetence relative to peers with regard to the usage of ICT. Technostressors impede productivity such that it counteracts gains brought by ICT usage (Tarafdar et al., 2007).

In an effort to update this five-dimension measure constructed by Tarafdar et al. (2007) more than a decade ago, Fischer et al. (2019) conducted an interview of 75 individuals from four organizations to evaluate the contemporary relevance of the specified measures, as well as identify potential additions to the construct. They identified techno-unreliability to be the most prominent cause of technostress. Additionally, IT monitoring by companies

lead to a fair amount of stress in employees. Although minimal, some employees reported cyberbullying as another dimension of technostress. In a recent update of definitions by Tarafdar et al. (2019), the unreliability of technology has been included as an aspect of techno-complexity that employees need to deal with. Furthermore, IT monitoring or surveillance by employers has been deemed a form of techno-invasion. Fischer et al. (2019) called for a quantitative study to ascertain if these dimensions (i.e., unreliability, IT monitoring, cyberbullying) should be included as separate dimensions under the main construct.

### 1.1.3 Technostress Inhibitors

Technostress can be coped with through the application of technostress inhibitors (Fuglseth & Sørebø, 2014). Ragu-Nathan et al. (2008) conceptualized "technostress inhibitors" as organizational tools that have the ability to lessen the implications of technostress. One of the technostress inhibitors identified by Ragu-Nathan and colleagues is literacy facilitation. Literacy facilitation refers to instruments that further the sharing of ICT knowledge in the workplace. It alleviates technostress because it advances users' comprehension of ICT applications and helps them handle learning new ICTs (Ragu-Nathan et al., 2008). Research in the field of education has also proven that adequate technical skills are instrumental in reducing technology-induced stress. Dong et al. (2020) confirmed that peer and administrative support advanced teachers' computer self-efficacy, which in turn significantly reduced their technostress.

Another technostress inhibitor identified by Ragu-Nathan et al. (2008) is technical support provision which is the support given to users to resolve their ICT issues. Recent studies found that prompt technical support effectively improves performance, reduces

bodily arousal and ameliorates techno-exhaustion during computer freezes (Weinert et al., 2020). Besides that, Li and Wang (2020) confirmed a similar finding in universities where technical support helped reduce lecturers' technostress in online learning. The third technostress inhibitor identified by Ragu-Nathan et al. (2008) is involvement facilitation which involves educating users about the impact of ICT usage as well as inviting them to experiment with it. Li and Wang (2020) found that involving teachers in technology integration activities was crucial to reducing techno-insecurity among other types of technostress. The involvement of teachers in the decision-making enabled better integration of their needs into how ICT is used in teaching and learning.

A recent study by Pflügner et al. (2020) found that segregating work and home-life helps reduce techno-invasion by means of setting clear boundaries. Using separate devices for work purposes, turning off work devices during non-working hours and limiting receiving emails to only working hours reduces techno-invasion. However, these measures may in turn increase techno-overload due to the accumulation of tasks that need to be dealt with on the next working day. Recommendations for overcoming techno-overload include working with superiors to delegate the work tasks, establishing priorities, reduce the number of emails that are shared with people with whom it does not concern and establishing alternative resources for getting support rather than reaching out to workers. These measures reduce the number of ICT demands assigned to the worker, thus alleviating feelings of overload (Pflügner et al., 2020).

Based on a review of 10 years' worth of technostress research, Sarabadani et al. (2018) found that individual technostress inhibitors have shown mixed results in terms of efficacy of mitigating technostress creators and strain. Interestingly, while some

individual technostress inhibitors show promising results, studies which have explored the overall impact of the inhibitors tell a very different story. When individual inhibitors are integrated to form a second-order construct, inhibitors are insignificant to the mitigation of strain. Sarabadani et al. (2018) attribute this to the occasionally burdensome nature of engaging with technostress inhibitors.

### 1.1.4 Demographic Characteristics of Technostress

Past works have placed a considerable amount of emphasis on exploring the demographic characteristics of those who experience technostress. Some of the key aspects considered are gender, age, level of education and ICT competency (Ragu-Nathan et al., 2008; Tarafdar et al., 2011; Wang et al., 2020). Results are largely inconsistent across studies and typically reflect the specific population studied. Past studies of adults have shown that in some instances women experience higher technostress than men (Syvänen et al., 2016; Upadhyaya & Vrinda, 2020), in other instances men suffer more (Jena & Mahanti, 2014), and sometimes gender differences were found to be insignificant (Ibrahim et al., 2007; Agbu et al., 2015; Li & Wang, 2020). These distinctions are attributable to aspects such as cultural and economic differences between men and women (Çoklar & Şahin, 2011), differing values, perceptions and experiences pertaining to ICT use (Venkatesh & Morris, 2000; Marchiori et al., 2019) and differing levels of computer anxiety (Maurer, 1994; Chua et al., 1999).

Several studies state that technostress increases with age because older people have a harder time assimilating with technology (Tu et al, 2005; Agbu, 2015; Berger et al., 2016; Marchiori et al., 2019). However, some studies prove otherwise citing that older adults cope better due to their experience (Ragu-Nathan et al., 2008; Şahin & Çoklar, 2009).

Generally, those with greater ICT competence experience lower levels of technostress (Syvänen et al., 2016; Upadhyaya & Vrinda, 2020). But some studies have shown that ICT competence can be indirectly detrimental because competent individuals are sometimes burdened with higher workload and the task of helping their less-competent counterparts (Tu et al., 2005). Besides that, personality traits such as extraversion, agreeableness, conscientiousness and openness are also linked to technostress experience (Srivastava et al., 2015; Hsiao et al., 2017; Krishnan, 2017). Technostress is a highly contextual matter, and experience typically relies on an interplay of factors (Tarafdar et al., 2015; Li & Wang, 2020). Although demographic findings have consistently contradicted each other, they provide some insight into how one's background might affect their technostress experience.

### 1.1.5 Effects of Technostress

One of the negative effects of technostress is towards physiological well-being. Controlled studies have shown that technostress is linked to the incidence of stress hormones in the body like cortisol, adrenaline (Riedl, 2012) and alpha-amylase (Tams et al., 2014; Galluch et al., 2015). Other physical implications of technostress include eye strain, elevated heart rate, back and shoulder pains, wrist pains, headaches and irritability (Bichteler, 1987; Laspinas, 2015). Technostress also has behavioural implications and is proven to hamper employee productivity (Tarafdar et al., 2007). Based on Hung et al. (2011), technostress reduces workers' productivity through its mediating effect on job stress. Job stress is a negative mental state that stems from workers' interaction with the ever-changing job environment which curbs productivity. Other studies show that certain aspects of technostress such as techno-overload can positively influence productivity. Certain cultures encourage workers to embrace work overload, thus techno-overload enhances worker productivity to a certain extent (Tu et al., 2005). Furthermore, the

general consensus on technostress and work performance is that they are inversely related (Suharti & Susanto, 2014; Tarafdar et al., 2015). However, Li and Wang (2020) found that techno-overload led to overall improvement in teacher's work performance. Similar to the findings of Hung et al. (2015), while the diverse ICT applications may cause stress, they also provide added convenience and improve overall efficiency.

Technostress is also associated with some psychological outcomes. Ragu-Nathan et al.'s (2008) study proved that technostress is linked to lower job satisfaction. Job satisfaction is the positive emotion associated with the evaluation that a person's job effectuates their job values (Locke, 1969). In addition, Tarafdar et al. (2010) and Fuglseth and Sørebø (2014) found that technostress is negatively related to end-user satisfaction, which is the positive perception people hold about the ICT used for carrying out work tasks. These negative outcomes have adverse spillover effects on other management concerns such as organizational commitment (Ragu-Nathan et al., 2008), intention to further the use of ICT (Fuglseth & Sørebø, 2014) as well as employee performance (Tarafdar et al., 2010). Similarly, one Malaysian university-level study found satisfaction to mediate the relationship between technostress and student performance expectancy (Aziz et al., 2022). Another study found certain technostressors (i.e., techno-complexity and techno-uncertainty) to affect both satisfaction and performance expectancy directly (Aziz et al., 2021). Meanwhile, another Malaysian tertiary education study proved that technostress has a direct relationship with students' behavioural intention to use ICT in learning (Kader et al., 2022).

In addition to physiological, organizational and psychological outcomes, technology also has societal outcomes. Technology evolution challenges existing norms, prompting

people to change the way they live. This induces adverse emotional states, such as anxiety and fear for many (Bondanini et al., 2020). Sarabadani et al. (2018) conclude that different individual technostressors lead to different effects with regard to strain. They cite the importance of in-depth analyses of the effects of varying individual technostressors on strain to support the development of informed mitigation solutions.

### 1.2 Problem Statement

Technostress has been extensively studied in organizational settings and for general purposes. Prior studies have investigated technostress creators and inhibitors, the impact of technostress towards job-related outcomes such as productivity, satisfaction, and continuation commitment (Tarafdar et al., 2007; Ragu-Nathan et al., 2008), the effect of technostressors on information system usage (Maier et al., 2015; Zhang et al., 2016), coping responses (D'Arcy et al., 2014; Weinert, 2016; Ortiz de Guinea, 2016; Weinert et al., 2020), as well as the role of moderators such as personality (Srivastava et al., 2015; Krishnan, 2017) and technological self-efficacy (Tarafdar et al., 2014) on the relationship between technostressors and outcomes.

The proliferation of ICT use in education has given rise to the extension of technostress research to the e-learning landscape. A considerable number of studies have explored the technostressors and mitigation strategies used by teachers (Joo et al., 2016; Estrada-Muñoz et al., 2020; Li and Wang, 2020; Dong et al., 2020). Thus far, two systematic literature reviews have explored teachers' experience with technostress (Fernández-Batanero et al., 2021; Nang et al., 2022), one scoping review investigated the technostress experienced by school principals (Ata & Saltan, 2023) and one systematic literature review discovered the technostress experienced by the general population which also

includes some accounts of technostress experienced by academic staff and students (Bhatt & Kothari, 2022).

In recent years, several studies exploring students' technostress have emerged. Studies of technostress experienced by students in e-learning environments have been predominantly focused on the context of higher education. These studies have investigated the validity of technostress scales and constructs for higher education students (Wang et al., 2020, Abilleira et al. 2020; Aziz & Yazid, 2021), the technostressors experienced (Upadhyaya & Vrinda, 2020; Sharma & Gupta, 2022), its impact on students (Aziz et al., 2021; Aziz et al., 2022), the demography (Upadhyaya & Vrinda, 2020, Wang, Tan & Li, 2019, Wang et al., 2020; Agbu, 2015), personality-related factors that affect technostress (Hsiao et al., 2017; Wang et al., 2020), how the interactive relationship between students and their environment give rise to technostress (Wang, Tan & Li, 2019; Wang et al., 2020; Abilleira et al. 2020), as well as support features in higher education e-learning that help mitigate technostress (Zhao et al., 2022). Thus far, there have been no systematic literature reviews conducted to synthesize these findings.

In terms of school students' technostress, research has been generally limited. However, studies on technostressors faced by adolescents have highlighted several issues such as Internet addiction (Li et al., 2019), cyberbullying (Wang, Musumari, Techasrivichien, et al., 2019; Park et al., 2021), social pressure to use particular applications and privacy disclosure among friends and romantic partners (Schmidt et al., 2021). Research has also explored coping strategies that adolescents can apply as well as the role of parents, peers and learning institutes that support them in overcoming technostressors (Li et al., 2016; Weinstein et al., 2015; Schmidt et al., 2021; Gao et al., 2022). While most of these studies

obtain their participants from schools, many of them consider technology usage for general purposes (including leisure) and it is unclear how many of these studies specifically apply to learning applications. Thus, the present study aims to delineate these findings and synthesise what is known about technostress and coping strategies in e-learning environments. The study of coping strategies is crucial as they are instrumental in reducing stress, promoting well-being (Javadi-Pashaki & Darvishpour, 2019) and improving one's perception and management of stressors (Abraham et al., 2018).

There has been a growing body of empirical research about technostress and coping by students in recent years. Instead of conducting another empirical exploration, this study employs a systematic review to address the ambiguity that exists with the rich literature on students' technostress and coping. Based on current research, it is unclear how many of the studies consider the application of ICT for the specific purpose of e-learning. While several technostress studies have used students as their research sample, some include both experiences with e-learning as well as non-e-learning applications (e.g., studies by Wang et al. (2022) and Mehtälä et al. (2022)). Dowd and Johnson (2020) stated that one of the objectives of systematic reviews is to provide answers to specific research questions. Thus, this systematic review contributes to this field of study by answering what are the technostressors students face and the coping strategies they apply when engaged with e-learning applications specifically. If administrators of e-learning are to effectively resolve this issue, it is crucial that they understand how students experience e-learning technology in particular, and not just technology as a whole.

Besides that, despite the growing number of empirical studies about student technostress and coping studies, it is unclear whether the findings of particular studies are sufficiently

robust to guide decision-making. Much like any field, policy and practice in the field of education should be guided by the findings within a body of evidence instead of any singular study (Zawacki-Richter et al., 2020). Aside from collecting and comparing conflicting evidence from multiple sources (Charrois, 2015), the application of a systematic literature review is also useful for mitigating bias in the selection of research studies, evaluating the quality of selected studies, and objectively summarizing the findings while being transparent about the process (Dowd & Johnson, 2020). Given that researchers have already carried out several empirical studies in the area of student technostress and coping, a methodologically transparent analysis of these findings significantly contributes to this field of study by fortifying decisions that emerge from their analyses.

ICT is widely used to support learning activities (Livingstone, 2012; Goldhammer et al., 2016), making the exploration of technostress among students a matter of interest. Learning with ICT offers many benefits such as flexibility, interactivity and collaboration (Ferri et al., 2020; Huang et al., 2020). On the flip side, high exposure to ICT also makes one vulnerable to its stressors (Camarena & Fusi, 2022). While several studies have been conducted, neither the technostressors nor the coping strategies applied by students in e-learning environments have been systematically defined by previous studies. This study aims to fill the gap in technostress literature by systematically reviewing the technostressors faced by students when engaging with learning technology, as well as the coping strategies they use to cope with it. Additionally, this study will be the first to synthesise these coping strategies based on their two main subtypes as postulated by Lazarus and Folkman (1984), which are problem- and emotion-focused coping. Furthermore, this study will be the first to view technostress coping strategies through the

lens of the metacognitive effort students apply to cope with the challenges of e-learning as proposed by Tsai (2009).

### 1.3 Research Objectives

The research objectives of this study are as follows:

1.0 To systematically review the technostressors faced by students in e-learning environments based on research published in journal articles, book chapters, reports, conference papers and dissertations.

2.0 To systematically review the coping strategies used by students to cope with technostress in e-learning environments based on research published in journal articles, book chapters, reports, conference papers and dissertations.

2.1 To systematically review the problem-focused coping strategies used by students to cope with technostress in e-learning environments based on research published in journal articles, book chapters, reports, conference papers and dissertations.

2.2 To systematically review the emotion-focused coping strategies used by students to cope with technostress in e-learning environments based on research published in journal articles, book chapters, reports, conference papers and dissertations.

## 1.4 Research Questions

This study aims to answer the following research questions:

1.0 What are the technostressors faced by students in e-learning environments based on the systematic review of research published in journal articles, book chapters, reports, conference papers and dissertations?

2.0 What are the coping strategies used by students to cope with technostress in e-learning environments based on the systematic review of research published in journal articles, book chapters, reports, conference papers and dissertations?

2.1 What are the problem-focused coping strategies students use to cope with technostress in e-learning environments based on the systematic review of research published in journal articles, book chapters, reports, conference papers and dissertations?

2.2 What are the emotion-focused coping strategies students use to cope with technostress in e-learning environments based on the systematic review of research published in journal articles, book chapters, reports, conference papers and dissertations?

## 1.5 Conceptual Framework

This study begins with an analysis of the technostressors faced by student engaged in e-learning. As per Tsai's (2009) conceptualization of the Model of Strategic e-Learning, the larger rectangle in the problem analysis stage represents the dimensions or nature of online learning environments (e.g., school, university, social media). The four dimensions of the learning environments (i.e., flexible time and space, indirect social interactions, abundant information resources and dynamic learning interfaces) pose unique advantages and challenges to learners (Tsai, 2009). Within the learning environment, specific

technological characteristics as proposed by Ayyagari et al. (2011) prevail (i.e., usefulness, complexity, reliability, presenteeism, anonymity and pace of change). These technological characteristics provide a basis for identifying the technostressors experienced by students (Ayyagari et al., 2011). Students conduct a primary appraisal by measuring their abilities against the demands made by technology (as defined by the technological characteristics). This ascertains if they experience the demands as a technostressor or not (Tarafdar et al., 2019). The technostressors that they face include but is not limited to overload, invasion, complexity, uncertainty and insecurity as proposed by Tarafdar et al. (2007), Ragu-Nathan et al. (2008) and Upadhyaya and Vrinda (2020), social isolation as suggested by Phirangee and Malec (2017); Phirangee (2016), lack of personalized attention as suggested by Kim et al. (2021); Nassar (2021), addiction as described by Young (1998); Li et al. (2019); Leung (2014), cyberbullying as proposed by Patchin and Hinduja (2006; 2015) and social pressure and privacy disclosure as proposed by Schmidt et al. (2021).

The first research objective of this study is to systematically review the technostressors faced by students in e-learning environments. The various modalities of e-learning such as synchronous and asynchronous learning, distance and in-person learning, the use of applications specifically developed for learning and otherwise and the use of personal devices and institution-provided devices pose unique advantages and challenges to students. These modalities fall under the larger characterization of the nature of online learning environments proposed by Tsai (2009). The use of various types of devices and applications that support these modalities (e.g., video-conferencing, text messaging, LMS, social media) have unique technological characteristics as postulated by Ayyagari et al. (2011). Thus, the present study aims to identify technostressors students face with

regard to the overarching nature of e-learning environments and the technologies used. Identifying the technostressors concludes the problem analysis part of this study.

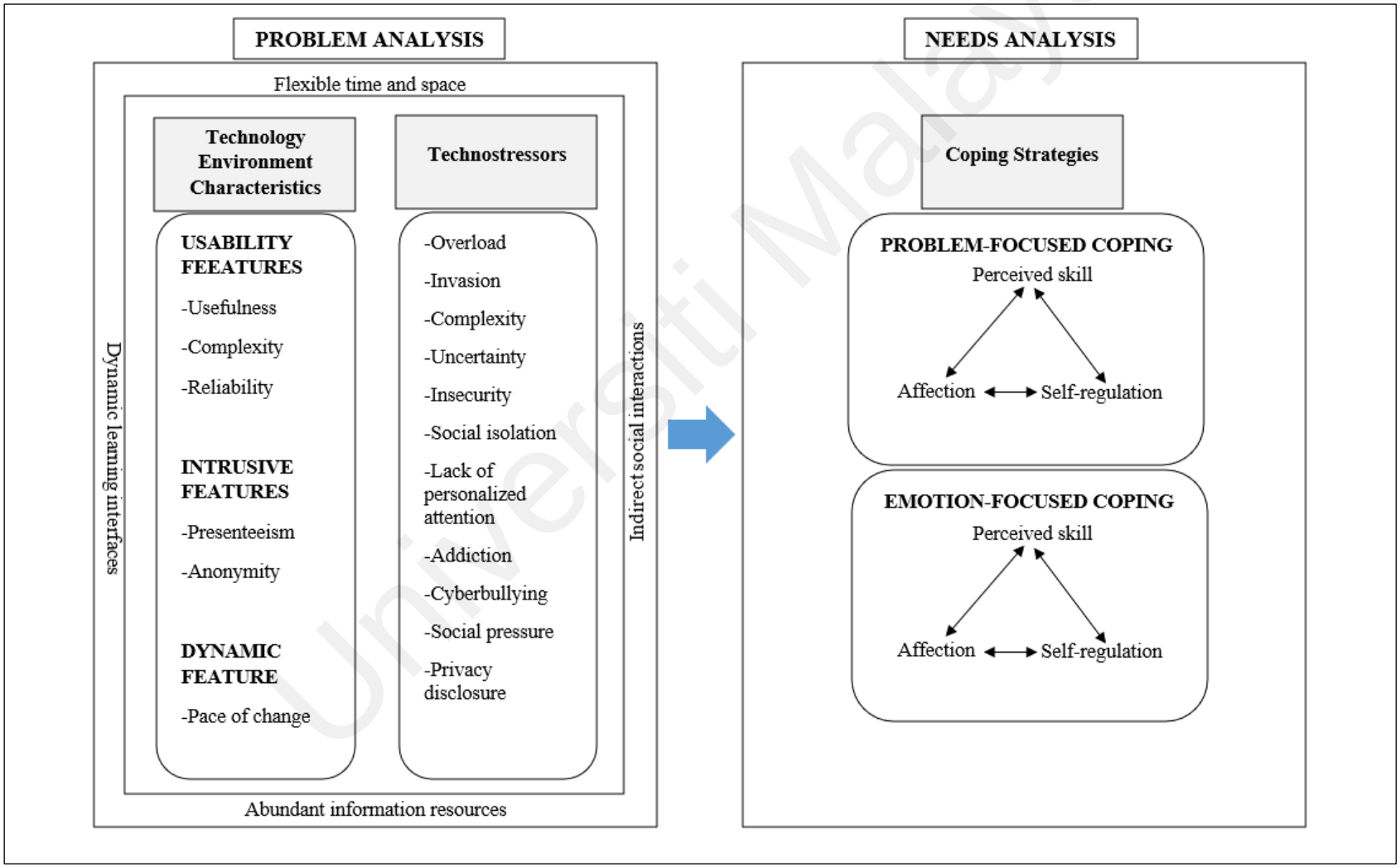
The second research objective of this study is to systematically review the coping strategies used by students to cope with technostress in e-learning environments. An analysis of students needs identifies the various coping strategies which help them overcome the technostress experienced. Prior to deciding on coping strategies, students carry out a secondary appraisal to assess their control over the situation (Kaiseler et al., 2012). During the secondary appraisal, students assess their coping options, the likelihood that the chosen option will resolve their problem and the likelihood of them executing it successfully. Once this assessment is conducted, students decide between problem and emotion-focused coping strategies. If they perceive that they can alter stress-causing elements in their environment, they need problem-focused coping strategies. If they perceive that they cannot take specific actions to modify things in their environment, they require emotion-focused coping strategies (Lazarus & Folkman, 1984). This meets the two sub-objectives of the second research objective, which is identifying the problem- and emotion-focused coping strategies students use to cope with technostress in e-learning environments.

The two sub-objectives are explored in terms of the online learning strategies as proposed by Tsai (2009) that improve students' perceived skill, self-regulation and affection towards learning. For example, within the domain of problem-focused coping, one can improve their self-regulation by changing one's personal habits to adjust to the demands of the technology used (Beaudry & Pinsonneault, 2005). Another example would be distancing from ICTs to cope with stressful events (e.g., anxiety) as an affective strategy

within the emotional-focused coping domain (Weinert et al., 2013). The final output of this study is the problem- and emotion-focused coping strategies that students can employ to overcome technostress in e-learning environments. The conceptual framework of this study is presented below.

**Figure 1.1**

*Conceptual Framework*



## 1.6 Significance of Study

Prior studies have extensively explored technostress in the workplace while research conducted in learning institutions is relatively limited. Within this limited work, more emphasis has been given to investigating technostress from the perspective of educators at various levels (Wang, Tan & Li, 2019). At present, there have been systematic reviews conducted to synthesise teachers' and administrators' experiences with technostress (Fernández-Batanero et al., 2021; Nang et al., 2022; Ata & Saltan, 2023). Despite the emergence of studies related to students' experiences in recent years, no reviews have been conducted to synthesize its findings in e-learning environments. Additionally, no reviews have been conducted to ascertain what is known about the ways students cope with technostressors when using e-learning applications.

The present study consolidates existing research to highlight the technostressors students of all levels face in e-learning environments, whether in-person, remote, synchronous or asynchronous. This study highlights the pain points that must be considered by educators and e-learning policymakers when designing learning with ICT modalities. Additionally, this study is the first to consolidate the coping strategies, specifically the problem- and emotion-focused coping strategies students apply. Coping is how individuals mitigate physical, psychological or social damages incurred by stress (Gallagher et al., 2021). This study will help learning administrators understand how students manage stressors. This will enable them to provide suitable resources to encourage effective coping strategies. Besides that, they can gain a better understanding of maladaptive coping behaviours students exhibit as a form of coping.

## 1.7 Purpose of Study

This study aims to analyse and synthesise the technostressors students experience and coping strategies they apply in e-learning environments as identified by existing literature. Additionally, this study synthesises the specific problem- and emotion-focused coping strategies students use to cope with e-learning technostress. Through this synthesis, this study aims to highlight what is known about student technostress and coping, and the gaps in the literature that could guide future research in this area.

## 1.8 Rationale of Study

ICT has made significant contributions to the field of learning. However, recent literature indicates that technostress is an issue that persists. Several empirical studies have effectively identified the technostressors experienced by students such as techno-overload, techno-complexity, techno-invasion, techno-uncertainty and techno-insecurity (Upadhyaya & Vrinda, 2020; Sharma & Gupta, 2022). However, no studies have systematically consolidated this information.

The use of a systematic literature review in the present study is justified not only by its ability to provide an overview of technostressors and coping strategies but to also provide a deeper analysis of these factors. By reviewing the available literature, this study aims to pinpoint the most prominent technostressors and coping strategies, the contextual backing behind conflicting findings and the interplay between the stressors and strategies that emerge. A systematic literature review provides a holistic view of existing findings that effectively guide evidence-based decision-making in the area of e-learning.

## 1.9 Limitations of Study

Systematic literature reviews effectively synthesise knowledge in areas where extensive empirical research has already been conducted, however, it is subject to certain limitations. By reviewing existing studies, the present study only highlights what is known. It does not expand our understanding of undiscovered technostressors or coping strategies within e-learning environments which an empirical study could address. Besides that, this systematic literature review only includes studies published in the English language. This decision was guided by the researcher's language proficiency. Therefore, papers conducted in other languages which may explore the phenomena of technostress and coping in different contexts and cultures are excluded from this review, potentially limiting the findings.

## 1.10 Definition of Terms

***Cognitive reinterpretation:*** Cognitive strategies to alter the meaning of stress-inducing encounters within e-learning environments.

***Coping strategy:*** Mental or behavioural efforts to overcome the situational demands of ICT usage in e-learning which exceed students' abilities.

***Desiderative thinking:*** Cognitive strategies which personify the wish that an encounter with e-learning is not stress-inducing.

***Disengagement:*** An effort to evade or downplay stressful encounters within e-learning that negatively affect one's mental well-being.

***E-learning:*** Learning facilitated by digital devices, both synchronous and asynchronous, in-person and from a distance.

***Learning environment:*** The physical and psychological setting in which students learn.

***Technostressor:*** The demands of e-learning technology which invoke stress in students.

## 1.11 Summary

Prior research about technostress has predominantly focused on individuals in work-related settings (Kader et al., 2022), while the minimal studies in educational settings are primarily centred around teachers' technostress instead of students (Wang, Tan & Li, 2019). Nevertheless, there are a number of studies exploring students' technostress. While there are a few systematic and scoping reviews studying this phenomenon in e-learning environments, none of these reviews focus on the experience of students specifically (Fernández-Batanero et al., 2021; Nang et al., 2022; Ata & Saltan, 2023; Bhatt & Kothari, 2022). Additionally, no systematic reviews have been conducted to synthesize what is known about the ways students cope with technostress in e-learning environments. This study is highly valuable in that it provides an overall view of the technostressors faced by students in e-learning environments as well as the coping strategies used to overcome the specific issues outlined. The next chapter will present supporting theories which will guide this study as well as a review of relevant past works.

# CHAPTER 2

# LITERATURE REVIEW

## 2.0 Introduction

This chapter begins with the theoretical framework which serves as the basis of this study. This is followed by a review of past literature about e-learning in schools and universities, private tuition and e-learning via social media. The review also includes what is known about the technostressors experienced and coping strategies applied by students. Finally, this chapter concludes with a brief summary of the theoretical framework and the topics explored in the literature review.

## 2.1 Theoretical Framework

### 2.1.1 Transactional Theory of Stress and Coping

One of the theories used to guide the design of this study is the Transactional Theory of Stress and Coping by Lazarus and Folkman (1984). This theory suggests that stress does not stem singularly from individuals nor their environments, but rather it comes from the ongoing process of interactions between them. Even when facing identical situational circumstances, different people were found to experience different levels of stress and apply different coping methods (Lazarus and Folkman, 1984). This section will describe the cognitive appraisal process and the different types of coping strategies.

#### 2.1.1.1 Cognitive Appraisal

Cognitive appraisal is a personal assessment of an event that affects the degree to which it is perceived as stressful (Campbell et al., 2013). Cognitive appraisals are affected by two causal antecedents which are person-related factors, such as personal commitment

towards particular goals and beliefs, and situational factors such as prior experiences, predictability, uncertainty, time-constraints, timing of stressful events and overall situational clarity (Lazarus & Folkman, 1984). Cognitive appraisal into two main steps which are primary and secondary appraisal (Simães et al., 2021).

According to Carpenter (2016), during a primary appraisal of an interaction, a person evaluates if an encounter is irrelevant, benign-positive or stress-inducing. An encounter which is irrelevant is non-consequential to the person. An encounter which is evaluated to be benign-positive does not burden the person and is expected to produce benefits or favourable outcomes. Whereas, stress-inducing evaluations involve losses, threats and challenges. Losses relate to damage or injury that has already occurred. Threats are the anticipation of future losses, whereas challenges are threats that can be resolved and are perceived positively as an opportunity for advancement. Loss, threats and challenges lead to a secondary appraisal of the matter. Based on Glanz and Schwartz (2008) secondary appraisal involves the evaluation of potential actions that can be taken to deal with the circumstances. Examples of this include one's perceptions about their ability to alter events, perceptions about one's ability to take control over their emotions as well as perceptions about the efficacy of available coping resources.

#### 2.1.1.2 Coping

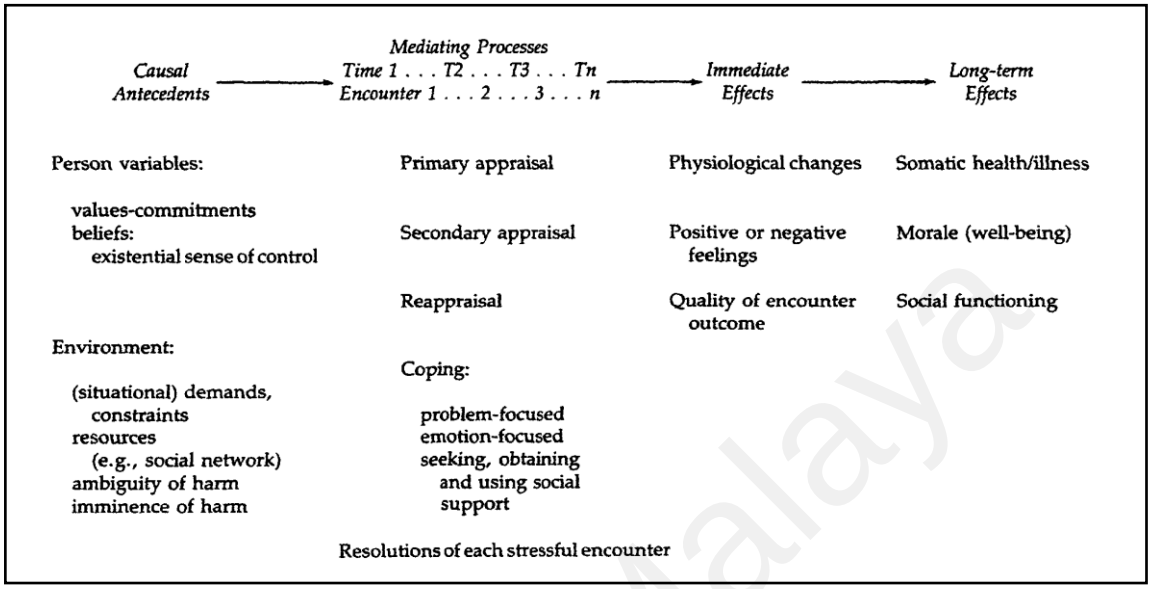
Coping is an attempt to inhibit or reduce threat, harm and losses, or lessen the stress that is typically linked to those events. There are two main forms of coping, namely emotion-focused coping and problem-focused coping (Carver, 2013). Emotion-focused coping serves to change how a person perceives a situation as well as regulating negative emotions (Zhao et al., 2020). Emotional coping strategies include venting, positive

reframing of situations, pursuing social support, diverting one's attention away from the problem and indulging in intoxicants (Krischer et al., 2010). Some people need to feel negatively about an event, before they can feel positively about it again. Other people purposely increase their stress in order to push themselves to action (Lazarus & Folkman, 1984).

Problem-focused coping targets overcoming a stressful event, or addressing elements that cause the stress. Strategies of this category include eliminating the source of the stress, obtaining knowledge or help to manage the situation and distancing oneself from stress (Carroll, 2013). Strategies that are problem-centred are typically aimed at coming up with possible solutions, comparing them based on their benefits and disadvantages and carrying out the necessary steps (Baker & Berenbaum, 2007). Some solutions are aimed at altering some aspect of the environments, such as locating resources, removing barriers and changing existing procedures. Other problem-focused coping solutions are aimed at changing some aspect of one's self. This can involve gaining new skills, cultivating new behaviours, finding other sources of fulfilment and the like (Lazarus & Folkman, 1984).

**Figure 2.1**

*A Theoretical Schematization of Stress, Coping and Adaptation (Lazarus & Folkman, 1984, p. 305)*

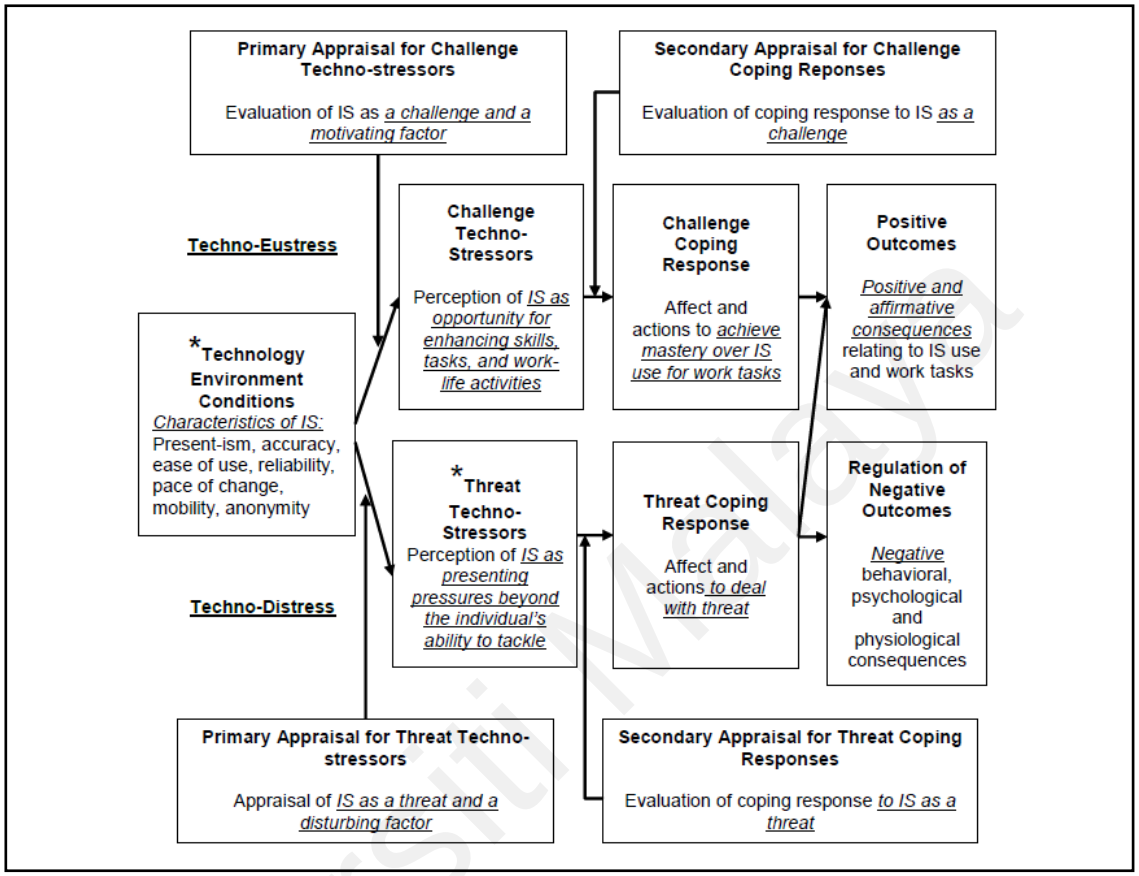



### 2.1.1.3 Application to Technostress Research

Based on the transactional theory, stress is defined as a process that concerns environmental circumstances, which an individual evaluates as exceeding their resources, which compels the activation of coping responses that result in somatic, cognitive and behavioural outcomes (Tarafdar et al., 2019). This conception of stress has shaped technostress research. Studies have investigated characteristics of technology (Ayyagari et al., 2011), individuals' perception of technostressors (Tarafdar et al., 2007, Maier et al., 2015; Qi, 2019), technostress coping responses (Beaudry & Pinsonneault, 2005; Ortiz de Guinea, 2016; Zhao et al., 2020) and technostress outcomes (Ragu-Nathan et al., 2008; Tarafdar et al., 2010, Zhao et al., 2022). Below is the interplay of these components as conceptualized by Tarafdar et al. (2019).

**Figure 2.2**

*A Conceptualization of Technology Environment Conditions, Technostressors, Coping Responses and Outcomes (Tarafdar et al., 2019, p. 16)*




Based on the Transactional Theory of Stress and Coping, environmental conditions is one of the antecedents to stress (Lazarus & Folkman, 1984). Technology conditions are the features of information systems that have the ability to make demands from its users. It is the characteristics of technology systems (e.g., presenteeism, reliability, anonymity) that create technostress for its users (Ayyagari et al., 2011). The primary appraisal of technology users in technology environments lead them to perceive challenge technostressors and threat technostressors. Challenge technostressors or "techno-eustress" is experienced when individuals perceive an event as an opportunity to enhance their skills and competencies. Whereas threat technostressors or "techno-distress" is experienced when individuals perceive an event more negatively (Tarafdar et al., 2019). ICT stressors compel users to adapt and cope with them. A secondary appraisal of the

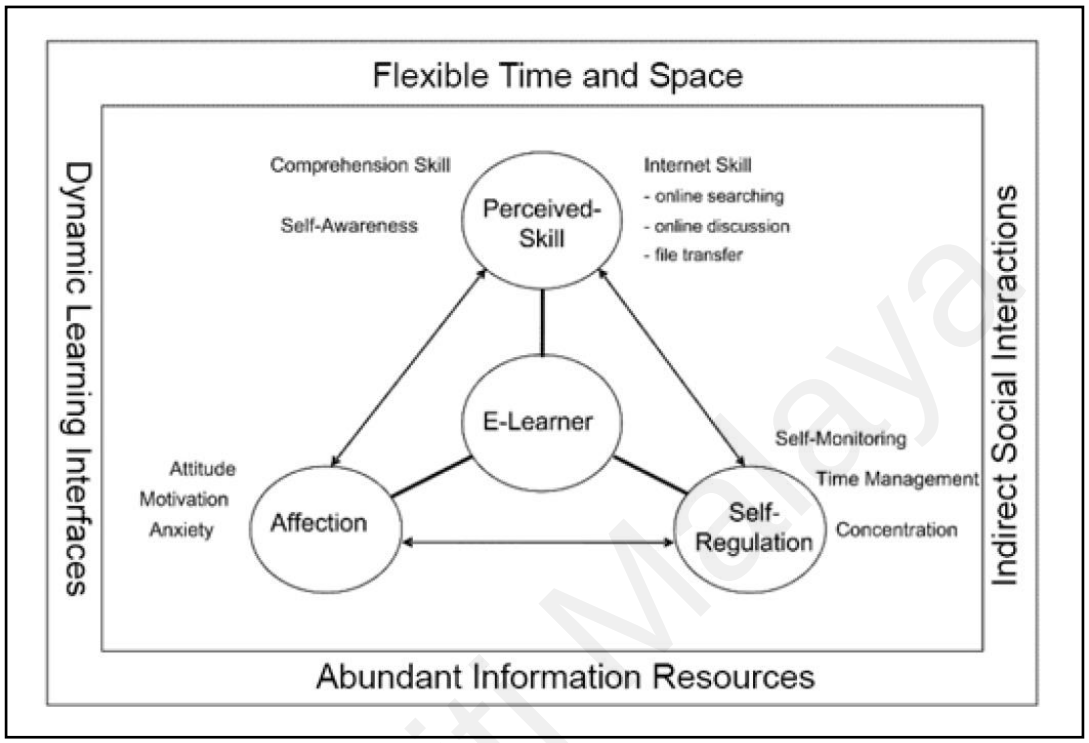
challenge and threat coping responses informs the user about their control over the ICT event. Based on their level of control, individuals choose between different problem- and emotion-focused adaptational strategies in order to cope effectively (Beaudry & Pinsonneault, 2005). Other coping responses include the expression of negative emotions, ascribing negative IT events to external factors (Ortiz de Guinea, 2016) and even disengagement from information security policy requirements (D'Arcy et al., 2014).

Finally, the implementation of coping responses helps users generate positive outcomes as well as manage negative outcomes of stressful events. The negative outcomes of technostress have generally been referred to as 'strain'. Technostress has been found to reduce job satisfaction, lower organizational commitment (Ragu-Nathan et al., 2008), increase role stress, reduce productivity (Tarafdar et al., 2007), reduce end-user satisfaction and hamper performance (Tarafdar et al., 2010). Some positive outcomes of implementing coping strategies include improved efficiency, reduction of the perceived threats of using technology and the reinstatement of users' emotional well-being (Beaudry & Pinsonneault, 2005). While coping responses may help ameliorate stress, it does not always lead to the most ideal outcome. For instance, the disengagement from adhering to information security policy requirements as a form of coping leads to increased noncompliance of set protocols (D'Arcy et al., 2014).

### 2.1.2 Model of Strategic e-Learning

**Figure 2.3**

*Model of Strategic e-Learning (Tsai, 2009, p. 41)*




The Model of Strategic e-Learning by Tsai (2009) depicts the challenges that exist in online learning environments and the strategies students can apply to effectively manage them. This model is an adaptation of Weinstein's (1994) Model of Strategic Learning which explores challenges and strategies in face-to-face learning environments. The outer rectangle represents the four dimensions of online learning environments which presents challenges to students. The four dimensions are flexible time and space, indirect social interaction, abundant information resources and dynamic learning interfaces. The learner is at the centre of the model, and the three nodes which extend out of it are the domains of learning strategies that can be applied to deal with the aforementioned online learning challenges. The strategies (i.e., perceived skill, affection and self-regulation) are connected as they interact and are associated with one another.

#### 2.1.2.1 Student Learning Strategies in Online Learning

The learning strategies of students are defined as "any thoughts, behaviors, beliefs, or emotions that facilitate the acquisition, understanding, or later transfer of new knowledge and skills" (Weinstein et al., 2000, p. 733). According to Weinstein (1994), the learning strategies that students can employ to be academically successful are categorized into three components which are skill, will and self-regulation. 'Skill' refers to a variety of knowledge that makes one an expert learner. As cited in Weinstein et al. (2000) based on the work of Weinstein (1994), skills include knowledge about oneself as a learner, knowledge about the nature of learning tasks, knowledge about learning methods and competencies and knowledge about the contextual underpinnings of things learnt. It also includes knowing how to apply different learning strategies, identifying key concepts when learning, effective reading, listening and note-taking, preparing for assessments and applying sound problem-solving and thinking skills. 'Will' is the affective and motivational aspect of learning. It includes the setting of goals, motivation to achieve, affect towards learning (e.g., curiosity, apathy), beliefs about one's ability and self-efficacy, volition towards learning, and development of a positive mindset pertaining to learning. Finally, 'self-regulation' refers to how learners manage their course of learning. This includes time management, ensuring sustained concentration, monitoring comprehension of learning content, managing academic stress, managing motivation levels and undertaking a systematic approach to learning. A systematic approach comprises of setting goals, curating a plan of action and choosing specific strategies to attain the goal, implementing them, formatively assessing progress, making changes to the set goals and strategies as required and summatively assessing the final outcome (Weinstein et al., 2000).

Based on findings from in-depth interviews, Tsai (2009) determined the three components of e-learning strategies to be perceived skill, affection and self-regulation. 'Skill' was changed to 'perceived skill' as it was difficult to ascertain students' actual skill level from the interview data. It is tough to ascertain the metacognitive skills of students in online learning due to the cognitive overload from processing an abundance of information. Based on Tsai's conceptualization, skill is comprised of comprehension of learning content, Internet competency and self-awareness about one's roles and duties ascribed by online learning. Based on Atto and Kotova (2019), honing students' skills help them effectively resolve challenges posed by LMS usage. Orientation sessions help new students learn how to use the LMS and helpdesk services support them in resolving issues they may face when using the platform.

Next, Tsai (2009) modified 'will' to 'affection' to provide a broader definition which adequately describes its subconstructs. Affection consists of attitude towards online learning and motivation to engage in online learning, in addition to anxiety which was included based on the interview findings. Anxiety relates to students' feelings about the ever-changing nature of e-learning systems. Yoshida et al. (2016) furthered Tsai's conceptualization of anxiety which focuses on individuals as self-regulated learners to explore anxiety from a social perspective with regard to online collaborative learning. They identified three subscales of anxiety in the context of collaborative learning, namely computer anxiety, online learning anxiety and communication anxiety. Computer anxiety relates to one's apprehension about using the computer device and systems correctly, while online learning anxiety refers to the fear of Internet-based learning and achieving online cooperative learning goals. Communication anxiety is regarded as apprehension about one's ability to effectively communicate with peers, participate in discussions and engage with new acquaintances in the online collaborative learning scene.

Acknowledging learners' social anxiety will improve the quality of online cooperative learning (Yoshida et al., 2016). In another study, Castillo et al. (2021) found that the more positive a student's attitude towards online learning, the lower the levels of anxiety experienced. Besides that, students' own perception about the state of their mental health significantly predicted their anxiety. This suggests that different components under the 'affective' subconstruct influence each other.

Finally, Tsai (2009) conceptualized self-regulation as comprising self-monitoring of learning strategies applied, concentration and time management. In order to effectively self-monitor, a student must comprehensively understand the tasks and subtasks that need to be performed in order to set suitable goals and oversee their progress. Time management skills are needed to cope with the flexible nature of online learning. Meanwhile, concentration helps students deter themselves from getting distracted by the other attractions online. Tsai also suggests that bidirectional relationships exist between skill, affection and self-regulation such that the strategies may be associated with one another. In a study of Taiwanese university students by Yang (2012), it was found that poor self-monitoring and concentration (as it relates to self-regulation) caused them to feel demotivated (as it relates to affection) when learning the English language with online materials. While the materials were suitable for learning with the instructor in the classroom, the same could not be said when they navigated the materials unsupervised at home. Another study by Marimuthu et al. (2013) also proved that the strategies from the three domains interact with one another. The internet literacy, concentration, self-monitoring and motivation of diploma students in an English course positively predicted one another. Similarly, Atto and Kotova (2019) proposed that an improvement in students' self-management in online learning can lead to motivation to adhere to their academic schedule.

#### 2.1.2.2 Characteristics of Online Learning Environments

Weinstein (1994) also ascertained some dimensions by which learning environments can be examined. These dimensions are the nature of learning tasks, social support, available resources and learning systems. Based on the dimensions of learning environments by Weinstein (1994) and the findings in Internet-based learning settings by Miller and Miller (2000) and Linn et al. (2004), Tsai (2009) defined four characteristics of online learning environments that challenge students. The first feature of online learning is flexibility in time and space. While online learning provides flexibility and convenience in terms of the time and place in which learning takes place, it also gives students plenty of autonomy in managing their learning. Students need to be conscious about their duties, set learning goals, make study plans, monitor their progress, keep focused and manage their time for learning tasks. Beginners in online learning may not have the necessary skills and strategies to perform these tasks. According to Yang (2012), students struggle to manage their time for online learning. Instead of learning using the online resources provided, students spent their time away from class indulging in leisure activities. While the materials were suitable for supervised class activities, students failed to engage with the materials unsupervised at home. This finding is corroborated by Atto and Kotova (2019) who states that students are unable to manage their time and allocate enough time for learning.

The second feature of online learning environments proposed by Tsai (2009) is indirect social interactions. The lack of face-to-face interactions particularly in asynchronous learning causes students to feel socially isolated. Besides that, social support is no longer limited to the immediate stakeholders (i.e., teachers and peers), rather it can be obtained from the global Internet community. Furthermore, students may not take very well to the evolved role of teachers as just facilitators of learning in online environments. Thus,

students must be well-equipped with cooperative and negotiation strategies in order to get the social support they need online. On the other hand, Yang (2012) suggests that online platforms like forums and chat features give shy students the confidence to participate in discussions. The third feature of online learning environments described by Tsai (2009) is the abundant information resources. Although the Internet provides a great variety of information, it is up to students to ascertain the quality and reliability of the information found. Not only do students need to know how to look for information, they also need to assess, integrate and evaluate the information found. Besides that, the abundance of information resources could cause anxiety due to feelings of overload which students must learn to manage. As supported by Yang (2012), English language learners felt demotivated when faced with learning materials whereby the reading passages were long and difficult to interpret.

Finally, the fourth feature of online learning environments by Tsai (2009) is dynamic learning interfaces. With quick developments in technology, the online platforms used to mediate the interactions between teachers and students also undergo rapid change. Students' drive to learn, attitude towards learning and accomplishments depend on well-designed interfaces and functional systems. Unreliability of technological system causes stress towards learning online. Therefore, students need to understand the essence of how Internet technology works, how to use new applications and ways to manage them. They also need to know how to leverage available resources to solve the problems faced, in addition to developing a good attitude about Internet usage. Based on Atto and Kotova (2019), one of the problems students faced with their institution's LMS is not knowing how to properly utilize the functionalities afforded by the platform.

## 2.2 Literature Review

### 2.2.1 E-learning in School

Based on the Malaysia Education Blueprint 2013-2025, the Ministry of Education is committed to ensuring that school students leverage ICT to advance their learning. One way of achieving this is through the application of 'blended learning', or the combination of in-person and ICT-supported instructional approaches. One of the initiatives underlined in this blueprint is the provision of a virtual learning platform and internet access to 10,000 primary and secondary public schools under the 1BestariNet project (Kementerian Pendidikan Malaysia, 2013). The Frog Virtual Learning Environment (Frog VLE) was introduced as a cloud-based platform which enabled two-way learning, communication and resource-sharing between school administrators, teachers, students and parents. The platform was first introduced in primary schools in 2013 (Phoong et al., 2020). The platform was also used to support flipped learning whereby students are furnished with learning materials (e.g., video lectures, notes) prior to lessons (Noh et al., 2017; Ang et al., 2018). The learning community faced several challenges in adopting the platform for the purpose of teaching and learning such as inadequate ICT facilities (Cheok & Wong, 2016; Cheok et al., 2017) and low ICT competency (Awang et al., 2018). In mid-2019, the 1BestariNet project was discontinued (Kementerian Pendidikan Malaysia, 2019).

The following year, the Malaysian government launched the Digital Educational Learning Initiative Malaysia (DELIMa) platform which integrated Google Classroom, Microsoft Office 365 and Apple Teacher Learning Centre to bring unified teaching and learning applications to Malaysian schools (Microsoft, 2020). In collaboration with Google, Malaysian schools adopted the G Suite for Education package for teaching and learning (Yusoff et al., 2021; Saimi & Mohamad, 2022). The package includes

communication, collaboration, productivity and task organization tools that can support the teaching and learning process such as Google Meets, Google Classroom, Google Documents and Google Calendar (Google, 2022). Similarly, the Microsoft Office 365 Education package provides a variety of tools such as Microsoft Word, Microsoft Excel, Microsoft PowerPoint, Microsoft Teams and Microsoft OneDrive (Microsoft, 2022). Finally, the Apple Teacher Learning Centre is a platform which allows teachers to learn how to best utilize Apple products for the purpose of teaching and learning. To date, there are seven Apple Distinguished Schools in Malaysia (Apple, 2022).

Samsudin (2021) states that the COVID-19 pandemic sped up the adoption of ICT in the Malaysian education system. Schools were ordered to close and commence online learning following the movement control order (MCO) in mid-March 2020. When conditions began to improve, schools were allowed to open in stages with restrictions in place. Depending on their ability to accommodate students, some schools underwent rotational mode whereby blended learning was used (Samsudin, 2021). Aside from the tools afforded by the DELIMa platform, schools also used game-based learning applications such as Kahoot and Quizizz as engaging methods of assessments following the delivery of lessons (Singh et al., 2020; Augustine et al., 2022). Besides that, social media applications (e.g., WhatsApp, Facebook) are used for delivering learning content, serving as a platform for students to do exercises and demonstrate what they have learnt (Wen & Tan, 2020), aside from facilitating communication with students and parents (Ramly et al., 2021). Furthermore, teachers could use video-based learning resources like EduWebTV and Cikgootube provided by the Ministry of Education to carry out teaching and learning activities (Ismail et al., 2021).

### 2.2.2 E-learning in Private Tutoring

Private tuition is a growing practice in the Malaysian education system. Private tutoring is no longer a luxury, instead it has been regarded a need by a significant proportion of students (Jelani & Tan, 2012). Bray (2007) defines private supplementary tutoring as a paid service whereby tutors provide supplementary instruction to students in the academic subjects they learn in school. There are several factors driving the uptake of private tutoring around the world. Parents believe that their children will perform better academically and feel compelled to invest in this service alongside mainstream schooling (Bray, 2009; Zhang, Cui, He, et al., 2022). According to Krishnaswamy et al. (2019), flaws in the school system such as lack of personalized attention, insufficient guidance for slower learners, fixation on heavy syllabus coverage, overly packed classrooms and insufficient practical lessons also drive the uptake of private tutoring. Based on Kenayathulla (2013), besides in-person tutoring, private tutoring is also conducted in online mode in Malaysia. In a study conducted by Kenayathulla (2016) of 4,200 Form 3 and Form 5 pupils, it was found that 8.4% of the respondents have attended online tutoring, and it is gradually gaining traction in Malaysia.

According to Ooi and Lim (2011), the Score A program is a web-based program which allows students to attempt an unlimited amount of practice questions to prepare them for examinations and cultivate their confidence. The study reported that primary school students at a tuition centre found the mathematics subject content highly relevant, contradictory to the reports of the secondary school students studied. This is likely due to secondary school syllabus being denser and more difficult to be comprehensively covered by the program. Besides that, the online program helped students reflect on their learning as it allowed them to think and develop their thoughts about the content learnt. Furthermore, this study indicated that students expected more support from their tuition

teacher compared to their peers when learning using the web-based technology. Peer interaction was limited when students worked individually on computers in a shared physical space (Ooi & Lim, 2011). Another way ICT has been introduced in the private tutoring is through the flipped classroom method. In a study by Halili and Sulaiman (2020), students were given English online learning materials to learn before attending in-person tutoring. Students reported becoming more active learners in the classroom and found more opportunities to converse with their peers and instructors in the English language. They also reported a higher level of motivation to learn using the flipped method compared to the regular method of teaching. Similarly, Tan et al. (2021), also found that interaction and motivation improved when using the flipped approach in a tuition centre. It also enabled instant formative feedback as discussions in class showed whether students successfully grasped the concepts learnt in the video-based lesson provided prior to the class. One of the disadvantages reported by the instructors was having to allot time to source and create video-based materials (Tan et al., 2021).

In the wake of COVID-19, Palanisamy and Sulaiman (2020) stated that all learning centres faced closures in an effort to curb the spread of the disease. This called for the use of platforms such as Zoom, Skype, Telegram, Google Classroom and Google Hangouts to carry out online synchronous lessons in private tutoring. Tuition centre administrators faced the challenge of having to upskill themselves to utilize technology in teaching besides having to prepare appropriate learning and assessment materials. Palanisamy and Sulaiman opined that even with the easing of restrictions, they do not expect that large tuition classes will exist anymore with social distancing restrictions in place. According to Azuar (2021), the demand for online-based tutoring surged as parents increasingly preferred this mode of lessons. Many tuition centres around the country have become aware of the feasibility of online tutoring. The demand for online tutoring is driven by the

need to prepare for examinations. They also help students catch up with studies due to the disruption in learning during the year prior.

### 2.2.3 E-learning via Social Media Platforms

Using social media for learning gives students access to a large variety of learning materials, at no cost for the most part (Bexheti et al., 2014). One of the benefits of social media tools is the ability to provide learners with more control and personalization, an advantage that institution-administered LMS have failed to do. Social media supports learners' informal learning, defined as learning through observation, experimentation, seeking assistance, communicating with other people, listening to people's recollections of experiences, reflections or learning driven by one's interests (Dabbagh & Kitsantas, 2012). Another benefit that social media grants learners is the unique affordances of its features. For instance, learning with YouTube videos enables learners to pause, fast forward and even go back to any part of a video to replay it (Hong et al., 2016). Besides that, applications like TikTok have gained popularity for language learning in English as a Second Language (ESL) courses for learning pronunciation and sentence construction (Anumanthan & Hashim, 2022). Some students also use the application to learn independently, outside of course requirements (Yang, 2020). However, exposing young-learners to a globally-accessible platform puts them at risk of cyberbullying and privacy concerns. More monitoring and regulations are required to safeguard these young learners online (Zhai & Razali, 2021).

Other studies warn of the distractive nature of social media and how it could potentially be addictive to students (Simsek et al., 2019). Addiction to social media could lead to a reluctance to partake in outdoor activities, thus contributing to health problems in learners. Furthermore, the continued involvement in online modes of communication will

hamper learners' in-person communicative abilities (Latif et al., 2019). Other studies pinpoint the contributions of social media in enhancing the communication of shy learners (Balakrishnan, 2017). Furthermore, social media learning enables students to connect with the global learning community as well as experts in the subject matter. It enhances engagement with other learners, instructors and the learning content. It invites students to collaborate on authentic, real-world projects and relate to the subject matter in new ways, merging the gap between formal and informal learning (Chen & Bryer, 2012).

In Malaysia, many learning institutions incorporate the use of social media in their everyday teaching and learning (Sim et al., 2014; Chung et al., 2020). Aside from this institution-enforced usage, students also depend on social media as a form of independent, informal method of learning (Ng et al., 2018). Based on Ng et al.'s study of 799 secondary school students, almost a third of them spent more than five hours a day on social media platforms for both academic and non-academic purposes. This is a cause for concern and alludes to the possible abuse of technology in the time to come. Generally, students valued the ability to acquire new knowledge, interact with others and enhance their English vocabulary. They showed a lower preference for learning alone, learning with teachers' support and learning via group chats (Ng et al., 2018). In another study of Malaysian university students, a majority of them agreed that Web 2.0 tools (e.g., Facebook and Wikis) expand their learning beyond the classroom. These tools gave them the flexibility to collaboratively learn with their peers, thus improving their individual learning (Ibrahim et al., 2014). Based on Temban et al. (2021), primary school students successfully use YouTube Kids as a supplementary learning tool. However, they also find the content to be limited compared to the regular version of YouTube. Unfortunately, all students reported having been exposed to varying types of harmful content on the regular YouTube platform.

### 2.2.4 Technostress in Students

Being born in the computer age, students are presumed to be competent enough to manage technology without facing technostress (Qi, 2019). Nevertheless, recent studies have found that students experience all five dimensions of technostress as postulated by Tarafdar et al. (2007). Tertiary students experience techno-overload, techno-invasion, techno-complexity, techno-uncertainty and techno-insecurity (Upadhyaya & Vrinda, 2020; Sharma & Gupta, 2022). Studies have also determined the validity of these constructs in higher education settings (Aziz & Yazid, 2021), the effects of technostress on students' satisfaction and performance expectancy when learning with ICT (Aziz et al., 2021; Aziz et al., 2022), the impact of technostress on students' quality of sleep and self-perception regarding academic ability (Yao & Wang 2023), as well as the impact of technostress on students' intention to continue participating in e-learning (Rafsanjani et al., 2023).

Aside from the widely used five-construct measure, studies in adolescents' technostress have investigated several direct and indirect stressors that come with the use of technology in learning. For instance, students felt socially isolated while engaging in e-learning during the COVID-19 pandemic due to school closures (Akuratiya & Meddage, 2020; Asanov et al., 2021). However, the issue of social isolation in online learning has long persisted and was a significant concern in e-learning even prior to the recent global health crisis. The physical separation of students from their peers and instructors reinforces feelings of disconnectedness in online learning (Phirangee & Malec, 2017; Phirangee, 2016). Besides that, students receive insufficient personalized attention from educators in technology-mediated learning (Chen, 2015; Kim et al., 2021; Nassar, 2021) leading to a higher attrition rate among learners (Glomb et al., 2009).

According to Wang, Tan and Li (2019), since technostress is the psychological response to misalignments between people and their environment, the application of the person-environment fit theory is vital to the study of technostress. In the context of higher education, Wang, Tan and Li (2019) applied the person-environment fit theory to define the relationship between students' abilities and needs against institutional demands and resources supplied. They hypothesized three dimensions of person-environment misfits in higher education institutes that explain technostress, namely person-organization misfit, person-technology enhanced learning misfit and person-people misfit. A misfit occurs when students' abilities are unable to meet the university's academic requirements, and keep up with e-learning practices and the expectations of other people in the learning environment. A misfit also arises when students' needs are not met with support from the university environment, support concerning e-learning practices as well as support and help from other people in the environment. Based on the application of the same theory, Erdoğan et al. (2022) found that technostress stemming from the use of ICT tools was slightly more prominent than that caused by the institution or other people in the learning environment despite university students being digital natives. Students who receive more psychological support, have a suitable learning environment, regularly participate in learning activities and have a better perception of distance education experienced lower levels of technostress.

### 2.2.5 Technostress in Adolescents

Adolescents are especially susceptible to being afflicted by the cognitive, psychological and bodily effects of technostress. Being that they are in the midst of their psychosocial development, they may not have the necessary faculties to deal with the challenges posed by digital technologies (Schmidt et al., 2021). One of the issues adolescents face when using web technologies is Internet addiction. Young (1998) described Internet addiction

as an impulse-control disorder whereby a person is unable to control their Internet usage. Much like other forms of addictions, Internet addictions can lead to a deterioration in performance at school, work as well as social relationships. According to Li et al. (2019), adolescents are more prone to Internet addiction and experience its adverse effects more profoundly than adults because of their ongoing personality and psychosocial development. Leung (2014) reported that adolescents who receive gratifications (i.e., in the form of status advancement, expression of personal viewpoints and identity experimentation) run a higher risk of falling victim to Internet addiction. Adolescents who are already facing the adverse effects of internet addiction (i.e., regression in academic performance and declining offline interpersonal relationships) will further turn to social media as a means of coping.

Another stressor that affects adolescents in online environments is cyberbullying (Chang et al., 2013, Wang, Musumari, Techasrivichien, et al., 2019). Cyberbullying is defined as the "wilful and repeated harm inflicted through the medium of electronic text" (Patchin & Hinduja, 2006, p. 152). A systematic review of cyberbullying in East Asia by Park et al. (2021) indicates that bullying behaviours differ across a variety of technological platforms. Besides that, adolescents who spend more time online and are confident Internet users are more likely to be perpetrators. The anonymity of identity in online spaces also contributes to cyberbullying. A significant portion of perpetrators of cyberbullying are also victims, implying that victims cope by bullying others. Students with poor academic performance also tend to be both perpetrators and victims of cyberbullying as compared to their higher-achieving peers in Asian countries (Park et al., 2021).

Besides that, adolescents experience social pressure as a stressor in online environments. Social pressure occurs when adolescents feel pressured by their peers to use certain technologies. Adolescents may defy rules set by their parents in order to conform with the expectations of their peers (Schmidt et al., 2021). Social pressure can take the form of trying to keep with trends and maintain a high social standing. For example, having more friends on online platforms is a display of popularity and prominence (Maier et al., 2012). Furthermore, privacy disclosure is a prominent form of stress for adolescents. This happens when the use of technology advances intentional or unintentional infringements of an individual's privacy (Schmidt et al., 2021). Adolescents face pressure to comply to requests of sensitive content such as explicit photographs from romantic partners. Besides that, friends (and romantic partners) exert pressure by demanding access to sensitive information such as passwords to social media accounts (Weinstein & Selman, 2016).

### 2.2.6 Technostress Mitigation in Students

Prior research in technostress mitigation among students have highlighted the important role of administrative support from institutes of learning. Zhao et al. (2022) found that when institutes of higher education create supportive learning environments, their students report lower levels of technostress. Similarly, a study by Mehrolia et al. (2021) found that literacy facilitation, technical support provision and involvement facilitation provided by the institution significantly reduced technostress in higher education students. Wang, Tan and Li (2019) which investigated technostress from the perspective of person-environment fit theory also reinforced the role of institutes in effectively communicating academic requirements and offering adequate support to learners. Besides that, self-efficacy has also been linked to lower technostress in students (Ingusci et al., 2023). However, the findings of recent studies propose a different outlook. Qi (2019) found that the use of mobile devices in learning does not cause technostress, and ICT self-

efficacy is not a prominent coping factor for university students. Similarly, Zhao et al. (2022) concluded that ICT competence was not an obstacle faced by students as they are tech-savvy enough to manage it. Instead, these students were more prone to facing stress due to academic demands.

Furthermore, social support from peers is associated with decreased technostress among students. Social support was found to mediate the relationship between technostress in e-learning and the self-perception of health in male university students (Asensio-Martínez et al., 2023). Learning communities help students develop good attitudes and gratifying experiences within ICT-supported learning (Wang, Tan & Li, 2019). Bonds formed outside the classroom also positively build social capital which effectively reduce students' technostress (Abbas et al., 2020). However, it is worth noting that while peer support may improve students' ICT skills, it may not have direct effects on technostress reduction (Zhao et al., 2022). Another study highlighted the role of the mindset and perception towards technostress (Garg et al., 2022). They suggest that gratitude and positive reevaluations of situations can effectively reduce technostress in university students. Similarly, a recent study by Ingusci et al. (2023) found optimism to be a factor that directly reduces technostress experienced by university students.

### 2.2.7 Technostress Mitigation in Adolescents

A study on online gaming addiction found that adolescents who actively try to reduce their own participation in online games successfully mitigated their addiction levels. Education about the adverse effects of excessive gaming proved to effectively deter adolescents from over-indulging in online games, thus decreasing addiction (Xu et al., 2012). Besides that, Li et al. (2016) stated that the adoption of positive coping strategies

(e.g., problem-solving, attaining social support) to cope with stressful life events indirectly reduces Internet addiction. Stressful life events contribute to unmet psychological needs (e.g., relatedness, competence, autonomy) in adolescents. To compensate for their unmet needs, adolescents turn to the Internet to satisfy these needs and may develop an addiction to it. Positive coping strategies help adolescents reframe stressful life events as opportunities for growth, thus reducing unmet needs and Internet addiction. Another study by Gao et al. (2022) found that adolescents who have better relationships with their parents and peers experience lower mobile phone addiction, mediated by the satisfaction of their psychological need for autonomy and competence.

Based on Weinstein et al. (2015), adolescents found the best strategy for overcoming bullying and harassment in online spaces is to seek help from others. This includes getting necessary help from peers, parents, school and legal authorities. Adolescents suggested communicating directly with the person or "stressor", cutting off contact and avoiding the encounter as a way to deal with the challenges of navigating interpersonal relationships in online spaces (Weinstein et al., 2015). According to Schmidt et al. (2021), adolescents cope with infringements of their privacy by following rules laid down by parents and schools, avoiding stressful technology, curbing negative emotions and acquiring their own devices. They use the same coping strategies to deal with social pressure in online spaces, with the exception of adhering to parents' rules. Instead, social pressure is better dealt with by adopting a mindful approach to ICT usage.

### 2.2.8 Socioeconomic Determinants of Technostress and Coping among Students

Socioeconomic factors also play a role in the prevalence of technostress in e-learning. According to Priyadarshini & Pattnaik (2021), urban and rural populations in India face

a wide disparity in Internet access and ICT device ownership. The rural poor cannot afford this infrastructure and the disruption towards their studies poses significant stress. Sharma and Gupta (2022) propose that universities equip students with device rentals, Internet access, and the software programs needed to help students overcome technostress. Rural students also face difficulty coping with e-learning due to insufficient ICT skills (Carri, 2023). Interestingly, Fu et al. (2023) found that students' location of residence (as it relates to affluence) bore no significance in predicting students' technostress coping behaviour in China. Contrastingly, Peng and Yu (2022) found that students from families of high socioeconomic standing and parental educational attainment lead to better ICT literacy in students, thus circumventing technostress. However, students' own education level had no effect towards their technostress coping behaviour, while employment slightly reduced the application of problem- and emotion-focused coping strategies (Galvin et al., 2022).

### 2.2.9 Systematic and Scoping Reviews on Technostress and Coping in e-Learning

Within the area of technostress and coping, other studies have conducted systematic and scoping reviews in the area of e-learning. Two systematic reviews were carried out by Nang et al. (2022) and Fernández-Batanero et al. (2021) about teachers' technostress. The study objectives are similar such that Nang's study aimed to identify the factors that affect teachers' technostress and the strategies they use to cope with it. Meanwhile, Fernández-Batanero's study was focused on identifying how the use of e-learning applications led to teachers' stress and anxiety. Both systematic reviews were guided by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. Besides that, Nang et al. (2022) study aimed to identify technostressors and coping strategies experienced by teachers during the COVID-19 pandemic, hence their eligible

articles were published between the years 2019 and 2021. Meanwhile, Fernández-Batanero et al. (2021) study extended over a longer period from 2005 to 2019.

Besides teachers, one study by Ata and Saltan (2023) aimed to identify school principals' perceptions about technostress. They conducted a scoping review guided by a five-phase framework by Arksey and O'Malley (2005) and included articles published from the years 2004 to 2023. Another study by Bhatt and Kothari (2022) employed a systematic review to identify the individual and organizational determinants of technostress of the general population. This study includes some accounts of the technostress experienced by students and academicians (among workers from other fields). Their systematic review was guided by a review method used by the systematic review strategy developed by the Joanna Brigg's Institute (Aromataris & Munn, 2017).

While reviews by Fernández-Batanero et al. (2021), Nang et al., (2022) and Ata & Saltan (2023) explored the phenomenon of technostress in e-learning environments, their review did not involve students. Furthermore, although the review by Bhatt and Kothari (2022) includes some accounts of students' technostress, the study did not consider how the environmental or situational factors in e-learning environments affect students' technostress. Instead, the organizational determinants explored how work-related factors led to technostress in academicians and workers of other fields. Additionally, none of the reviews explored the ways students cope with technostress in e-learning environments.

## 2.3 Summary

In this chapter, the two theories on which this study is grounded are elaborated in detail. The Transactional Theory of Stress and Coping by Lazarus and Folkman (1984) forms the basis for the technostress aspect, meanwhile, the Model of Strategic e-Learning by Tsai (2009) supports the student online learning strategies portion of the research. This is followed by a literature review which examines the school, private tuition and social media e-learning environments. The review explores the applications, characteristics, advantages and disadvantages of these e-learning environments as identified by past works. Next, a review of the prevalence of technostress in students and adolescents provides some insight into the issues these groups face when using technology. Besides that, a review of technostress mitigation strategies is conducted to highlight what is known in the context of students and adolescents. Finally, a review of past systematic reviews and scoping reviews in the area of e-learning are elaborated. The next chapter explores the research methodologies used to address the research questions of this study.

# CHAPTER 3

# METHODOLOGY

## 3.0 Introduction

This chapter outlines the methods used to achieve the research objectives of this study. The methods are elaborated in terms of research design, research procedure, instruments used, sampling as well as data analysis. This is followed by a research matrix which provides an overview of the research objectives, research techniques, research instruments and research outputs. The ethical considerations involved in this study are elaborated in the final part of this chapter.

## 3.1 Research Design

A systematic literature review is used to answer the research questions of this study. Systematic literature reviews involve collecting, evaluating and synthesizing information within a particular domain (Paul & Barari, 2022). The application of this research technique is justified by the abundance of prevailing research within the domain of students' technostress. Firstly, given that several primary research studies have already been conducted, this systematic literature review extends current research by providing a structured overview of what is known and the gaps that still exist within the domain of students' experience of technostress in e-learning. Secondly, systematic literature reviews are useful when existing empirical studies show conflicting or inconclusive findings (Charrois, 2015). Existing studies have shown several conflicting findings, meriting the use of this research technique to highlight the consistencies and contradictions in this study area thus providing a deeper understanding. Thirdly, systematic literature reviews

utilize a systematic protocol for reducing bias in findings, while ensuring transparency and replicability of the process (Linares-Espinós et al., 2018). Past technostress studies have employed a variety of quantitative and qualitative methodologies. Thus, systematic literature review tools such as the Joanna Briggs Institute (JBI) critical appraisal checklist and the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines the quality of findings by reducing bias and ensuring transparency and reproducibility. Quality findings support evidence-based practice and guide sound decision-making (Page et al., 2021a; Kraus et al., 2020). Lastly, systematic literature reviews are useful for answering specific research questions. Inclusion and exclusion criteria determine if a study meets the study's objectives and is eligible for the review (Aromataris & Pearson, 2014; Lame, 2019). Currently, some student-related studies explore technostress in the context of mixed technology use (e-learning and non-e-learning) (Wang et al., 2022; & Mehtälä et al., 2022) and other studies mixed target populations (students, academic staff, workers) (Bhatt & Kothari, 2022). Thus, a systematic literature review is useful for filtering out studies that do not meet the criteria of exploring students' technostress and coping strategies in e-learning environments specifically.

The present study employs a mixed-method systematic literature review. Reviewing both quantitative and qualitative studies leads to a more comprehensive understanding of quantitative data and more substantiated findings (Hong et al., 2017). The variety of methodologies in prevailing technostress literature enables the application of a mixed-method research design. Two systematic literature reviews are carried out in accordance with the research objectives. The first systematic literature review aims to identify the technostressors experienced by students in e-learning environments. The second systematic literature review aims to identify the coping strategies used by students to cope

with technostress in e-learning environments. Specifically, the second systematic review aims to investigate and discover the problem-focused coping strategies and emotion-focused coping strategies used by students to cope with technostress in e-learning environments. This study employs two separate systematic reviews to meet the research objectives due to the nature of Boolean operators in the databases searched. According to Jha et al. (2022), Boolean operators are used to combine search terms and refine search criteria in research databases. The Boolean operator 'AND' ensures that articles retrieved from a database contain all combined terms searched. In contrast, the operator 'OR' ensures that the retrieved articles contain any of the terms searched (Jha et al., 2022). If a search of technostress 'AND' coping strategies is carried out, studies which do not include both terms will be excluded, thus studies which study only technostress will be excluded. Whereas if the same search was carried out using the 'OR' operator, too many studies would emerge in the initial search as the term "coping strategies" applies to various fields and is not technostress-specific. Thus, it is appropriate to carry out two separate systematic literature reviews. The reporting of these systematic literature reviews was guided by the standards of the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) 2020 statement. The findings of each systematic review are analyzed using thematic analysis.

## 3.2 Research Technique

### 3.2.1 Research Procedure

For nearly two decades, the topic of technostress has been extensively studied in organizations (Tu et al., 2005; Tarafdar et al., 2007; Ragu-Nathan et al., 2008; Pirkkalainen et al., 2019; Tarafdar et al., 2020a). Some systematic reviews have been conducted to explore various facets of this topic, such as technostress definitions,

creators, inhibitors, symptoms, antecedents, effects and sampling bias (Sarabadani et al., 2018; Torre et al., 2019, Nisafani et al., 2020; Borle et al., 2021). More recently, a number of studies specializing in the technostress experienced by students in learning environments have emerged (Wang, Tan & Li, 2019; Upadhyaya & Vrinda, 2020, Wang et al., 2020; Aziz & Yazid, 2021, Aziz et al., 2021, Aziz et al., 2022; Kader et al., 2022). However, there have been no systematic reviews carried out to synthesize these findings to date. The rationale behind this study is to synthesize these studies to identify the technostressors experienced, as well as the coping strategies students use to overcome technostress in e-learning environments. Bondanini et al. (2020) encourage the use of systematic reviews to extend our understanding of the correlation between the different aspects of technostress such as causes, moderators and outcomes. Accordingly, two separate systematic literature reviews are conducted with the following objectives: 1) to identify the technostressors faced by students in e-learning environments, and 2) to identify the coping strategies used by students to cope with technostress in e-learning environments. The second systematic literature review is further broken down into two more specific objectives: 2.1) to investigate the problem-focused coping strategies used by students to cope with technostress in e-learning environments and 2.2) to discover the emotion-focused coping strategies used by students to cope with technostress in e-learning environments.

The reporting of these systematic literature reviews was guided by the standards of the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) 2020 statement. The PRISMA 2020 statement comprises a 27-item checklist which assures transparency, completeness and replicability of the process as shown in Appendix A (Page, McKenzie, Bossuyt et al., 2021a). According to Page, McKenzie, Bossuyt et al., (2021b), the PRISMA 2020 statement succeeds the PRISMA 2009 statement and includes

new guidelines that reflect improvements in the methods used in the synthesis of studies. Several additions were made to the PRISMA 2020 statement compared to the PRISMA 2009 such as the requirement to specify how studies were collated for synthesis, the requirement to specify the comprehensive search strategies applied for all databases, registers and websites searched (instead of just a minimum requirement of one database), the necessity to provide the information of automation tools used and many more (Page, McKenzie, Bossuyt et al., 2021b). Correspondingly, a procedure was established to specify the selection eligibility criteria data sources, search strategy, data sources and findings analysis.

### 3.2.2 Selection Eligibility Criteria

The first objective of the study is to systematically review the technostressors faced by students in e-learning environments based on research published in journal articles, book chapters, reports, conference papers and dissertations. Studies are assessed based on four criteria, namely the account of technostress, population studied, the environment investigated and the type of publishing.

With regard to the first criterion, the review includes studies whose objectives are to identify the technostressors in e-learning, specifically the causes of technostress, factors which affect technostress or antecedents of technostress. Additionally, this review includes studies whose main objective is not to identify technostressors, but whose data analysis includes some measure of the prevalence of technostressors. In this case, the main objective (e.g., the effect of technostress on strain) is excluded from the review, but the prevalence of technostressors (e.g., the mean and standard deviation of techno-overload) is included in this review. The review also includes studies whose objective is

to study students' perceptions of e-learning provided that the findings include accounts of technostress. Besides that, this study only accounts for situational or environmental factors which cause technostress (e.g., the pervasiveness of online learning in daily life) and not personal or individual factors (e.g., students' personality traits, learning styles).

Secondly, concerning the population studied, the systematic literature review explores the technostress of students at all levels of education (i.e., primary, secondary and tertiary). The review excludes studies of other populations in academic environments (e.g., teachers, staff) or papers which study the academic community as a whole. With regard to the third criterion, the review aims to identify the incidence of technostressors within e-learning environments. Hence, the systematic review includes studies that have investigated technology-induced stress where learning is carried out in-person, remotely, synchronously or asynchronously. Finally, the review includes information from journal articles, book chapters, reports, conference papers and dissertations. If a retrieved document does not belong to any of these categories, it is effectively excluded.

The second research objective of the study is to systematically review the coping strategies used by students to cope with technostress in e-learning environments based on research published in journal articles, book chapters, reports, conference papers and dissertations. This is further specified into two types of strategies, namely problem- and emotion-focused strategies. Thus, studies eligible for review are evaluated based on four criteria, namely the account of coping with technostress, the population studied, the environment investigated and the type of publishing. With regard to the first criterion, the review identifies the various problem- and emotion-focused coping strategies students use to cope with technostress in e-learning environments. Studies eligible for review

include studies where coping strategies are shown as an outcome of technostress, as a factor which has an effect on technostress, is correlated with technostress or is simply prevalent (as shown by descriptive statistics) in e-learning environments. Studies are eliminated if they contain some mention of coping in the overall text, but it is not the main objective of the paper (e.g., the effects of technostressors, the effects of coping towards other factors). Besides that, studies are eliminated if the mentioned strategies are misinterpreted as coping strategies by the author when they should be instead interpreted as a person's natural traits. Lazarus and Folkman (1984) define coping strategies as efforts to manage a stressor, which excludes automized behaviours (e.g., self-efficacy). By extension, the existence of support systems (e.g., peer support) is not considered a coping strategy, but the effort exerted to obtain the support (seeking peer support) is considered a coping strategy. The selection of studies based on the other three criteria (population studied, the environment investigated and the type of publishing) follows the same consideration as the first review.

Both reviews include quantitative and qualitative analyses of technostressors and coping strategies in e-learning environments. The documents eligible for review are those for which the full text is available, are in the English language and were published between January 2000 and June 2023. This time frame was chosen due to the popularization of ICT in e-learning since the turn of the century (Basak et al., 2018), hence the databases were searched from the year 2000 to the present. The database was last searched on 1 July 2023 and not any later due to a time limitation. Both published and unpublished manuscripts are eligible for review.

### 3.2.3 Search Strategy

For the first review which identifies the technostressors, the following search terms were used to search for the articles in the selected electronic databases:

**Education Resources Information Center (ERIC) via EBSCOhost**

| Field | Search Terms |
|---|---|
| TI Title | technostress OR "techno stress" OR techno-stress OR "digital stress" |
| OR AB Abstract | technostress OR "techno stress" OR techno-stress OR "digital stress" |
| OR SU Descriptors | technostress OR "techno stress" OR techno-stress OR "digital stress" |
| OR DE Descriptors [exact] | technostress OR "techno stress" OR techno-stress OR "digital stress" |
| OR KW Identifiers | technostress OR "techno stress" OR techno-stress OR "digital stress" |
| AND TX All Text | student OR students OR learner OR learners |

**Web of Science (WoS)**

| Field | Search Terms |
|---|---|
| Title | technostress OR "techno stress" OR techno-stress OR "digital stress" |
| OR Abstract | technostress OR "techno stress" OR techno-stress OR "digital stress" |
| OR Author Keywords | technostress OR "techno stress" OR techno-stress OR "digital stress" |
| OR Keywords Plus | technostress OR "techno stress" OR techno-stress OR "digital stress" |
| AND | |
| Title | student OR students OR learner OR learners |
| OR Abstract | student OR students OR learner OR learners |
| OR Author Keywords | student OR students OR learner OR learners |
| OR Keywords Plus | student OR students OR learner OR learners |

**Scopus**

| Field | Search Terms |
|---|---|
| Article title, Abstract, Keywords | {technostress} OR {techno stress} OR {techno-stress} OR {digital stress} AND {student} OR {students} OR {learner} OR {learners} |

**ScienceDirect**

| Field | Search Terms |
|---|---|
| Title, abstract or author-specified keywords | (technostress OR "techno stress" OR techno-stress OR "digital stress") |

For the second review which identifies the coping strategies used to cope with technostress, the following search terms were used to search for the articles in the selected electronic databases:

**Education Resources Information Center (ERIC) via EBSCOhost**

| Field | Search Terms |
|---|---|
| TI Title | technostress OR "techno stress" OR techno-stress OR "digital stress" |
| OR AB Abstract | technostress OR "techno stress" OR techno-stress OR "digital stress" |
| OR SU Descriptors | technostress OR "techno stress" OR techno-stress OR "digital stress" |
| OR DE Descriptors [exact] | technostress OR "techno stress" OR techno-stress OR "digital stress" |
| OR KW Identifiers | technostress OR "techno stress" OR techno-stress OR "digital stress" |
| AND TX All Text | student OR students OR learner OR learners |
| AND TX All Text | cope OR coping OR coping strategies OR coping mechanisms OR coping skills |

**Web of Science (WoS)**

| Field | Search Terms |
|---|---|
| Title | technostress OR "techno stress" OR techno-stress OR "digital stress" |
| OR Abstract | technostress OR "techno stress" OR techno-stress OR "digital stress" |
| OR Author Keywords | technostress OR "techno stress" OR techno-stress OR "digital stress" |
| OR Keywords Plus | technostress OR "techno stress" OR techno-stress OR "digital stress" |
| AND | |
| Title | student OR students OR learner OR learners |
| OR Abstract | student OR students OR learner OR learners |
| OR Author Keywords | student OR students OR learner OR learners |
| OR Keywords Plus | student OR students OR learner OR learners |

| | |
|---|---|
| AND | |
| Title | cope OR coping OR coping strategies OR coping mechanisms OR coping skills |
| OR Abstract | cope OR coping OR coping strategies OR coping mechanisms OR coping skills |
| OR Author Keywords | cope OR coping OR coping strategies OR coping mechanisms OR coping skills |
| OR Keywords Plus | cope OR coping OR coping strategies OR coping mechanisms OR coping skills |

**Scopus**

| Field | Search Terms |
|---|---|
| Article title, Abstract, Keywords | {technostress} OR {techno stress} OR {techno-stress} OR {digital stress} AND {student} OR {students} OR {learner} OR {learners} AND {cope} OR {coping} OR {coping strategies} OR {coping mechanisms} OR {coping skills} |

**ScienceDirect**

| Field | Search Terms |
|---|---|
| Title, abstract or author-specified keywords | (technostress OR "techno stress" OR techno-stress OR "digital stress") AND (cope OR coping OR coping strategies OR coping mechanisms OR coping skills) |

The ScienceDirect database allows a maximum of eight Booleans in the search. Therefore, the search could not include the terms "students" or "learners". Studies unrelated to students in e-learning environments were removed manually upon conducting the search. Generally, all the databases searched are filtered for English language papers published between January 2000 and June 2023. The exact databases and filters used are specified in the Information Sources section.

### 3.2.4 Study Selection Process

One researcher worked independently to screen the documents gathered. No software or automation tools were used to process or classify the documents. Furthermore, no

translation tools were used as non-English language papers do not meet the inclusion criteria and are therefore eliminated from the review.

### 3.2.5 Data Collection Process

One researcher worked independently to collect the data from each document. Each document was studied to identify the objectives of the research to ensure it meets the outlined selection eligibility criteria. Then, the themes were manually identified and extracted from the document. The extraction of data from figures was also done manually without the help of any tools.

### 3.2.6 Risk of Bias Assessment

The risk assessment of the study is conducted using the Joanna Briggs Institute (JBI) critical appraisal checklist for analytical cross-sectional studies (see Appendix B). One researcher assessed the studies independently using this tool. According to Moola et al. (2020), this eight-item checklist serves to assess the level of bias of studies selected for systematic reviews. Based on this tool, low-risk studies are studies for which the inclusion criteria for participants are clearly specified, the sample is reported in detail, the exposure is measured validly and reliably, the condition is assessed based on objective and standard criteria, there are no confounding factors, there are strategies in place to manage confounding factors, the validity and reliability of the measured outcome are ensured and suitable statistical analysis was applied (Moola et al., 2020). The scores of each study are computed by taking the score received for the study and dividing it by the total score. The resulting proportion is then multiplied by 10. Studies with scores (≥8) are considered strong, while scores (6-7.9) are considered moderate and scores (≤5.9) are considered weak (Yasin et al., 2020). The assessment of the risk of bias of the documents assessed

in the first and second systematic literature reviews are shown in table 3.1 and table 3.2 respectively.

**Table 3.1**

*JBI Critical Appraisal of Documents Pertaining to the Technostressors Students Experience in e-Learning Environments*

| Author/Checklist item | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | Score |
|---|---|---|---|---|---|---|---|---|---|
| Abuzant et al. (2022) | Y | Y | N/A | Y | N | N | N | Y | 5.71 |
| Al-Abdullatif et al. (2020) | Y | Y | N/A | Y | N | N | Y | Y | 7.14 |
| Alexa et al. (2022) | Y | Y | N/A | Y | N | N | Y | Y | 7.14 |
| Al-Tammemi et al. (2022) | Y | Y | N/A | Y | N | N | N | Y | 5.71 |
| Asad 2023 | Y | Y | N/A | Y | N | N | Y | Y | 7.14 |
| Bravo-Adasme and Cataldo (2022) | Y | Y | N/A | Y | N | N | Y | Y | 7.14 |
| Cataldo 2023 | Y | Y | N/A | Y | N | N | Y | Y | 7.14 |
| Cook and Bell 2022 | Y | Y | N/A | Y | N | N | Y | Y | 7.14 |
| Erdoğan et al. (2022) | Y | Y | N/A | Y | N | N | N | Y | 5.71 |
| Essel et al. (2021) | Y | Y | N/A | Y | N | N | Y | Y | 7.14 |
| Galvin et al. (2022) | Y | Y | N/A | Y | N | N | Y | N | 5.71 |
| Garg et al. (2022) | Y | Y | N/A | Y | N | N | Y | Y | 7.14 |
| Kader et al. (2022) | Y | Y | N/A | Y | N | N | Y | Y | 7.14 |
| Kasemy et al. (2022) | Y | Y | N/A | Y | N | N | N | Y | 5.71 |
| Kekkonen and Oinas-Kukkonen (2021) | Y | Y | N/A | Y | N | N | N | Y | 5.71 |
| Lee et al. (2021) | Y | Y | N/A | Y | N | N | Y | Y | 7.14 |
| Loh et al. (2021) | Y | Y | N/A | Y | N | N | Y | Y | 7.14 |
| Mehtälä et al. (2022) | Y | Y | N/A | Y | N | N | N | Y | 5.71 |
| Morales-Rodríguez (2021) | Y | Y | N/A | Y | N | N | N | Y | 5.71 |
| Oladosu et al. (2020) | Y | Y | N/A | Y | N | N | N | Y | 5.71 |
| Qi (2019) | Y | Y | N/A | Y | N | N | Y | Y | 7.14 |
| Quinn (2000) | Y | Y | N/A | Y | N | N | N | Y | 5.71 |
| Schauffel et al. (2022) | Y | Y | N/A | Y | N | N | N | Y | 5.71 |
| Schettino et al. (2022-2) | Y | Y | N/A | Y | N | N | Y | Y | 7.14 |
| Upadhyaya and Vrinda (2021) | Y | Y | N/A | Y | N | N | Y | Y | 7.14 |
| Wang et al. (2021) | Y | Y | N/A | Y | N | N | Y | Y | 7.14 |
| Zhao et al. (2021) | Y | Y | N/A | Y | N | N | Y | Y | 7.14 |

Note. Y is Yes.

N is No.

N/A is Not applicable.

The first item checks if the criteria of inclusion for the sample are clearly specified. The studies must meet the criteria of studying students' technostress in e-learning environments. If the study does not mention the specific population studied in a learning institution, it is excluded. All 27 papers met this inclusion criteria. The second item on the JBI critical appraisal tool checks if the study provides sufficient details about the sample studied about where they were obtained, their demographic background, location and the period for which the sample was collected. This study considers this item fulfilled if the study describes the country in which the study was carried out, the level of study (i.e., primary, or tertiary) and the number of students involved in the study. All 27 papers fulfilled this criteria. The third item on the checklist checks if the exposure was measured validly and reliably. In this study, students are exposed to a technology-supported learning environment which is not a factor which can be measured. Thus, this item does not apply to this appraisal.

The fourth item on the checklist ascertains if objective and standard criteria were used to assess the condition. The condition in the present study is e-learning. Thus, the study must explicitly mention the use of ICT for learning purposes, a criterion for which all the papers met. The fifth item on the checklist checks for confounding factors. Aside from the characteristics of ICT environments, other factors such as students' personalities can cause technostress. None of the studies identified confounding factors that may affect technostress. The sixth item on the checklist checks whether the confounding factors were appropriately dealt with. While three papers studied factors such as personality (Bravo-Adasme & Cataldo, 2022; Cataldo et al., 2023) and the role of basic human needs (Schauffel et al., 2022) in determining technostress, no effort was made to remove its potential effect on the sample studied. The seventh item on the checklist determines if the outcomes of the study are measured in a valid and reliable manner. The outcome of the

first systematic review is technostressors. Only 17 papers measured technostressors reliably and validly through the use of Cronbach's alpha, composite reliability, standardized factor loadings, confirmatory factor analysis (CFA), exploratory factor analysis (EFA), average variance extracted (AVE), heterotrait–monotrait ratio of correlations (HTMT) and Fornell & Larcker criterion. 10 papers failed to either measure technostressors reliably, validly or both. The eighth and final item on the JBI checklist ascertains if appropriate statistical analysis was used in the research. Generally, all papers used suitable methods to analyze the prevalence of technostressors such as descriptive statistics, correlation, structural equation modelling, linear regression and interviews. Although using the appropriate methods, one paper by Galvin et al. (2022) is eliminated from this review due to evident errors in its reporting.

Based on the eight items on this checklist, only seven items are applicable to this study. Thus, the scores were computed out of a total score of 7 instead of 8. Out of the 26 papers, 10 scored a weak score (≤5.9), while 16 scored a moderate score (6-7.9) as per the categorization suggested by Yasin et al. (2020). Even though a considerable number of studies scored weakly on this JBI critical appraisal checklist, they are still included in the final analysis. It is not reasonable to measure the exposure in non-clinical studies such as this. Furthermore, since the lowest score is 5.71, which is reasonably close to the cut-off point of 5.9, it is safe to assume that a majority of these studies would have easily passed the threshold of 5.9 had the nature of this study allowed the empirical measurement of the exposure element.

**Table 3.2**

*JBI Critical Appraisal of Documents Pertaining to Coping Strategies Students Use to Cope with Technostress in e-Learning Environments*

| Author/Checklist item | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | Score |
|---|---|---|---|---|---|---|---|---|---|
| Cook and Bell 2022 | Y | Y | Y | Y | N/A | N/A | Y | Y | 10 |
| Galvin et al. (2022) | Y | Y | Y | Y | N/A | N/A | Y | N | 8.33 |
| Garg et al. (2022) | Y | Y | Y | Y | N/A | N/A | Y | Y | 10 |
| Morales-Rodríguez (2021) | Y | Y | N | Y | N/A | N/A | Y | Y | 8.33 |
| Sharma and Gupta 2022 | Y | Y | Y | Y | N/A | N/A | Y | Y | 10 |

Note. Y is Yes.

N is No.

N/A is Not applicable.

All five studies clearly specify the criteria of inclusion in the present paper. All of the studies involve the identification of coping strategies students use to cope with technostressors in e-learning environments. Next, all five studies provide sufficient details about the sample studied in terms of the country in which the study was carried out, the level of study (i.e., primary, secondary or tertiary) and the number of students involved in the study. The third item on the checklist checks if the exposure was measured in a valid and reliable way. For this second systematic review, the exposure in question is technostress. All five papers measured technostress in a reliable way through the use of Cronbach's alpha, composite reliability and factor analysis. Meanwhile, only four out of five papers measured technostress in a valid way through the use of exploratory factor analysis, confirmatory factor analysis, Variance Inflation Factor, bootstrapping, correlations, AVE and the Durbin-Watson statistic. Similar to the first systematic review, the condition of the study is e-learning. All five studies fulfil the criteria of specifying that the use of ICT is for e-learning purposes.

The fifth item on the checklist checks for confounding factors that may lead to the application of coping strategies. There are no other factors which call for the application of coping strategies besides stressors, thus this criterion is not applicable to this review. The sixth item on the checklist checks whether the confounding factors were appropriately dealt with, which is also not applicable to this review. The seventh item on the checklist determines if the outcomes of the study are measured in a valid and reliable manner. The outcome of the second systematic review is coping strategies. All five studies fulfilled this criterion using the same methods used to assess the reliability and validity of the exposure variable (technostress), with the exception of confirmatory factor analysis. The final item on the JBI checklist identifies if appropriate statistical analysis was used in the research. All papers used suitable methods to analyse the prevalence of

technostressors such as descriptive statistics, correlation, structural equation modelling and linear regression. Similar to the first review, one paper by Galvin et al. (2022) is eliminated from this review due to evident errors in its reporting. Based on the eight items on this checklist, only six items are applicable to this study. Hence, the scores were computed out of a total score of 6 instead of 8. All papers scored a high score (≥8) as per based on Yasin et al. (2020), indicating a low risk of bias in the paper selection.

### 3.2.7 Study Selection

For the first systematic literature review, an initial search is run within the four databases to identify a pool of potentially relevant documents. A total of 292 entries (ERIC= 57, Scopus= 130, ScienceDirect= 17, WoS= 88) were found across the four databases. Out of the 130 entries in the Scopus database, six entries are volumes of the 18th Americas Conference on Information Systems (AMCIS) 2012, classified as Volume 1, Volume 2, …, and Volume 6 respectively. These six volumes contain a total of 571 individual articles. Besides that, there is one entry from the SIGMIS-CPR'18: 2018 Computers and People Research Conference which contains 32 individual articles. Thus, the Scopus database contains a total of 726 unique documents (Individual entries= 123, AMCIS (2012) = 571, SIGMIS-CPR'18= 32), bringing the total number of documents to be screened to 888 documents (ERIC= 57, Scopus= 726, ScienceDirect= 17, WoS= 88). Out of the 888 documents, only 747 documents were available for download (ERIC= 50, Scopus= 601, ScienceDirect = 17, WoS = 79).

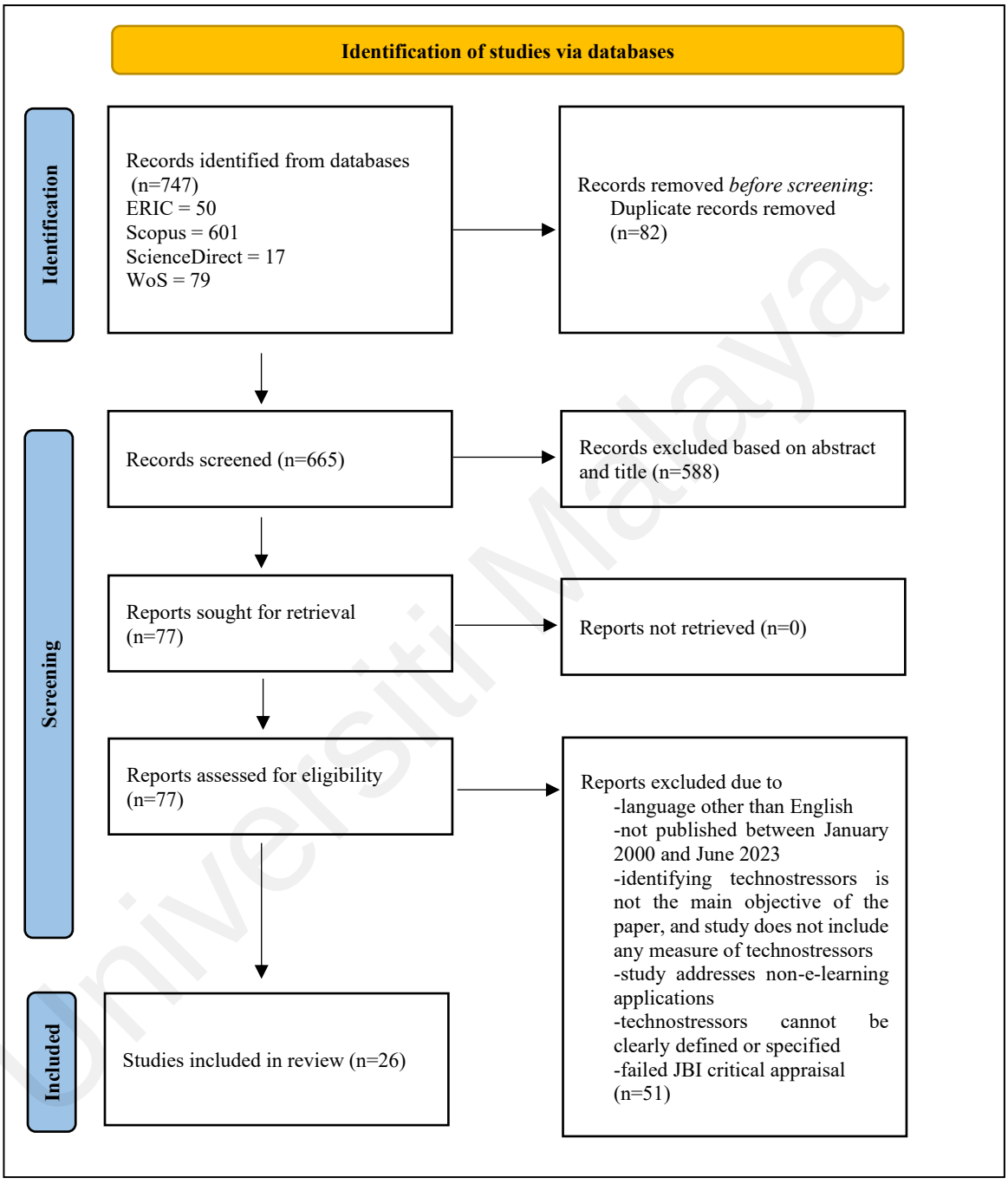
Out of the 747 documents, 82 duplicates are identified and removed leaving a total of 665 articles to be screened. 665 studies are screened based on their titles and abstracts to determine their relevance to this study's objectives. Based on the abstract and title

screening, a total of 588 documents were eliminated. 505 documents were eliminated as it was unrelated to technostress, 73 documents were eliminated for studying the wrong target group (e.g., teachers, lecturers, employees, general population), 7 documents were eliminated for studying technostressors in non-e-learning environments, 2 documents were eliminated for considering personal factors instead of situational factors (e.g., personality, learning approaches) and 1 document was eliminated for not being in the English language.

The remainder 77 documents' full text was sought for retrieval, for which all were available. The full text of the 77 documents was then screened based on the selection eligibility criteria. 35 documents were eliminated for containing the term technostress but not studying technostressors in specific (e.g., the effect of technostressors on other factors, the interplay of other factors surrounding the topic of technostress) or for failing to at least include any measure of technostressors such as descriptive statistics or correlations even though it is not the main objective of the paper. 9 documents were eliminated for including non-e-learning applications, 3 documents were eliminated because the accounts of technostress are too general and the technostressors could not be clearly specified (e.g., the use of ICT for learning, stress due to failure to adapt to ICT) and 3 documents were eliminated for not being in the English language. Finally, 27 documents were screened based on the JBI critical appraisal checklist, whereby 1 paper was eliminated for errors in its reporting. Finally, only 26 documents were included in the review. The flowchart below is adapted from the PRISMA (2021) official webpage.

**Figure 3.1**

*PRISMA Flowchart of Systematic Literature Review to Identify the Technostressors Experienced by Students in e-Learning Environments*

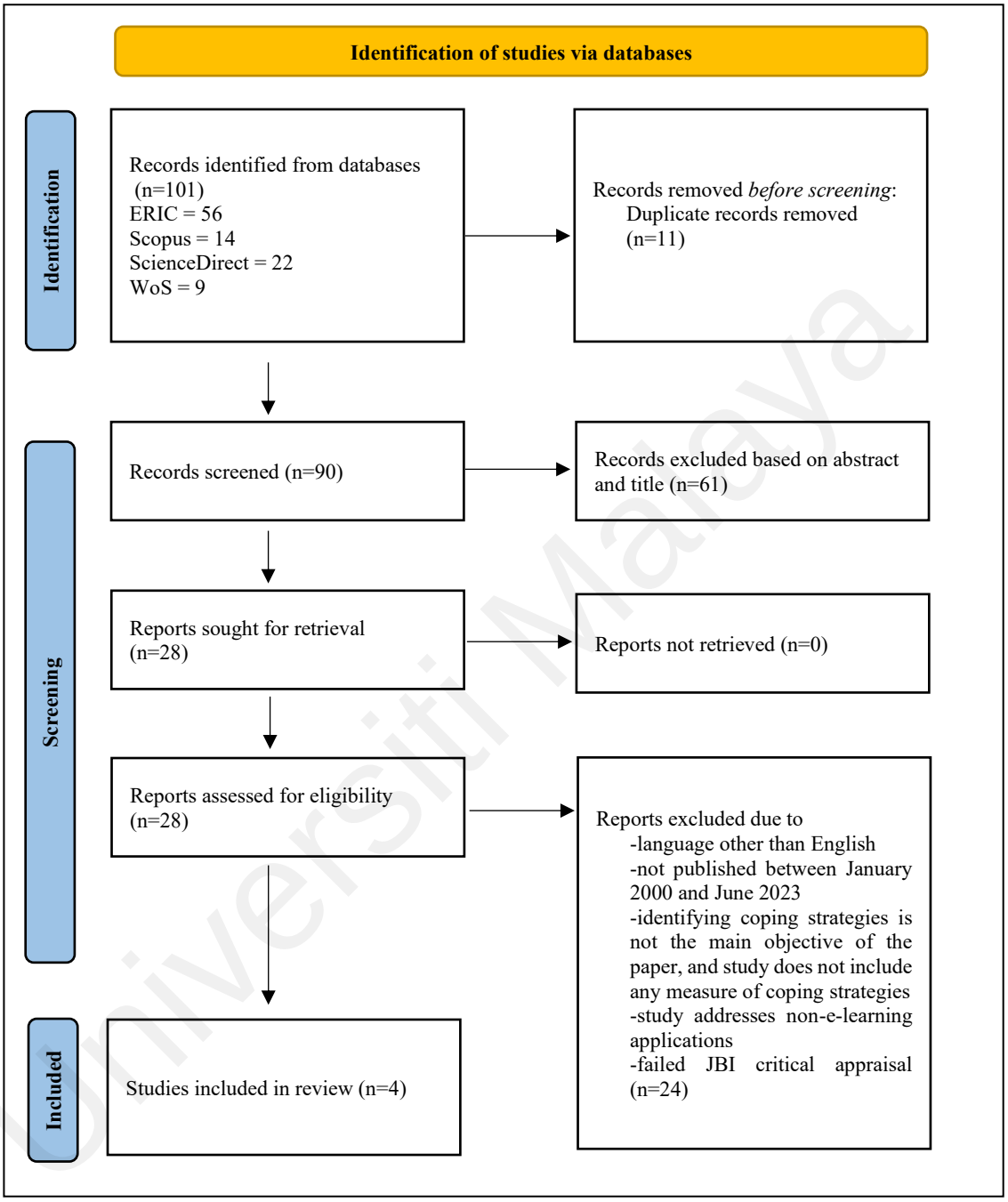



The same process is repeated for the second systematic literature review. An initial search is run in the four databases, producing 116 entries (ERIC= 62, Scopus= 18, ScienceDirect= 25, WoS= 11). Out of the 116 entries, only 101 documents were available for download (ERIC= 56, Scopus= 14, ScienceDirect= 22, WoS= 9). A total of 11

duplicates were removed. Then, the remaining 90 documents are screened by their titles and abstracts to ensure they answer the research objectives. One document was eliminated for being unrelated to technostress, 58 documents were eliminated for studying the wrong target group (e.g., teachers, lecturers, employees, general population) and 3 documents were eliminated for addressing non-e-learning environments. The remainder 28 documents' full text was sought for retrieval, for which all were available. The full text of the 28 documents was then screened based on the selection eligibility criteria, for which 16 documents were eliminated because while they have some mention of coping in the overall text, identifying coping strategies is not the main objective of the paper, 6 documents were eliminated for including non-coping strategies (existing traits and situational support systems), 1 document was eliminated because it includes the application of ICT for non-e-learning purposes. The remaining 5 documents were screened using the JBI critical appraisal checklist, whereby 1 document was eliminated due to errors in the data reporting. Finally, only 4 documents were included in the review.

**Figure 3.2**

*PRISMA Flowchart of Systematic Literature Review to Identify the Coping Strategies Used by Students to Overcome Technostress in e-Learning Environments*



### 3.3 Research Instrument

#### 3.3.1 Information Sources

For both systematic reviews, the documents which are eligible for review are journal articles, book chapters, reports, conference papers and dissertations. The inclusion of grey literature such as conference papers, book chapters, reports and dissertations ensure the minimization of bias in systematic review (Hopewell et al., 2005). As for databases, Scopus, ScienceDirect and Web of Science (WoS) were used as they are frequently considered to be repositories which contain high-quality, reliable research (Yulianti et al., 2023; Yallew & Dipitso, 2022). Besides that, Education Resources Information Center (ERIC) via EBSCOhost was searched due to its relevance to educational research (Silber-Varod et al., 2019). Other databases such as Google Scholar were not used and deemed unsuitable for carrying systematic reviews due to their low precision or relevance of returned search results as well as low replicability of the search (Gusenbauer & Haddaway, 2020) and ResearchGate was not used due to its lack of Boolean operators which is crucial for the initial filtering of search results (Bhardwaj, 2017).

For the search using the ERIC database, the "Date Published" filter is set to "January 2000- June 2023", and the "Language" filter is set to "English". For the search using the ScienceDirect database, the "Year(s)" filter is set to "2000-2023". Next, for the search using the WoS database, the "Search in" filter is set to "Web of Science Core Collection". In the "Edition" filter, "Emerging Sources Citation Index (ESCI)" is unselected. The "Language" is filtered to "English" and the "Year Published" filter is set to "2000-2023". Finally, for the search using the Scopus database, the "Published from" filter is set to "2000" and the "To" filter is set to "2023". The databases were last searched on 1 July 2023.

### 3.3.2 Research Sample

For the first systematic literature review, the documents analyzed comprise of 23 journal articles by Al-Abdullatif et al. (2020), Alexa et al. (2022), Al-Tammemi et al. (2022), Asad et al. (2023), Bravo-Adasme and Cataldo (2022), Cataldo et al. (2023), Cook and Bell (2022), Erdoğan et al. (2022), Essel et al. (2021), Garg et al. (2022), Kader et al. (2022), Kasemy et al. (2022), Lee et al. (2021), Loh et al. (2021), Mehtälä et al. (2022), Morales-Rodríguez (2021), Oladosu et al. (2020), Qi (2019), Schauffel et al. (2022), Schettino et al. (2022-2), Upadhyaya and Vrinda (2021), Wang et al. (2021) and Zhao et al. (2021), 1 conference paper by Kekkonen and Oinas-Kukkonen (2021) and 2 book chapters by Abuzant et al. (2022) and Quinn (2000). The second systematic literature review is comprised of 4 journal articles by Cook and Bell (2022), Garg et al. (2022), Morales-Rodríguez (2021) and Sharma and Gupta (2022). While this appears to be a limited number of studies, systematic review guidelines do not indicate a minimum number of studies required to carry out reviews (Hallyburton & Hinton, 2017). These documents were published between January 2000 and June 2023. The documents include those which originate from anywhere in the world, are presented in the English language and for which the full text is available.

### 3.3.3 Data Items

For the first systematic review, any type of technology-induced stress in e-learning environments is eligible for inclusion. Past literature has established widely accepted metrics of technostress (i.e., techno-overload, techno-invasion, techno-complexity, techno-uncertainty, techno-insecurity), as well as additional potential technostressors in online environments (i.e., lack of personalized attention, social isolation, addiction, cyberbullying, social pressure, privacy disclosure). However, this systematic review goes beyond these known outcomes and explores any form of technology-induced stressors in

e-learning environments. For the second systematic review, any strategy for coping with technology-induced stress in e-learning environments is eligible for inclusion. Even strategies beyond the specified learning strategies domain (i.e., perceived skill, self-regulation, affection) are eligible for inclusion.

Besides the main outcomes of the studies, other variables collected include information about the report such as; 1) its author and publication year, 2) the country in which the research was carried out, 3) the study sample, such as sample size and level of study, 4) the research design, such as the research method and statistical method for data analysis, 5) the type of e-learning involved (i.e., synchronous, asynchronous, distance and in-person) and examples of platforms used (e.g., Google Meets, Moodle, Blackboard).

### 3.3.4 Data Analysis

#### 3.3.4.1 Effect Measures

This study determines technostressors and coping strategies by means of analyzing quantitative data such as descriptive statistics, correlation, structural equation modelling, linear regression. The factors are included in this study if they are significant at the 1%, 5% or 10% level of significance. This study also determines technostressors and coping strategies by means of analyzing qualitative data such as interview data and book chapters which are analyzed using thematic analysis.

### 3.3.4.2 Synthesis Methods

The descriptive statistics assessed is mean data. The mean values are categorized as low, medium or high based on their value on the particular Likert scale used in the study. The Likert scale is divided into three equal parts for the purpose of this categorization. The mean value interpretation can be seen below.

**Table 3.3**

*Mean Value Interpretation*

| Likert scale range | Low | Medium | High |
|---|---|---|---|
| 4 points | $\leq 1.33$ | $1.33 < \bar{x} \leq 2.67$ | $2.67 < \bar{x} \leq 4$ |
| 5 points | $\leq 1.67$ | $1.67 < \bar{x} \leq 3.33$ | $3.33 < \bar{x} \leq 5$ |
| 7 points | $\leq 2.33$ | $2.33 < \bar{x} \leq 4.67$ | $4.67 < \bar{x} \leq 7$ |

Besides that, other quantitative data analyzed utilize the following methodologies – structural equation modelling, Partial Least Squares Structural Equation Modelling, correlation, Pearson's correlation, bivariate correlation and linear regression. Technostressors and coping strategies which are statistically significant (and otherwise) are noted. Of the 26 technostressor studies, 23 employed one or more of the quantitative methods mentioned, while all four coping studies employed only quantitative ones.

On the other hand, the qualitative findings derived are analyzed using thematic analysis. Braun and Clarke (2006) conceptualized thematic analysis as a six-phase process. Upon evaluation, only six technostressor studies were found to employ qualitative methods. The first phase involves getting familiarized with the gathered data by reading and re-reading the full text of the six papers to understand it thoroughly. The ideas and patterns which emerge guide the coding process that follows. The second phase is to create the initial codes. The codes are elemental aspects of the data that can be evaluated

meaningfully. In this step, data extracts from the six papers are coded and collated. 15 codes are generated namely, 'techno-overload', 'techno-complexity', 'techno-uncertainty', 'techno-unreliability', 'lack of accessibility to ICT devices and Internet services', 'lack of accessibility to suitable learning spaces', 'physical strain', 'social isolation', 'social overload', 'negative parental attitudes', 'students' experiences with ICT-based assessments', 'structure of online examinations', 'instructors' digital skills', 'instructors' reachability' and 'students' perception of online learning'.

The third phase of the process is searching for themes. All the codes generated in the previous step are evaluated to consider how they might be integrated to form larger themes. In this stage, 'lack of accessibility to ICT devices and Internet services' and 'lack of accessibility to conducive learning spaces' were grouped under the same theme. 'Social isolation' and 'social overload' were also combined. Besides that, 'students' experiences with ICT-based assessments', 'structure of online examinations' and 'students' perception of online learning' were placed in one theme. Finally, 'instructors' digital skills' and 'instructors' reachability' were combined as well. Meanwhile, factors such as 'techno-overload', 'techno-complexity', 'techno-uncertainty', 'techno-unreliability', 'physical strain' and 'negative parental attitudes' remain as individual themes.

The fourth phase of the thematic analysis process is reviewing the identified themes. The collated data within the themes should be coherent and the distinction between themes should be evident. Since parental influence is also a form of social influence, it is grouped with social isolation and social overload. Meanwhile, students' experience with ICT-based assessments, structure of examinations, perception of online learning and instructor-related factors were combined as they collectively pertain to students' in-class

experience of the materials, lessons, exams and instructors. The final thematic map is then evaluated to ensure it accurately represents the works' essence.

In the fifth phase, the themes are further defined and given labels such as ‘techno-overload’, ‘techno-complexity’, ‘techno-uncertainty’, ‘techno-unreliability’, ‘physical strain’, ‘lack of accessibility to ICT and suitable learning space’, ‘social factors’, and ‘structure of lessons and assessments, instructor and administrative factors’. Each theme does not contain too many diverse elements and does not contain components that overlap too much with other themes. The sixth and final phase of the thematic analysis is producing a report. The report answers the research question through a concise and coherent account of the literature studied (Braun & Clarke, 2006).

#### 3.3.4.3 Reporting Bias Assessment

Reporting bias is the selective reporting of particular studies based on their outcomes. For instance, the protocol for selecting papers which will be included in a review may be altered after analyzing the findings to allow for particular findings to be highlighted in the study (Drucker et al., 2016). This study eliminates reporting bias by setting the paper selection eligibility criteria ahead of conducting the database search and results analysis to ensure a non-biased reporting of the results obtained.

#### 3.3.4.4 Certainty Assessment

According to Schünemann et al. (2019), a certainty assessment is conducted to ascertain the certainty (or confidence) in the evidence of the outcomes measured. The Grades of Recommendation, Assessment, Development and Evaluation (GRADE) approach using

the online GRADEpro tool is used to carry out certainty evaluations. This approach has five considerations: 1) risk of bias, 2) imprecision, 3) indirectness, 4) publication bias and 5) consistency of effect. An increase in any of these domains results in lowered overall certainty. A certainty assessment was not conducted for these systematic reviews because they are typically conducted in clinical studies which have control groups which enable comparisons to be made to assess the relative effect of a particular intervention plan or exposure element.

### 3.4 Research Matrix

The research matrix outlines the research objectives, research questions, research techniques, instruments used, participants involved and research outputs.

**Table 3.4**

*Research Matrix*

| Research Objectives | Research Questions | Research Technique | Instruments | Research Output |
|---|---|---|---|---|
| Problem Analysis:<br>1.0 To systematically review the technostressors faced by students in e-learning environments based on research published in journal articles, book chapters, reports, conference papers and dissertations. | 1.0 What are the technostressors faced by students in e-learning environments based on the systematic review of research published in journal articles, book chapters, reports, conference papers and dissertations? | Systematic literature review | Document analysis of journals, book chapters, reports conference papers and dissertations | 1.0 The technostressors faced by students in e-learning environments. |
| Needs Analysis:<br>2.0 To systematically review the coping strategies used by students to cope with technostress in e-learning environments based on research published in journal articles, book chapters, reports, conference papers and dissertations. | 2.0 What are the coping strategies used by students to cope with technostress in e-learning environments based on the systematic review of research published in journal articles, book chapters, reports, conference papers and dissertations? | | | 2.0 The coping strategies students use to overcome technostress in e-learning environments.<br>2.1 The problem-focused coping strategies students use to overcome technostress in e-learning environments.<br>2.2 The emotion-focused coping strategies students use to overcome |

| | | |
|---|---|---|
| 2.1 To systematically review the problem-focused coping strategies used by students to cope with technostress in e-learning environments based on research published in journal articles, book chapters, reports, conference papers and dissertations. | 2.1 What are the problem-focused coping strategies students use to cope with technostress in e-learning environments based on the systematic review of research published in journal articles, book chapters, reports, conference papers and dissertations? | technostress in e-learning environments. |
| 2.2 To systematically review the emotion-focused coping strategies used by students to cope with technostress in e-learning environments based on research published in journal articles, book chapters, reports, conference papers and dissertations. | 2.2 What are the emotion-focused coping strategies students use to cope with technostress in e-learning environments based on the systematic review of research published in journal articles, book chapters, reports, conference papers and dissertations? | |

### 3.5 Ethical Considerations

One of the ethical considerations of this research is the papers chosen to be included in the systematic review are not biased. The present study ensures that credible papers which fulfil the research criteria are chosen for review. This is ensured through the use of the JBI critical appraisal checklist for cross-sectional studies. The scoring of the papers provides an accurate assessment of the strengths and weaknesses of each included paper and transparency of the credibility of the findings. Besides that, the present study prevents reporting bias by clearly specifying the selection eligibility criteria of the papers to be included in the review prior to running the database search. This ensures that the process is not manipulated in order to obtain a pre-determined set of outcomes.

### 3.6 Summary

This chapter explained the methods used to identify the technostressors and coping strategies students need to overcome technostress in e-learning environments. The research design is elaborated in terms of the two systematic literature reviews aimed at answering the research questions. The first systematic review is aimed at identifying the technostressors students face in e-learning environments, and the second review aims to identify the coping strategies students use to cope with those technostressors. Furthermore, the second review aims to fulfil two sub-objectives which are to identify the problem- and emotion-focused coping strategies students use to overcome technostress in e-learning environments. Data analysis in the form of thematic analysis is conducted to synthesize the review findings. The next chapter elaborates the findings of this study.

# CHAPTER 4

# FINDINGS

## 4.0 Introduction

The findings of the study will be explained in detail in this chapter. The findings are tabulated based on the two research objectives outlined in this study. Two systematic literature reviews are conducted per the set research objectives as well as search strategies detailed in the previous chapter. The chapter is concluded with a summary of the findings of the two systematic reviews.

## 4.1 Findings

### 4.1.1 To systematically review the technostressors faced by students in e-learning environments based on research published in journal articles, book chapters, reports, conference papers and dissertations.

The first research objective of this study is to systematically review the technostressors faced by students in e-learning environments based on research published in journal articles, book chapters, reports, conference papers and dissertations. Table 4.1 shows the technostressors experienced by students in e-learning environments.

**Table 4.1**

*Technostressors Faced by Students in e-Learning Environments*

| Author (Year) | Country | E-learning application | Study sample | Research method | Data analysis method | Findings |
|---|---|---|---|---|---|---|
| Abuzant et al. (2022) | Palestine | Synchronous and asynchronous distance learning using Moodle and Microsoft Office, including online examinations | 321 university students | Quantitative survey | Descriptive statistics | **Mean (Standard deviation)**<br>Techno-overload: 2.27 (0.60)<br>Techno-invasion: 2.95 (0.81)<br>Techno-complexity: 1.90 (0.75)<br>Techno-uncertainty: 2.89 (0.90)<br><br>-5-point Likert scale |
| | | | | | Structural equation modelling | -Techno-overload negatively affects technostress, while techno-invasion, techno-uncertainty and techno-complexity positively affect technostress |
| | | | 10 university students | Qualitative semi-structured interview | Thematic analysis | -Unreliable infrastructure is a cause for technostress<br>-Online examinations cause technostress due to inappropriate time allocation, the difficulty of questions and the layout of the questions in online mode<br>-Insufficient technological devices and a suitable home environment for online classes cause technostress |

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| | | | | | | -Insufficient technological devices push students to use mobile phones for e-learning causing vision problems |
| Al-Abdullatif et al. (2020) | Saudi Arabia | Texting through mobile applications including social media apps. E.g., communication with instructors and other students, completion of projects, quizzes, evaluations, general enquiries | 235 university students | Quantitative survey | Structural equation modelling | -The compulsive use of mobile text messaging for learning purposes causes technostress |
| Alexa et al. (2022) | Romania | Synchronous and asynchronous distance learning using Microsoft Teams, Google Classroom, Zoom, Moodle and Blackboard | 36 university students | Qualitative focus group | Thematic analysis | -Social isolation from peers and instructors causes technostress<br>-Increased working hours and assignments (techno-overload) cause technostress |

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|---|---|---|---|---|---|---|
| Al-Tammemi et al. (2022) | Jordan | Synchronous and asynchronous distance learning using Microsoft Teams, Zoom and Moodle | 17 university students | Qualitative semi-structured interview | Thematic analysis | -The absence of reliable internet service is a cause for technostress<br>-The absence of sufficient digital devices is a cause for technostress<br>-Lack of teachers' digital skills causes technostress for students |
| Asad et al. (2023) | Pakistan | Synchronous and asynchronous e-learning | 564 postgraduate students | Quantitative survey | Descriptive statistics | **Mean (Standard deviation)**<br>Techno-overload: 3.65314 (1.04385)<br>Techno-invasion: 3.7930 (0.93033)<br>Techno-complexity: 3.39843 (1.04134)<br>Techno-uncertainty: 3.4961 (0.89214)<br>Techno-insecurity: 3.5625 (2.18921)<br><br>-5-point Likert scale |
| Bravo-Adasme and Cataldo (2022) | Chile | Synchronous and asynchronous distance learning | 189 university students | Quantitative survey | Correlation | -Work overload is positively correlated with techno-overload<br>-Work-home conflict is positively correlated with techno-invasion |
| Cataldo et al. (2023) | Chile | Synchronous and asynchronous distance learning | 189 college students | Quantitative survey | Descriptive statistics | **Mean (Standard deviation)**<br>Study-family conflict: 3.74 (1.005)<br>Techno-overload: 3.97 (0.87)<br>Techno-invasion: 4.10 (0.97)<br>Techno-complexity: 2.65 (1.04)<br>Techno-uncertainty: 3.07 (0.97)<br>Techno-insecurity: 2.62 (0.98)<br><br>-5-point Likert scale |

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| | | | | | Partial Least Squares Structural Equation Modelling | -Study-family conflict positively affects techno-invasion |
| Cook and Bell (2022) | South Africa | Synchronous and asynchronous distance learning | 100 university students | Quantitative survey | Linear regression | -Techno-complexity positively affected technostress<br>-Techno-overload, techno-invasion, techno-uncertainty and techno-insecurity do not affect technostress |
| Erdoğan et al. (2022) | Turkey | Synchronous and asynchronous distance learning | 259 university students | Quantitative survey | Pearson's correlation | -Required attendance and participation negatively impact technostress<br>-Adequate learning environment negatively affects technostress |
| Essel et al. (2021) | Ghana | Distance learning | 525 university students | Quantitative survey | Descriptive statistics | **Mean (Standard deviation)**<br>Techno-overload: 3.91 (0.71)<br>Techno-invasion: 4.68 (0.55)<br>Techno-uncertainty: 3.88 (0.78)<br>Techno-complexity: 3.27 (0.59)<br>Techno-insecurity: 4.26 (0.75)<br><br>-7-point Likert scale |
| | | | | | Bivariate correlation | -Technology dependence (addiction) is positively correlated with technostress |

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| | | | | Structural equation modelling | -Technology dependence (addiction) positively impacts technostress<br>-Techno-overload positively impacts technostress<br>-Techno-invasion positively impacts technostress<br>-Techno-complexity positively impacts technostress<br>-Techno-insecurity positively impacts technostress<br>-Techno-uncertainty positively impacts technostress |
| Garg et al. (2022) | India | Distance learning | 552 college students | Quantitative survey | Descriptive statistics | **Mean (Standard deviation)**<br>Techno-overload: 2.125 (0.083)<br>Techno-invasion: 2.481 (0.118)<br>Techno-complexity: 2.113 (0.154)<br><br>-4-point Likert scale |
| | | | | | Correlation | -Techno-overload, techno-invasion and techno-complexity are positively correlated with technostress |
| Kader et al. (2022) | Malaysia | Synchronous and asynchronous distance learning | 212 university students | Quantitative survey | Structural equation modelling | -Teachers' support positively influence technostress<br>-The availability of technology infrastructure negatively impacts technostress<br>-Social influence of peers does not affect technostress |

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|---|---|---|---|---|---|---|
| Kasemy et al. (2022) | Egypt | Distance and in-person e-learning | 2,526 university students | Quantitative survey | Descriptive statistics | **Mean (Standard deviation)**<br>Techno-overload: 3.98 (0.83)<br>Techno-invasion: 3.93 (0.87)<br>Techno-complexity: 3.45 (0.85)<br>Techno-insecurity: 2.56 (0.67)<br>Techno-uncertainty: 0.64 (0.16)<br>-5-point Likert scale |
| | | | | | Linear regression analysis | -Task interdependence among students and their peers negatively predicts technostress by reducing social isolation and improving collaboration.<br>-Autonomy in carrying out learning tasks negatively predicts technostress in students.<br>-IT complexity positively affects technostress in students<br>-Pace of change positively influences technostress in students |
| Kekkonen and Oinas-Kukkonen (2021) | Finland | Doctoral research work using software such as R, SPSS and RefWorks | 11 university students | Qualitative workshop | Thematic analysis | -Students experience techno-complexity in learning to use new programs, using specific software and figuring out differences in program syntax or logic. Students also experience techno-complexity when using programs for non-research-related work<br>-Students experience techno-uncertainty due to the need to update software and deal with bugs in software |

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| | | | | | -Students experience techno-overload because they have to spend time compiling new datasets and instruments, besides dealing with unanticipated results when using software for research-related work. Students also experienced information overload when engaged in non-research-related work<br>-Students experienced techno-unreliability due to poor usability or user interface issues for non-research-related work<br>-Students experienced social overload in the form of communication overload when engaged in non-research-related work |
| Lee et al. (2021) | Malaysia | Synchronous and asynchronous distance learning using platforms such as Microsoft Teams, Zoom and Google Meet. | 388 university students | Quantitative survey | Descriptive statistics | **Mean (Standard deviation)**<br>Techno-overload: 4.5057 (1.5597)<br>Techno-invasion: 4.2339 (1.6624)<br>Techno-exhaustion: 4.2887 (1.6563)<br>Social isolation: 5.3621 (1.4755)<br>Delay in responses: 4.6778 (1.5803)<br>Risk of arbitrary learning: 4.5193 (1.6313)<br><br>-7-point Likert scale |
| | | | | | Partial Least Squares Structural Equation Modeling | -Delay in responses from instructors does cause technostress in students<br>-Risk of arbitrary learning causes technostress in students<br>-Social isolation does not affect technostress in students |

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| Loh et al. (2021) | Malaysia | Synchronous and asynchronous mobile distance learning using social media platforms such as Facebook, Instagram, Line, LinkedIn, Pinterest, Skype, Snapchat, Tumblr, Twitter, WeChat, WhatsApp, YouTube and others. | 384 university students | Quantitative survey | Partial Least Squares Structural Equation Modeling | -Information overload positively affects technostress<br>-Life invasion positively influences technostress<br>-Privacy invasion positively affects technostress<br>-Social overload does not affect technostress |
| Mehtälä et al. (2022) | Finland | Synchronous and asynchronous distance e-learning | 20 primary and 11 secondary school students | Qualitative semi-structured interview | Content analysis | -Adolescents feel like they spend too much time on e-learning<br>-Adolescents experience headaches and eye problems due to the long hours spent e-learning<br>-Adolescents feel demotivated and dissatisfied with the structure of the lessons and the requirement for their participation. Besides that, they experience difficulty contacting their teachers<br>-Adolescents faced technical problems with using technology for e-learning |

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| | | | | | | -Adolescents may not have a suitable space at home to carry out e-learning as it clashes with other family members |
| Morales-Rodríguez (2021) | Spain | Distance education | 180 university students | Quantitative survey | Pearson's correlation | -Techno-overload, techno-invasion and techno-complexity are positively correlated with technostress |
| Oladosu et al. (2020) | Nigeria | Synchronous and asynchronous distance and in-person e-learning | 150 university students | Quantitative survey | Descriptive statistics | **Mean**<br>Techno-overload: 3.02<br>Techno-invasion: 3.11<br>Physical strain: 3.23<br>Addiction: 2.89<br><br>-4-point Likert scale |
| Qi (2019) | Hong Kong | In-person and distance e-learning using mobile devices | 208 university students | Quantitative survey | Partial Least Squares Structural Equation Modeling | -Techno-overload, techno-invasion and techno-complexity positively affect technostress |
| Quinn (2000) | United States of America | In-person, asynchronous use of library reference services | University students | Qualitative report | - | -Adult learners whose parents had negative attitudes towards ICT are more likely to have negative attitudes themselves, contributing to technostress<br>-Adult learners experience technostress due to fear of using computers stemming from their early experiences with technology in |

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| | | | | | | educational settings having been in a performance evaluation context<br>-Adult learners experience technostress due to its complexity. They do not comprehend Boolean logic, the structure of library records, are unable to create alternative search terms to help their searches, have low memory capacity to learn and remember the various commands, principles and technical terms involved in using library reference services and lack the manual dexterity to handle a computer mouse<br>-Adult learners face technostress due to their inability to keep up with the pace of change in technology |
| Schauffel et al. (2022) | Germany | Synchronous and asynchronous distance learning | 205 university students | Quantitative survey | Structural equation modelling | -Technical problems, coordination difficulties and work overload are positively and directly related to technostress |
| Schettino et al. (2022-2) | Italy | Distance learning | 915 university students | Quantitative survey | Descriptive statistics | **Mean (Standard deviation)**<br>Techno-overload: 3.051 (0.867)<br>Techno-invasion: 3.207 (0.943)<br>Techno-complexity: 2.129 (0.872)<br><br>-5-point Likert scale |
| | | | | | Bivariate correlation | -Techno-overload, techno-invasion and techno-complexity are positively correlated with technostress |

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|---|---|---|---|---|---|---|
| Upadhyaya and Vrinda (2021) | India | Synchronous and asynchronous e-learning using learning management systems, MOOC digital assessments and attendance management system | 673 university students | Quantitative survey | Descriptive statistics | **Mean (Standard deviation)**<br>Techno-overload: 3.43 (0.78)<br>Techno-invasion: 3.31 (0.87)<br>Techno-complexity: 2.91 (0.83)<br>Techno-insecurity: 2.68 (0.93)<br>Techno-uncertainty: 3.42 (0.64)<br><br>-5-point Likert scale |
| | | | | | Structural equation modelling | -Techno-overload, techno-invasion, techno-complexity, techno-insecurity and techno-uncertainty positively affect technostress |
| Wang et al. (2021) | China | Synchronous and asynchronous distance and in-person e-learning using MOOCs, flipped learning, blended learning and mobile learning. | 796 university students | Quantitative survey | Descriptive statistics | **Mean (Standard deviation)**<br>Techno-overload: 2.23 (0.89)<br>Techno-invasion: 2.21 (0.92)<br>Techno-complexity: 2.18 (0.92)<br>Techno-insecurity: 2.19 (0.91)<br>Techno-uncertainty: 2.12 (0.93)<br><br>-5-point Likert scale |
| Zhao et al. (2021) | China | Synchronous and asynchronous e-learning such as MOOC and flipped classroom. | 1,367 university students | Quantitative survey | Descriptive statistics | **Mean (Standard deviation)**<br>Administrative support: 3.86 (0.81)<br>Peer support: 3.98 (0.71)<br><br>-5-point Likert scale |
| | | | | | Structural equation modelling | -Administrative support negatively affects technostress<br>-Peer support does not affect technostress |

**Techno-overload**

Techno-overload emerged as the most popular technostressor experienced by students in e-learning environments. Based on the descriptive statistics reported, six studies found that students experienced a medium level of techno-overload (Abuzant et al., 2022; Essel et al., 2021; Garg et al., 2022; Lee et al., 2021; Schettino et al., 2022; Wang et al., 2021) and five studies reported high levels of techno-overload (Asad et al., 2023; Cataldo et al., 2023; Kasemy et al., 2022; Oladosu et al., 2020; Upadhyaya & Vrinda, 2021). Studies of causality also prove that techno-overload is a technostressor experienced by students in e-learning environments. Essel et al. (2021), Qi et al. (2019) and Upadhyaya and Vrinda (2021) found that students do more work at a faster pace, work with tight schedules, change work practices to accommodate new technology and have a bigger workload due to the complex nature of technology. Loh et al. (2021) reported that students experience information overload when learning with social media sites. They feel overwhelmed with excessive information about their friends that they see online, feel distracted and burdened by the amount of information they have to process online when learning and feel that only a small portion of the information available is relevant to their learning. Similarly, Schauffel et al. (2022) reported that students feel burdened by the information and workload they have to manage with consideration of the amount of time allocated during distance learning due to the COVID-19 pandemic. Only one study by Abuzant et al. (2022) found techno-overload to be negatively associated with technostress. Meanwhile, another study by Cook and Bell (2022) found no relationship between techno-overload and technostress.

Correlation studies also found techno-overload to be positively associated with overall technostress levels (Garg et al., 2022; Morales-Rodríguez, 2021; Schettino et al., 2022-2) and work overload to be linked to techno-overload in students (Bravo-Adasme &

Cataldo, 2022). Besides that, qualitative studies show that students feel that they were given too many assignments (Alexa et al., 2022) and spent too much of time interacting with ICT when engaged in distance learning due to the COVID-19 pandemic (Alexa et al., 2022; Mehtälä et al., 2022). In another study, doctoral students experienced techno-overload when compiling sets of data and instruments when using research software (e.g., R and SPSS), dealing with unanticipated results when utilizing research software and also experiencing information overload outside of research-related work (Kekkonen & Oinas-Kukkonen, 2021).

**Techno-complexity**

Techno-complexity was the second most prevalent technostressor experienced by students in e-learning environments. Descriptive analyses found that students experience medium (Abuzant et al., 2022; Cataldo et al., 2023); Essel et al., 2021; Garg et al., 2022; Schettino et al., 2022; Upadhyaya & Vrinda, 2021; Wang et al., 2021), or high levels of complexity (Asad et al., 2023; Kasemy et al., 2022). Furthermore, studies exploring causality unanimously agree that techno-complexity and technostress are positively related. Based on Abuzant et al. (2022), Cook and Bell (2022), Essel et al. (2021), Qi et al. (2019) and Upadhyaya and Vrinda (2021), students have insufficient knowledge about the ICT used in e-learning to carry out their tasks, need to spend a considerable amount of time to understand how to use new ICTs, find it difficult to manage their time for both studies and improving their ICT skills, find that some of their classmates have a better understanding about ICT than themselves and frequently find new ICTs too difficult to use. In addition to regarding ICTs as too complex to use, Kasemy et al.'s (2022) indicated that students find it difficult to achieve the desired e-learning outcomes. Correlational studies by Garg et al. (2022), Morales-Rodríguez (2021) and Schettino et al. (2022-2) also prove techno-complexity to be associated with overall technostress levels.

Qualitative findings by Kekkonen and Oinas-Kukkonen (2021) reported that doctoral students experienced techno-complexity when learning how to use new programs, using certain software and encountering different program syntax or logic when doing their research work. They also faced techno-complexity when using programs for other non-research learning activities. Similarly, Quinn (2000) reported that adult learners faced found library reference services at their universities too complex to use. This is because many of them grew up before the popularization of ICTs, do not comprehend the structure of bibliographic records or principles of Boolean logic, are unable to come up with alternative search terms when their searches fail to produce the desired result, have low memory capacity to learn and remember the various commands, principles and technical terms involved in using library reference services and are not sufficiently adept in using a computer mouse.

**Techno-invasion**

Techno-invasion is the third most popular technostressor experienced by students in e-learning environments. According to the descriptive statistics reported, students mostly experienced a medium level of techno-invasion (Abuzant et al., 2022; Garg et al., 2022; Lee et al., 2021; Schettino et al., 2022; Upadhyaya & Vrinda, 2021; Wang et al., 2021), while some studies indicated high levels of techno-invasion (Asad et al., 2023; Cataldo et al., 2023; Essel et al., 2021; Kasemy et al., 2022; Oladosu et al., 2020). Causality studies also show that techno-invasion is a direct cause of technostress in students. Students feel that they do not get to spend as much time with their families, have to keep in touch with their studies even on rest days, give up rest days to keep themselves updated on new ICTs and feel that their personal lives are being taken over by ICTs due to e-learning. The pervasiveness of e-learning technologies causes the boundaries between learning and personal time to become blurred (Abuzant et al., 2022; Essel et al., 2021;

Loh et al., 2021; Qi et al., 2019; Upadhyaya & Vrinda, 2021). Meanwhile, only one causality study by Cook and Bell (2022) found no relationship between techno-invasion and technostress. Correlational studies show that work-home conflict is linked to techno-invasion (Bravo-Adasme & Cataldo, 2022) and techno-invasion is correlated with overall technostress (Garg et al., 2022; Morales-Rodríguez, 2021; Schettino et al., 2022-2).

**Structure of lessons and assessments, instructor and administrative factors**

Students identified the way lessons and assessments were structured to be a cause for technostress. Students found it challenging to maintain their attention and interest given the way learning activities were structured, felt that they were not achieving their learning goals and did not consistently participate in the online distance learning activities set. These factors were reported by a medium mean (Lee et al., 2021). Similarly, Mehtälä et al., (2022) found students lacked the drive to participate in online distance learning activities, they were discontented with how lessons were carried out and how participation was made mandatory. Contrastingly, Erdoğan et al. (2022) found that regular attendance and participation in e-learning activities were negatively associated with students' technostress levels.

Besides that, the physical distance in online learning tends to create coordination issues which cause technostress (Schauffel et al., 2022). However, the incorporation of task interdependence in academic work (reporting a high mean) can also reduce technostress in online learning by encouraging interaction. While assigning interdependent work can serve as a protective feature against technostress, students should also be given a certain amount of autonomy (reporting a medium mean) to make decisions regarding their academic work as this also leads to lower technostress (Kasemy et al., 2022). In terms of

the structure of assessments, students reported that the time allotted for online examinations is insufficient given the question load and level of difficulty. Besides that, the questions are presented in a manner in which subsequent questions are concealed from view, thus increasing students' stress levels (Abuzant et al., 2022). Additionally, students who had early experiences of e-learning in an assessment-based context experience technostress when using ICTs for learning as an adult (Quinn, 2000).

Instructors and learning administrators also play an important role in terms of students' technostress. Students experience technostress when they are unable to reach instructors in a timely manner (Mehtälä et al., 2022). Delays in instructors' responses were reported by a high mean (Lee et al., 2022). Besides that, lecturers who do not have sufficient digital skills to utilize online learning platforms can cause disruptions to online lessons leading to students' technostress (Al-Tammemi et al., 2022). One study by Zhao et al. (2022) found that administrative support in the form of sufficient training, time and resource allocation reported a high mean but only had a small impact towards lowering students' technostress. Meanwhile, another study by Kader et al., (2022) found that lecturers' efforts to help students get acclimated to e-learning, encourage participation through discussion, ask meaningful questions and offer guidance to students who struggle with academic work somehow led to higher technostress. This suggests that students have a hard time getting accustomed to online learning and lecturers' support exacerbates technostress.

**Techno-uncertainty**

Techno-uncertainty is one of the technostressors experienced by students in e-learning environments. Descriptive statistics show that students experience low levels (Kasemy et

al., 2022), medium levels (Abuzant et al., 2022; Cataldo et al., 2023); Essel et al., 2021; Wang et al., 2021) and high levels of techno-uncertainty (Asad et al., 2023; Upadhyaya & Vrinda, 2021). Causality studies indicate that students experience techno-uncertainty due to new advancements in ICTs, updates in software and hardware used in e-learning, computer network improvements and the introduction of new features and capabilities (Abuzant et al., 2022; Essel et al., 2021; Kasemy et al., 2022; Upadhyaya & Vrinda, 2021). In addition, Quinn (2000) cited that adult learners face technostress due to their inability to keep up with the pace of changes in library technology. With regard to doctoral research work, Kekkonen and Oinas-Kukkonen (2021) found that students face techno-uncertainty due to having to periodically update research software and deal with bugs in the software. Meanwhile, only one causality study by Cook and Bell (2022) found no relationship between techno-uncertainty and technostress.

**Social factors**

Social factors can cause technostress within e-learning environments. According to Alexa et al. (2022), the social isolation faced by students in distance e-learning causes them to experience technostress. Even synchronous lessons do not live up to the personal connection students experience with their peers and instructors in face-to-face classes. On the other hand, Lee et al. (2021) reported that even though social isolation reported a high mean in e-learning, it does not significantly predict technostress. Students are social media natives who easily maintain social ties with their peers and instructors through the use of social media platforms. As opposed to isolation, Kekkonen and Oinas-Kukkonen (2021) found that an overload of communication is another form of technostress experienced when learning with ICT. The ubiquity of mobile phones forces students to be always accessible to others through social media, calls, messages and emails. However, another study by Loh et al. (2021) cites social overload is not a technostressor

and that the social connection between learners in traditional classrooms simply carries over to online settings.

In terms of social support from people within the learning communities, Zhao et al. (2022) found that peer support (reported by a high mean) had no impact on students' technostress levels. Furthermore, since ICT usage was made mandatory for students in e-learning environments during the pandemic, social influence to use particular platforms was found to be unrelated to technostress (Kader et al., 2022). Finally, parents' negative attitudes towards ICT usage can also influence their children's experience with ICT and serve as a cause for technostress when learning (Quinn, 2000).

**Techno-insecurity**

Techno-insecurity is another technostressors experienced by students in e-learning environments. Based on the descriptive statistics observed, students experience medium levels of techno-insecurity (Cataldo et al., 2023; Essel et al., 2021; Kasemy et al., 2022; Upadhyaya & Vrinda, 2021; Wang et al., 2021) and high levels of techno-insecurity (Asad et al., 2023). Causality studies also prove that techno-insecurity is positively related to technostress in students. Students feel like they have to constantly upgrade their skills to prevent poor academic performance, feel threatened by peers' skills, feel that new ICT pose a threat to achievement, refrain from sharing knowledge one's own with peers and think that there is little sharing of knowledge among peers (Essel et al., 2021; Upadhyaya & Vrinda, 2021). Meanwhile, only one causality study by Cook and Bell (2022) found no relationship between techno-insecurity and technostress.

**Techno-unreliability**

The unreliability of available ICTs is another prevalent technostressors for students in e-learning environments. Students reportedly face technical difficulties when using ICTs for learning (Mehtälä et al., 2022). According to Abuzant et al. (2022), students face technostress due to electricity and internet connectivity disruptions and have to deal with unstable learning applications, particularly during online examinations and assignment submissions. Al-Tammemi et al.'s (2022) study also highlighted students' concerns about the instability of internet connectivity during online examinations and the burden on internet service providers to accommodate a large number of students learning online during the COVID-19 pandemic. Another study by Kekkonen and Oinas-Kukkonen (2021) cited that doctoral students have to deal with usability and interface issues when using learning programs outside of their research work. Meanwhile, Schauffel et al. (2022) reported that only a small portion of students experienced technical issues in their study because several months had passed since the introduction of online learning due to the COVID-19 pandemic. Nevertheless, they still found technical problems such as loss of internet connectivity, loss of data and poor video and audio quality to be a significant cause of technostress in their student population studied.

**Accessibility to ICT and suitable learning space**

A lack of access to the ICTs required to participate in e-learning is a cause for technostress in students. Students who do not have the devices required tend to get lower grades, especially when graded in synchronous learning activities (Abuzant et al., 2022). Besides that, having to share devices with family members who are also undergoing online learning and not having a conducive space to learn contributes to technostress (Abuzant et al., 2022; Al-Tammemi et al., 2022; Mehtälä et al., 2022). Studies show that having the

necessary facilitating resources be it in the form of devices or infrastructure can protect against technostress in distance learning (Erdoğan et al., 2022; Kader et al., 2022).

**Physical and psychological strain**

Oladosu et al. (2020) reported that students experience physical strain due to uncomfortable seating and the inability to adjust the screen brightness when learning in their university's e-library (reported by a high mean). Abuzant et al. (2022) also found that students also experience vision problems due to the use of unsuitable devices for learning such as mobile phones (Abuzant et al., 2022). In addition to eye strain, students also experience headaches due to prolonged exposure to screens (Mehtälä et al., 2022). Besides that, Lee et al. (2021) reported that students experience psychological exhaustion when learning with ICTs (reported by a medium mean). They feel tired, burnt out and experience strain in e-learning environments (Lee et al., 2021).

**Addiction and compulsive use**

Al-Abdullatif et al. (2020) reported that the addictive and compulsive use of text messaging through mobile applications for learning purposes leads to technostress in students. Students compulsively using mobile texting to communicate with their lecturers and peers to inquire about assessments, learning content and administrative matters, collaborate on projects, complete quizzes and perform course evaluations leads to technostress (Al-Abdullatif et al., 2020). Furthermore, Oladosu et al. (2020) found that students become very dependent on smart devices when engaged in e-learning (reported by a high mean). Similarly, a correlation and causality analysis by Essel et al. (2021) found that the dependence on technology during emergency remote learning was linked to increased technostress in students.

**Privacy invasion**

One study by Loh et al. (2022) reported that privacy invasion is a technostressor in e-learning settings. Students have had their social media account credentials, photos and learning responses shared and reposted without their consent, positively contributing to their experience of technostress.

### 4.1.2 To systematically review the coping strategies used by students to cope with technostress in e-learning environments based on research published in journal articles, book chapters, reports, conference papers and dissertations.

The second research objective of this study is to systematically review the coping strategies used by students to cope with technostress in e-learning environments based on research published in journal articles, book chapters, reports, conference papers and dissertations.

#### 4.1.2.1 To systematically review the problem-focused coping strategies used by students to cope with technostress in e-learning environments based on research published in journal articles, book chapters, reports, conference papers and dissertations.

The first sub-objective is to systematically review the problem-focused coping strategies used by students to cope with technostress in e-learning environments based on research published in journal articles, book chapters, reports, conference papers and dissertations. Table 4.2 details the problem-focused coping strategies used by students.

**Table 4.2**

*Problem-Focused Coping Strategies Used by Students to Cope with Technostress in e-Learning Environments*

| Author | Country | E-learning application | Study sample | Domain | Coping strategies | Data analysis method | Findings |
|---|---|---|---|---|---|---|---|
| Sharma and Gupta 2022 | United States of America | Synchronous and asynchronous distance learning | 275 university students | Multi-domain strategies | Academic planning | PLS-SEM | -The 'positive' and 'challenge' appraisals of technostress positively affect problem-focused coping (in the form of academic planning) |
| Morales-Rodríguez 2021 | Spain | Distance education | 180 university students | Multi-domain strategies | Problem-solving | Pearson's Correlation | -Technostress is negatively correlated with problem-solving<br>-Techno-overload is negatively correlated with problem-solving<br>-Techno-invasion is negatively correlated with problem-solving |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Cook and Bell (2022) | South Africa | Synchronous and asynchronous distance learning | 100 university students | Multi-domain strategies | Use of digital collaboration tools | Descriptive statistics | **Mean (Standard deviation)**<br>Use of digital collaboration tools: 4.142 (1.301)<br><br>-7-point Likert scale |
| | | | | | | Linear regression | -The use of digital collaboration tools moderates the relationship between technostress and academic performance as well as academic productivity |
| | | | | Perceived skill | Seeking instrumental support | Descriptive statistics | **Mean (Standard deviation)**<br>Seeking instrumental support: 3.466 (1.687)<br><br>-7-point Likert scale |

**Academic planning**

Sharma and Gupta (2022) found that university students use academic planning to cope with technostress in e-learning environments. Students plan how they will best utilize available ICTs when adopting e-learning. The 'positive' and 'challenge' appraisal of technostress positively affect academic planning in students (Sharma & Gupta, 2022). Academic planning can be considered a multi-domain strategy per Tsai's (2009) conceptualization of the Model of Strategic e-Learning. Academic planning relates to the domain of 'perceived skill' in that it relates to students' self-awareness regarding their responsibilities and obligations in e-learning. Academic planning also relates to the domain of self-regulation as it pertains to elements of time management and self-monitoring whereby students set goals and monitor their e-learning goals.

**Problem-solving**

Morales-Rodríguez (2021) reported problem-solving as an effective technostress coping strategy used by students. He conceptualized problem-solving as an act of facing challenges directly, applying effort to overcome challenges, increasing effort manifold to resolve problems, and persisting to obtain a sought outcome. Morales-Rodríguez (2021) found problem-solving to be negatively correlated with techno-overload and techno-invasion in university students. Problem-solving can be classified as a multi-domain strategy as it can include a combination of improving one's perceived skills, managing one's affection as well as self-regulation.

**Use of digital collaboration tools**

Cook and Bell (2022) found that the use of digital collaboration tools as a technostress coping mechanism reported a medium mean. The use of digital collaboration tools moderated the relationship between technostress and academic performance, and also moderated the relationship between technostress and academic productivity. University students use video conferencing tools, whiteboard tools, online calendars and other time management tools to cope with technostress. The use of digital collaboration tools can be considered a multi-domain strategy per Tsai's (2009) conceptualization of the Model of Strategic e-Learning. On one hand, the use of digital collaboration tools alongside peers can advance one's perceived skill to cope with the stressors of e-learning. Besides that, the use of collaborative time management tools is a form of self-regulation as it enables students to closely monitor their group tasks. The use of collaboration tools can also improve one's affect through the mitigation of social isolation.

**Seeking instrumental support**

Cook and Bell (2022) identified that university students actively seek help to overcome problems they face. The prevalence of this coping mechanism reported a medium mean. According to Tsai's (2009) conceptualization, the act of seeking help is a form of improving one's perceived skill. Students are aware that they lack the skill or ability to overcome an issue and actively look for ways to solve a problem by asking for assistance from them people around them.

#### 4.1.2.2 To systematically review the emotion-focused coping strategies used by students to cope with technostress in e-learning environments based on research published in journal articles, book chapters, reports, conference papers and dissertations.

The second sub-objective of this study is to systematically review the emotion-focused coping strategies used by students to cope with technostress in e-learning environments based on research published in journal articles, book chapters, reports, conference papers and dissertations. Table 4.3 details the emotion-focused coping strategies used by students.

**Table 4.3**

*Emotion-Focused Coping Strategies Used by Students to Cope with Technostressors in e-Learning Environments*

| Author | Country | E-learning application | Study sample | Domain | Coping strategies | Data analysis method | Findings |
|---|---|---|---|---|---|---|---|
| Sharma and Gupta 2022 | United States of America | Synchronous and asynchronous distance learning | 275 university students | Affection | Seeking emotional support | PLS-SEM | -The 'harm' and 'threat' appraisal of technostress positively affects emotion-focused coping (in the form of general emotional support, emotional venting and academic disengagement) |
| | | | | Affection | Emotional expression or venting | | |
| | | | | Affection | Disengagement | | |
| Garg et al. 2022 | India | Distance learning | 552 college students | Affection | Cognitive reinterpretation | Descriptive statistics | **Mean (Standard deviation)**<br>Positive reframing: 3.197 (0.197)<br><br>-4-point Likert scale |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | | Correlation | -Positive reframing is negatively correlated with techno-overload, techno-invasion, techno-complexity and overall technostress |
| Morales-Rodríguez 2021 | Spain | Distance education | 180 university students | Affection | Emotional expression or venting | Pearson's Correlation | -Techno-overload is positively correlated with emotional expression |
| | | | | Affection | Cognitive reinterpretation | | -Techno-complexity is negatively correlated with cognitive restructuring |
| Cook and Bell (2022) | South Africa | Synchronous and asynchronous distance learning | 100 university students | Affection | Seeking emotional support | Descriptive statistics | **Mean (Standard deviation)**<br>Emotional expression: 3.484 (1.452)<br><br>-7-point Likert scale |
| | | | | Affection | Disengagement | Descriptive statistics | **Mean (Standard deviation)**<br>Emotional expression: 5.375 (1.351)<br><br>-7-point Likert scale |

**Emotional expression or venting**

Emotional expression or venting prevailed as one of the emotion-focused coping strategies used by students to cope with technostress in e-learning environments. According to Sharma and Gupta (2022), students get upset and express their feelings of emotional distress regarding the use of ICT for e-learning. They found that the 'harm' and 'threat' appraisal of technostress positively affects emotional venting in students. Additionally, Morales-Rodríguez (2021) found techno-overload to be positively correlated with emotional expression. They found that apart from letting out feelings and emotions, students also experience an eruption of feelings as a means for emotional expression. According to Tsai's (2009) Model of Strategic e-Learning, emotional expression or venting falls within the domain of 'affection' because it pertains to the elements of attitude or anxiety, in that students express their feelings or dislike or fear regarding the use of e-learning applications.

**Cognitive reinterpretation**

Another emotion-focused coping strategy applied by students is the cognitive reinterpretation of technostressors. Garg et al. (2022) conceptualize positive reframing as a method for cognitive reinterpretation of events. Students look for the positive in situations, reframe situations to see them in a more positive light and look at experiences as something to learn and grow from. Garg et al. (2022) found that students apply a high level of positive reframing. They found positive reframing to be negatively correlated with techno-overload, techno-invasion, techno-complexity and overall technostress. Morales-Rodríguez (2021) conceptualized this mental restructuring as reviewing problems repeatedly until they can view things differently, changing the way they viewed things to diminish negative perceptions, putting problems into perspective and seeking out the positive in situations. They found cognitive restructuring to be negatively

correlated with techno-complexity. Based on Tsai (2009), cognitive reinterpretation lies within the domain of 'affection' because it relates to one's attitude as it pertains to the shifting of one's perception of e-learning.

**Disengagement**

Sharma and Gupta (2022) found academic disengagement in the form of giving up on academic goals, skipping online classes and reducing the amount of work put into e-learning as one of the coping methods used by students. They found that the 'harm' and 'threat' appraisal of technostress causes disengagement in students. Morales-Rodríguez (2021) also found disengagement in the form of avoidance of problems as a coping strategy used by students. Students avoid problems by making light of situations, trying to forget about problems, pretending a problem does not exist and avoiding thinking about problems or taking action to resolve them. Besides that, Cook and Bell (2022) found that students ignore the problems that they experience for a period of time as a way to cope with technostress, reported by a high mean. According to Tsai (2009), disengagement is categorized under the domain of 'affection' as it pertains to the element of motivation. Students who get disengaged may feel that e-learning is outside their locus of control and they lack the motivation to effectively manage it.

**Seeking emotional support**

Seeking emotional support is another coping strategy employed by students to cope with technostress in e-learning environments. Sharma and Gupta (2022) conceptualized emotional support as talking to people about feelings and getting emotional support from family and friends. Sharma and Gupta (2022) found that the 'harm' and 'threat' appraisal of technostress positively affects emotional support in students. Besides that, Cook and Bell (2022) also found that students share their experience with stressors with friends and

family as a technostress coping strategy, reported by a medium mean. According to Tsai (2009), emotional support falls within the domain of 'affection' because it pertains to the elements of 'attitude' in that students discuss their feelings about e-learning.

## 4.2 Data triangulation of technostressors faced by students in e-learning environments

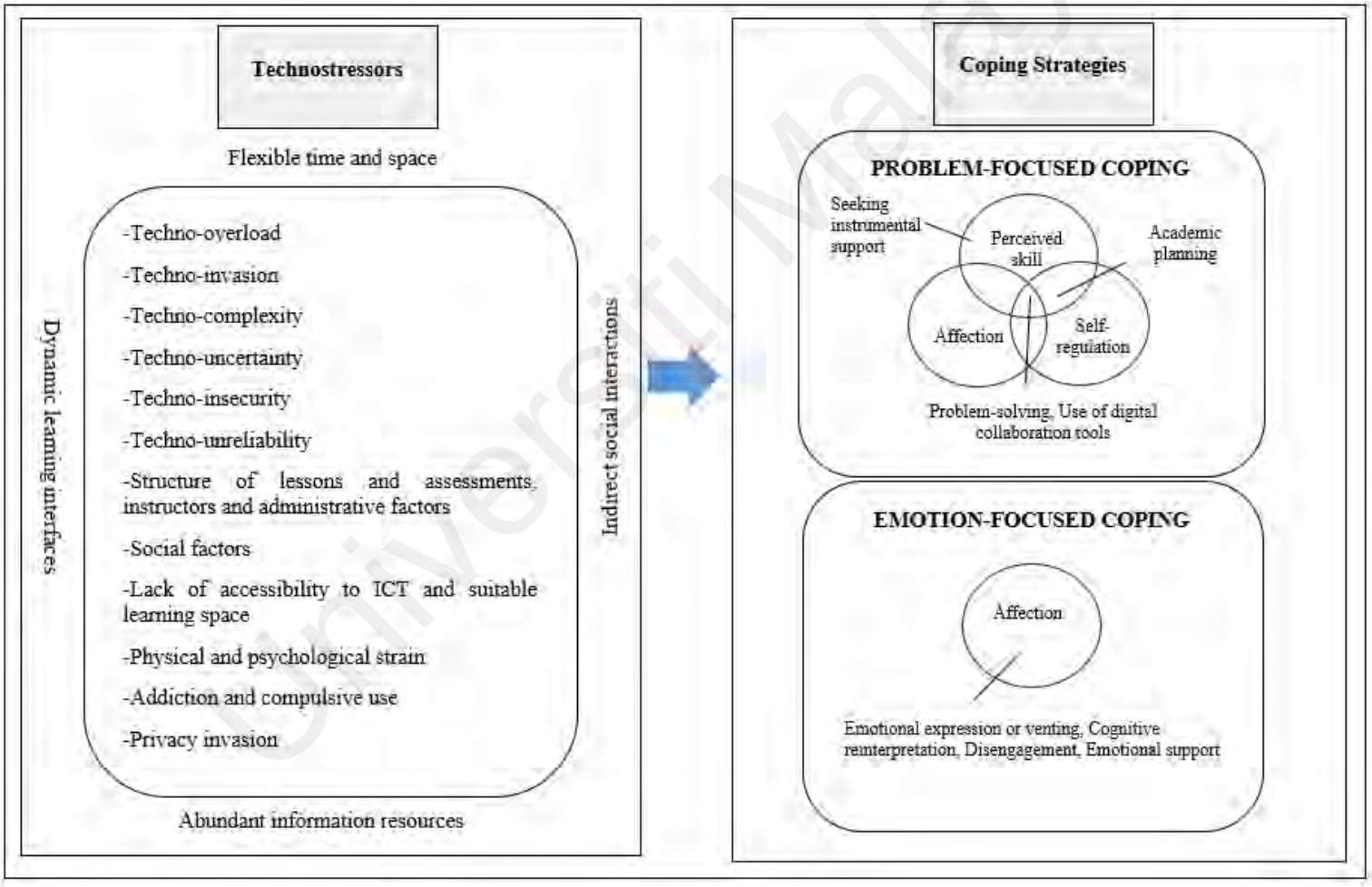
This study aimed to identify the technostressors experienced by students in e-learning environments and the coping strategies they apply to cope with them. The findings of this study have shaped a framework of student technostress and coping in e-learning environments. The present study reports that students experience 12 technostressors, namely techno-overload, techno-complexity, techno-invasion, techno-uncertainty, techno-insecurity, techno-unreliability, the structure of lessons and assessments, instructors and administrative factors, social factors, lack of accessibility to ICT and suitable learning space, physical and psychological strain, addiction and compulsive use and privacy invasion. By specifying the context of the experience of students in e-learning environments, the technostressors which emerged extended beyond the popularly studied five factors (i.e., techno-overload, techno-complexity, techno-invasion, techno-uncertainty, techno-insecurity) as proposed by Tarafdar et al. (2007). E-learning environments raise unique challenges that serve as stressors to students.

Additionally, the present study highlights the coping strategies students use to cope with these technostressors. In line with the conceptualizations of Lazarus and Folkman (1984), the coping strategies students apply are generally categorized into two categories, namely problem- and emotion-focused coping. Four problem-focused strategies, namely academic planning, problem-solving, seeking instrumental support and using digital collaboration tools; and four emotion-focused coping strategies, namely emotional

expression or venting, cognitive reinterpretation, disengagement and seeking emotional support emerged respectively. Furthermore, the present study found no interplay of strategies between the different domains proposed by Tsai (2009). Instead, the present study has found that the strategies which students apply can encompass more than one domain (i.e., perceived skill, affection, self-regulation) as conceptualized by Tsai (2009). For example, academic planning pertains to the improvement of one's perceived skill as well as self-regulation. Problem-solving is a multi-domain strategy as it involves improving one's perceived skills, managing affection, and self-regulation. Meanwhile, emotional expression or venting, cognitive reinterpretation, disengagement and seeking emotional support are all strategies stemming from the affection domain as they relate to managing attitude, motivation and anxiety. The figure below shows the framework of student technostress and coping in e-learning environments.

**Figure 4.1**

*Framework of Student Technostress and Coping in e-Learning Environments*



## 4.3 Summary

The first systematic literature review consisted of a total of 26 documents which discuss the technostressors that students experience in e-learning environments. Upon conducting a thematic analysis to identify the technostressors experienced by students, a total of 12 themes emerged which are: - Techno-overload, Techno-complexity, Techno-invasion, Structure of lessons and assessments, instructor and administrative factors, Social factors, Techno-uncertainty, Techno-unreliability, Accessibility to ICT and suitable learning space, Techno-insecurity, Physical and psychological strain, Addiction and compulsive use and Privacy invasion.

The second systematic literature review consisted of four documents which discuss the coping strategies used by students to cope with technostress in e-learning environments. Three out of the four documents discussed problem-focused coping strategies, while all four documents discussed emotion-focused coping strategies used by students to cope with technostress in e-learning environments. Upon conducting a thematic analysis, four problem-focused coping strategies emerged which are: - Academic planning, Problem-solving, The use of digital collaboration tools and Seeking instrumental help to overcome problems. Based on the thematic analysis, a total of four emotion-focused coping strategies emerged which are: - Emotional expression or venting, Cognitive reinterpretation, Disengagement and Seeking emotional support. The next chapter will discuss the key findings, research implications and limitations of this study and recommendations for future studies on student technostressors and coping strategies in e-learning environments.

# CHAPTER 5

# CONCLUSION

## 5.0 Introduction

This topic discusses the key findings of this study with regard to the two main research objectives and two sub-research objectives stated in previous chapters. Next, this chapter will highlight the implications of this research study in terms of how this study contributes to technostress literature. This is followed by recommendations for future studies in the area of technostress and coping as experienced by students in e-learning environments. Finally, the study is concluded based on what has been achieved through this research study.

## 5.1 Discussion

### 5.1.1 To systematically review the technostressors faced by students in e-learning environments based on research published in journal articles, book chapters, reports, conference papers and dissertations.

The proliferation of ICT usage in learning environments has given rise to an array of technostressors experienced by students. A majority of findings have shown that the students experience the five main technostressors (i.e., techno-overload, techno-complexity, techno-invasion, techno-uncertainty, techno-insecurity) in e-learning environments as initially proposed by Tarafdar et al. (2007) and Ragu-Nathan (2008). However, some findings also point to the contrary, suggesting that e-learning may not give rise to these technostressors in all situations. The possible reasons for this are discussed below.

One quantitative survey by Cook and Bell (2022) found no relationship between techno-overload, techno-invasion, techno-uncertainty, techno-insecurity and technostress. This may be because they studied a limited sample of only 100 university students which may not have been sufficient to capture the prevalence of technostress. Meanwhile, the other 20 quantitative studies had a substantial sample of between 150 and 1,367 students with an average of 525.85 student samples per study. The lack of relationship could also be attributed to the snowball sampling method employed by Cook and Bell which is prone to selection bias and leads to results that lack generalizability of the population studied (Ahmed, 2024). However, it is worth noting that these divergent findings may also be explained by other factors. Past literature in the workplace has shown that the pervasiveness of ICT in everyday life led employees to become more adaptive to stress due to techno-overload, thus reducing its significance (Zhang et al., 2022). Besides that, circumstantial factors can offset the effects of techno-overload, potentially making it irrelevant in certain situations. Salient relationships between employees and leadership have proven to partially moderate the relationship between techno-overload and poor work-life balance (Dingemans, 2020). Similarly, supporting conditions such as peer support and technical assistance have been shown to prevent techno-overload from translating into burnout in learning environments (Hameed et al., 2022).

Besides that, Zhang et al. (2022) stated that techno-invasion caused by the inability to spend time with one's family is mitigated by workplace friendships. This is because good relationships with colleagues can satisfy workers' need for belonging (Yu et al., 2021), thus reducing the feeling that workplace ICTs invade one's personal life. Another study by Califf and Brooks (2020) stated that those accustomed to ever-changing environments do not severely experience the brunt of techno-uncertainty. One metacognitive approach to active learning is the constant adaptation of learning strategies by students themselves

(Vovides et al., 2007), thus students may already be used to change and thus less affected by that brought about by the use of ICT. Concerning the divergent findings in techno-insecurity, Aziz et al. (2021) reported that students quickly adapt to e-learning environments and are willing to share information with their peers, thus promoting cooperation and reducing the feeling of being threatened by ICT. Another prominent divergent finding by the present review is the negative relationship between techno-overload and technostress as identified by Abuzant et al. (2022). Research in workplace psychology tells us that under-stimulation can also cause stress (Weinberg, 2016). Thus, the task of having to work longer hours (as described by techno-overload) could result in lowered overall stress in certain situations.

Furthermore, this study found that social factors played a conflicting role in causing technostress. The study by Lee et al. (2021) showed that social isolation did not contribute to technostress in students. This study employed a quantitative survey of 388 Malaysian students during the COVID-19 lockdown. This finding is justified by the fact that students may easily maintain communications through social media. On the other hand, a qualitative study by Alexa et al. (2022) found that even though students used social media such as Facebook, they still felt alone most of the time and that communication was not comparable to in-person interactions. Even though this study only targeted 36 students, its qualitative nature may have been able to capture the nuances of social media usage in remote learning settings. Previous studies have indeed shown that students experience greater social isolation in online learning. They dealt more with ICTs than with their peers or instructors, thus interactions were generally lower compared to those in face-to-face lessons (Ali & Smith, 2015). However, other studies have also proven that students are digital natives who rely on ICTs (including social media) to collaborate on assignments with peers (Ng, 2012) and even use social media to get information about classes from

their university's administration (Verčič & Verčič, 2013), thus reducing feelings of disconnect.

This review also found that peer support did not have any impact towards technostress (Zhao et al., 2022). Other studies show that the use of ICT in learning encourages students to take charge of their learning because learning takes place both inside and outside the classroom (Muhammad, 2020). Moreover, this review found that social influence had a contradicting impact towards students' technostress. On one hand, it found that social influence to use ICTs did not affect students' technostress because it was mandatory for e-learning during the pandemic (Kader et al., 2022). Kader et al.'s study regards social influence as influence from people deemed important by the student. Meanwhile, Quinn (2000) indicated that negative parental attitudes towards ICT cause their children (students) to experience technostress. One explanation for the difference is that Kader et al.'s study does not specify parental influence, so it might not have been accounted for in the findings. Another possibility is that both studies were conducted over two decades apart, and perception and influences around the usage of ICT in e-learning have undergone significant evolution. Recent studies show that social influence does not predict students' intention to use ICTs. Students already have experience using ICTs for online learning; thus, they hypothesized that students can independently decide whether they should continue using them without being influenced by others (Chen & Hwang, 2019). Since social influence does not affect one's intention to use ICT, it is unlikely to cause technostress in e-learning environments. Contrastingly, students may have been more dependent on cues from their parents to guide their stress-appraisal process before the proliferation of ICT in almost all aspects of modern life.

The present review also reported conflicting findings about social overload as a stressor. Kekkonen and Oinas-Kukkonen (2021) found social overload to be a cause for technostress, while Loh et al. (2021) did not. This could be because the former study involved older doctoral students with an average age of 32.5 years old, while the latter study involved students predominantly below the age of 25. Being that the students in Loh et al.'s study are younger, they may be more active users of ICT and less prone to feelings of overload. Other research supports that the experience of social overload is determined by the age of users (Maier et al., 2014).

Moreover, this study found that students' dissatisfaction with the way lessons were structured contributed to their technostress. Past studies have shown that students online learning can sometimes fail to meet students' expectations in terms of course content, delivery and level of difficulty, thus reducing their motivation (Meşe & Sevilen, 2021). Further, it has been proven that reduced intrinsic and extrinsic motivation is linked to increased technostress in e-learning (Panisoara et al., 2020). The present study also found conflicting outcomes about the effects of mandatory attendance on technostress. Mehtälä et al., (2022) found students were not motivated to participate in remote e-learning activities, while Erdoğan et al. (2022) found that regular attendance and participation in e-learning activities were negatively associated with students' technostress levels. This could be because the students in Erdoğan et al.'s study were enrolled in a university medical programme while the students in Mehtälä et al.'s study were in primary and secondary-level which is far less rigorous. Past literature has shown that students enrolled in highly intensive programmes found mandatory participation to be beneficial in helping them evenly distribute their learning across the span of the programme (Lochner et al., 2016).

Besides that, the present study found that interdependent group assignments had both protective (Kasemy et al., 2022) and detrimental effects (Schauffel et al., 2022) towards technostress. In Kasemy et al.'s study, learning was not conducted fully online and some amount of in-person interaction between peers was present. This would enable them to benefit from knowledge-sharing, while also overcoming coordination issues faced in a fully online learning environment. Meanwhile, in Schauffel et al.'s study, e-learning was fully remote, thus exacerbating coordination issues in interdependent tasks. This is supported by a past study by LaBeouf et al. (2016) who reported students face coordination issues in remote e-learning as they have to accommodate the availability of each group member. Additionally, students were unhappy with the allocation of grades due to the presence of free riders in group work. Another notable finding of the present study is the conflicting impact of administrative and teachers' support towards technostress. Zhao et al. (2022) found that when the school offers students support in terms of training, enough time to adapt to ICT and the necessary infrastructure, it reduces students' technostress. However, support in the form of teachers' active facilitation of discussions and guidance with academic tasks worsened matters (Kader et al., 2022). Both studies involve university students deemed sufficiently mature to leverage support and assistance. However, these findings suggest that while university students appreciate resources that empower them to learn with ICTs, they also lack the confidence to interact directly with academic staff even if it is to their benefit. Previous research has shown that active learning driven by instructor-student interactions can sometimes lead to higher anxiety in certain students (Cooper & Brownell, 2020).

Furthermore, the present study found that students experience online examinations as a technostressor because of the question load and difficulty. Based on Novick et al. (2022), the time allocated for in-person examinations cannot be simply maintained in online

settings. In online examinations, students first need to work out solutions on paper (e.g., mathematical calculations) and then transfer answers to the online platform. Thus, there is extra work involved in online examinations compared to offline. The present study also found that the layout of questions in online examinations is stressful for students because the upcoming questions are concealed from one's view. Students cannot view the entire examination paper before attempting to answer questions, provoking their stress. This finding is also corroborated by Novick et al. (2022) who found that online examination which does not allow backtracking further exacerbates students' stress, making them waste more time on questions they cannot solve because they are not allowed to come back to it. Besides that, the present study found that lecturers cause students' technostress by being difficult to reach in e-learning environments. Bailey and Lee (2020) state that lecturers face challenges in replying to all students' messages and providing the needed corrective feedback when learning online.

Another prominent finding of this study is that the unreliability of ICTs causes technostress for students in e-learning environments. Past studies have clearly documented the unreliability of ICTs as a cause for technostress in both school (Dahabiyeh et al., 2020) and work settings (Nitsch & Kinnebrock, 2021). This characteristic of ICTs hampers one's feeling of psychological safety as the outcome of its usage is inherently unpredictable, thus deeming it a stressor (Dumont, 2020). Besides that, the lack of accessibility to ICT devices, conducive learning space and supporting infrastructure is a cause for technostress which is corroborated by recent studies (Masha'al et al., 2020; Akpınar, 2021).

The present study also found physical and psychological strain to cause students' technostress in e-learning. This is supported by Manea et al. (2020) who found that students experience physical strain to their eyes, heads and backs due to prolonged exposure to computer screens. Besides that, it is also well-established that the stress caused by ICT not only affects physical strain, - but also psychological exhaustion and burnout (Mheidly et al., 2020). The present study also reported addiction and compulsive use of ICT for e-learning as a stressor. ICT such as social networking sites are becoming increasingly feature-rich, which leads to the possibility of addiction (Tarafdar et al., 2020b). The overuse of ICTs such as social media has proven to cause negative effects internally by affecting one's emotional state as well as externally through the wastage of time and impeded performance (Brooks et al., 2016). Finally, students experience privacy invasion as a technostressor in e-learning environments. Within the scope of online learning, teachers have expressed their concerns regarding privacy invasion when using e-learning applications (e.g., Zoom-bombing) (Chou & Chou, 2021). The use of new applications is particularly stressful as one becomes self-conscious about safeguarding their identity and privacy (Khlaif et al., 2023).

### 5.1.2 To systematically review the coping strategies used by students to cope with technostress in e-learning environments based on research published in journal articles, book chapters, reports, conference papers and dissertations.

The present study identified several coping strategies students apply to cope with technostress in e-learning environments. They can be categorized into two types, namely problem-focused and emotion-focused coping strategies.

**5.1.2.1 To systematically review the problem-focused coping strategies used by students to cope with technostress in e-learning environments based on research published in journal articles, book chapters, reports, conference papers and dissertations.**

Academic planning is one of the problem-focused coping strategies students apply to cope with technostress in e-learning. Past literature has proven that academic planning is one of the problem-focused coping strategies that mediate the relationship between academic stress and academic achievement. Contemplating how to handle issues, strategizing and creating an action plan is known to ameliorate the effects of stress in academia (Struthers et al., 2000). As an extension, students plan how they will use ICT in e-learning as a means of coping with the technostress that arises in this environment.

Besides that, the present study found problem-solving as an effective technostress coping strategy used by students. Proactively finding solutions by means of learning how to utilize new ICT, seeking assistance from peers and looking for instructions that fit a person's personal capabilities and tasks are effective ways to cope with technostress (Vendramin et al., 2021). Furthermore, facing problems caused by ICT in a direct manner is an effective method for coping with technostress. Avoidance might help one cope with other types of stressors, but it does not effectively mitigate technostress (Hauk, 2018).

Furthermore, the present study found the use of collaborative digital tools to be another effective coping strategy which students use. Studies have shown that both children and adults complete computer-supported tasks with more success when working with each other as compared to working alone. People who collaborated on computer-supported tasks were more likely to engage in collaborative problem-solving, plan their strategies

and amend weak strategies along the course of completing the task (Blaye & Light, 2012). Students who use digital tools to collaborate on e-learning tasks reap the same benefits from having a peer support system. Finally, the present study found that students cope with technostress by seeking instrumental support. Prior studies have shown that seeking instrumental social support is an effective method commonly used to cope with stressors (Webster et al., 2014; Babicka-Wirkus et al., 2021).

**5.1.2.2 To systematically review the emotion-focused coping strategies used by students to cope with technostress in e-learning environments based on research published in journal articles, book chapters, reports, conference papers and dissertations.**

Emotional expression or venting prevailed as one of the coping strategies used by students to cope with technostress in e-learning environments. Emotional expression or venting serves to release unpleasant feelings regarding an issue at hand (Behfar et al., 2020). Venting is reportedly one of the ways users cope with technostress in the workplace. Even though venting is caused by unpleasant emotions, it is effective in mitigating the impact of stressors. By expelling negative feelings, stress is reduced and there is an opportunity for the restoration of emotional stability (Pirkkalainen et al., 2019). Besides that, seeking emotional support is another emotion-focused coping strategy used by students to cope with technostress. Past studies have shown that students typically rely on emotional support from family and friends to cope with academic stress caused by studying, passing examinations and getting scholarships (Babicka-Wirkus et al., 2021). Similarly, the provision of emotional support in the form of encouragement, consolation and a listening ear has also been shown to reduce one's perception of stress caused by ICT in the workplace (Wahl et al., 2023).

Disengagement is another coping strategy used by students identified in this study. The use of ICT poses a number of challenges for students, triggering their withdrawal from attempts to tackle the problems that emerge. One study by Patall et al. (2018) found that students tend to disengage from learning when they perceive the lessons as too challenging. Students' motivation levels are highly reliant on their sense of competence, autonomy to make decisions and their ability to relate to the lesson (Patall et al., 2018). Low-performing students try to avoid failure and engage in maladaptive self-sabotaging behaviours to cope with challenges that arise in learning (Skilling et al., 2020). Finally, students apply cognitive restructuring as a method of coping with technostress in e-learning environments. Cognitive restructuring has been proven to help people cope with both mental and physical stressors that manifest as diseases (Larsen & Christenfeld, 2011). Cognitive restructuring is a skill which helps a person challenge inaccurate (negative) thoughts and beliefs which are a byproduct of stress (Mueser et al., 2015). Studies have proven cognitive restructuring to be effective in stress management, and its effectiveness extends to technostress.

## 5.2 Research Implications

Within the area of e-learning, several studies have explored the issues students experience in e-learning without identifying them as a cause for stress. This limits our understanding of the severity of these issues. In recent years, studies have emerged exploring the phenomenon of technostress as experienced by students when engaged with e-learning. However, none have systematically summarized what is known within this particular context. This study contributes to technostress literature by summarizing the technostressors experienced by students in e-learning environments, providing a comprehensive view of the matters that may eventually lead to strain and burnout. This study extends the framework of technostress proposed by Tarafdar et al. (2007) focused

on employees, to give rise to a framework of technostress in e-learning environments specifically from the perspective of students. The findings of this research report that in addition to the five main technostressors (i.e., techno-overload, techno-invasion, techno-complexity, techno-uncertainty, techno-insecurity) conceptualized by Tarafdar et al. (2007), students experience seven other technostressors in e-learning environments which are techno-unreliability, social factors, physical and psychological strain, addiction, lack of accessibility to ICT and suitable learning space, privacy invasion and the issues with the structure of lessons and assessments, instructor and administrative factors. This calls for the improvement of educational policies and e-learning systems.

Policymakers and learning administrators should collaborate to create guidelines that specify the appropriate volume of work assigned to students with reasonable deadlines. These guidelines should be tailored to the different types of programmes, levels of study and should be informed by student feedback. This ensures students do not feel overwhelmed and overloaded with tasks in e-learning. To address techno-complexity, learning institutions should ensure that their LMS is designed with user experience in mind and undergoes sufficient testing prior to being launched. Additionally, students should be given training on how to use the software used for lessons. Learning institutes can also set up a helpdesk to address technical problems promptly. In order to counter techno-uncertainty, regular surveys and check-ins need to be implemented to gauge learners' perceptions of the ICTs used. Given that ICT is evolving, continuous student feedback is imperative in meeting their changing needs. Learning administrators should align their ICT support services to the pace of ICT change, and student feedback will aid in highlighting gaps in the resources provided. Besides that, institutions can set up counselling centres to encourage students to explore ways to overcome their techno-

insecurity. Counsellors should be ready to offer general support and guidance as well as information on the ICT support services offered by the institution.

Approaches aimed at overcoming social factors as a technostressor are nuanced and require the right balance. On one hand, social isolation is a stressor that is prevalent in learning programmes that are conducted remotely. Instructors can conduct ice-breaker sessions as well as free and easy sessions to allow students to mingle in online spaces through the use of games and sharing sessions. This will help students get to know their peers, develop friendships and meet the need for socialization. On the other hand, some students feel overwhelmed by the socialization requirements of e-learning. Therefore, socialization activities should be flexible and optional to an extent to prevent feelings of social overload in some students. Learning administrators should carry out mandatory workshops to teach students and staff the importance of establishing good work-life balance and personal boundaries. This workshop should encourage cut-off times where contact is limited. By doing this, students can be away from devices and not feel the need to be ever-present thus addressing the issue of techno-invasion and social overload. Members of e-learning environments can benefit from understanding the different personal commitments and responsibilities that others have which exist beyond the classroom, thus enforcing the idea of respecting personal time. This is also a great opportunity for instructors to share their reachable hours, thus helping students overcome stress due to delays in the instructor's response. This workshop should also focus on time management skills so that students establish a personal cut-off time from ICT devices to overcome an addiction to checking notifications and updates within e-learning platforms.

The present study also found that students felt stressed by the way lessons are carried out in e-learning. For one, they struggled to maintain their motivation and level of interest towards their academic work. Learning institutions should explore using gamification principles and progress-tracking systems. The use of leaderboards can encourage healthy competition and keep students engaged throughout the course. Additionally, institutions can provide flexible learning options where possible within a given programme. Students should be able to participate asynchronously through methods such as forum discussions and self-recorded videos to exhibit their comprehension of course material. Alternative modes of participation should also be considered to encourage socially anxious students' participation. Some students may prefer written text compared to speaking up in class, and affordances should be made where possible and deemed sufficient.

Besides that, instructors can facilitate interdependent tasks by conducting regular virtual meetings with students to monitor their individual contributions to group-based projects. Programmes should also be structured in a manner whereby students have enough autonomy to determine their final grades, regardless of the commitment and participation of their peers. While interdependent tasks deter social isolation, incentivizing individual participation is beneficial to overall performance. Besides that, online examinations can be improved in a few ways. Institutions should conduct simulations before examinations so students can experience the outlay of the software or website used. Institutions should also allow backtracking in examination questions. Students should have the opportunity to focus on questions they are confident in answering while having a chance to revisit difficult questions as they would in a physical examination. Online examinations should also be longer than physical examinations to account for unexpected technical issues and the challenge of transferring answers from paper to typed words. Additionally, instructors should undergo training to improve their ICT facilitation skills in e-learning. Learning

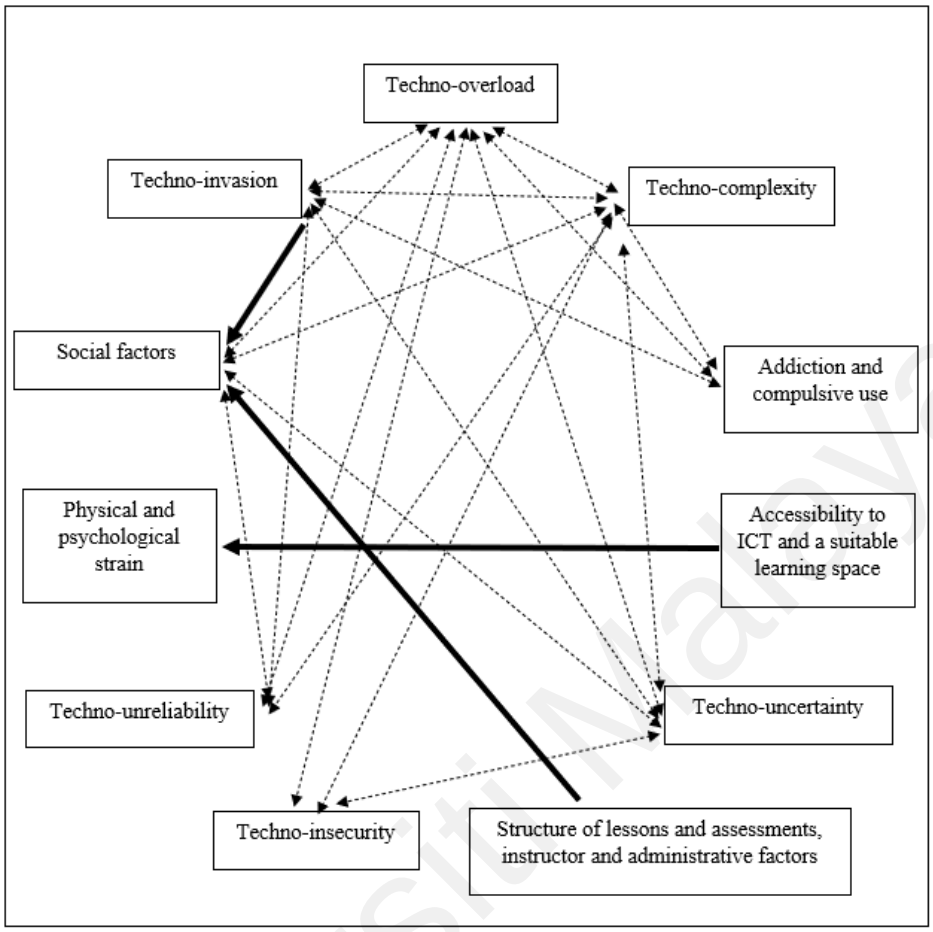
institutes can provide ongoing training to ensure instructors are keeping up with technological updates in e-learning platforms. Besides that, institutions can provide training for students and staff on the ethical use and sharing of information. Students may be required to upload photos, videos and other learning content to online platforms, thus subjecting them to invasion of privacy. It is important to establish that any content can only be shared with consent.

Learning institutions should also provide access to ICT devices, infrastructure and learning spaces to ensure all students can participate in lessons and assessments. Libraries and computer laboratories should be equipped with sufficient computers, high-speed internet access and study rooms. Additionally, institutions can offer device rentals for students who undertake lessons remotely. This ensures all students have access to the required resources and alternatives should their personal devices malfunction or become unreliable during the course of study. In addition to this, institutions should educate students about the importance of taking breaks from screens and encourage outdoor activities be it within or outside the learning campus. Comfortable and conducive learning spaces alongside regular physical activity help students counter the physical strain of e-learning.

The present study also discovered interplays between the technostressors. Technostressors are connected through causality and correlation, indicating that they are interrelated.

**Figure 5.1**

*The Interplay of Technostressors Students Experience in e-Learning Environments*




Note. ⟷ Correlation

⟶ Causality

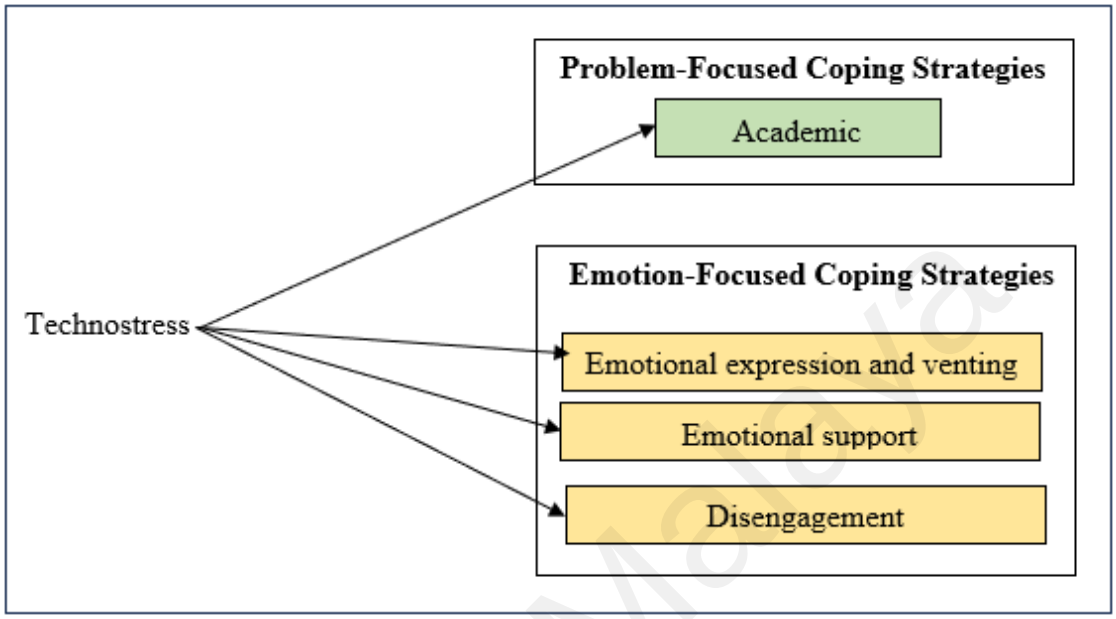
Figure 5.1 shows how the technostressors are linked to each other, the bold uni-directional arrows indicate causality while the breaking, bi-directional arrows indicate correlation between factors. The finding highlights that the presence of one technostressor can cause other technostressors within e-learning environments. Techno-invasion causes social isolation in students. Furthermore, the lack of accessibility to ICT devices causes students to rely on their mobile phones for learning leading to physical strain on the eyes (Abuzant et al., 2022). Besides that, a lack of administrative support causes reduced peer support among students engaged in e-learning (Zhao et al., 2021). Moreover, this study identified many correlations between the technostressors students experience in e-learning environments, indicating that technostressors are closely associated with one another.

Technostressors have negative spillover effects on other technostressors. This study provides learning administrators insight that a holistic approach is needed to resolve the technostressors present in e-learning environments. Learning administrators should integrate a variety of support elements to effectively counter technostress. Suitably designed e-learning platforms, provision of prompt technical support, training and ICT infrastructure, solid guidelines to moderate workload, workshops that model healthy interactions and adequate training for instructors need to be integrated systematically. A noteworthy advantage of the interrelated nature of technostressors is resolving any one technostressor can positively affect other technostressors.

The second part of this study explores the coping strategies students use to cope with technostressors in e-learning environments. The study found that students cope with technostress (as a general construct) in e-learning environments by applying both problem- and emotion-focused coping strategies. This study further contributes to the existing literature by conceptualizing the coping strategies based on the learning strategy domains (i.e., perceived skill, affection, self-regulation) per the Strategic Model of e-Learning proposed by Tsai (2009).

**Figure 5.2**

*The Relationship between Students' Technostress and Coping Strategies in e-Learning Environments*




Note. Affection

Multi-domain strategy

Causality

The solid unidirectional arrows indicate causality between the factors. Technostress causes the application of academic planning as a coping strategy. Academic planning is a problem-focused coping strategy applied by students to cope with technostress in e-learning environments. Academic planning is considered a multi-domain strategy per Tsai's (2009) conceptualization of the Model of Strategic e-Learning. Academic planning relates to the domain of 'perceived skill' in that it relates to students' self-awareness regarding their responsibilities and obligations in e-learning. Academic planning also relates to the domain of self-regulation as it pertains to elements of time management and self-monitoring whereby students set goals and monitor their e-learning goals. Learning institutions should encourage the use of academic planning by providing a course outline and highlighting the assignments and assessments early in the academic year. Besides

that, embedding progress trackers within the LMS can help students visualize pending tasks and deadlines easily, thus helping them plan effectively.

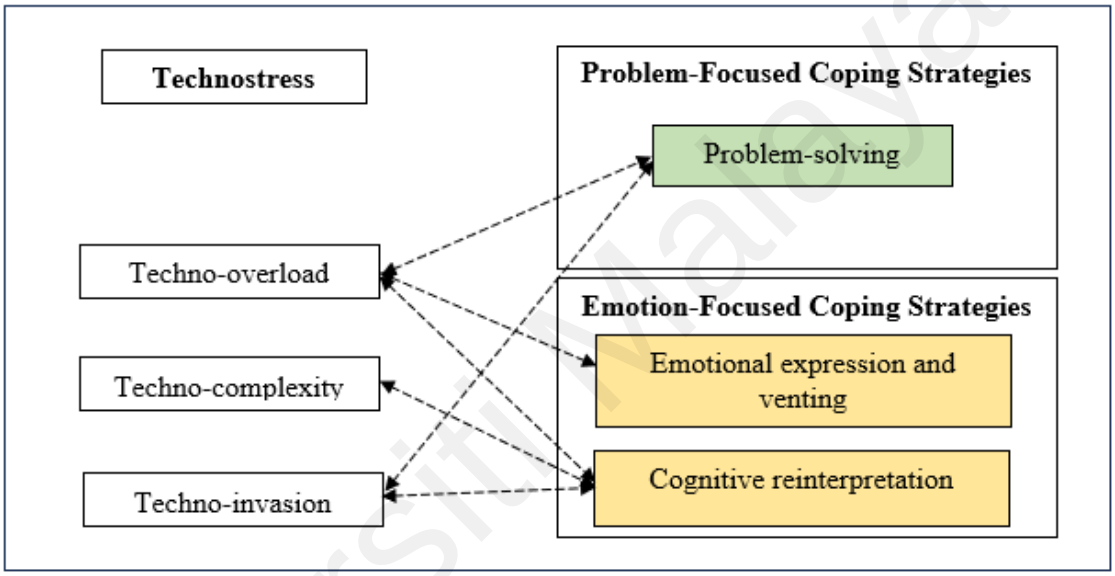
Technostress also causes the application of emotion-focused coping strategies like emotional expression and venting. According to Tsai's (2009) Model of Strategic e-Learning, emotional expression or venting falls within the domain of 'affection' because it pertains to the elements of attitude or anxiety, in that students express their feelings or dislike or fear regarding the use of e-learning applications. Besides that, technostress causes students to seek emotional support. According to Tsai (2009), emotional support falls within the domain of 'affection' because it pertains to the elements of 'attitude' in that students discuss their feelings about e-learning. Learning institutions should offer mental health services to provide a means for students to vent their frustrations and also receive emotional support to cope with the stressors encountered in e-learning.

Furthermore, technostress causes students to disengage from learning. According to Tsai (2009), disengagement is categorized under the domain of 'affection' as it pertains to the element of motivation. Students who get disengaged may feel that e-learning is outside their locus of control and they lack the motivation to effectively manage it. Policymakers should set up early detection programmes that train instructors to identify and address this issue promptly. Students who do not participate in class and are performing poorly require intervention followed by discussions on how the institution can support them in their learning.

The findings also highlight how specific technostressors relate to specific problem- and emotion-focused coping strategies.

**Figure 5.3**

*The Relationship between Specific Technostressors and Coping Strategies in e-Learning Environments*




Note. Affection
Multi-domain strategy
Correlation

The breaking, bi-directional arrows indicate a correlation between the factors. Techno-overload is associated with both problem- and emotion-focused coping strategies. Problem-solving (a problem-focused coping strategy) is conceptualized as facing challenges directly, applying and multiplying efforts to resolve problems, and persistence. It is classified as a multi-domain strategy as it can include a combination of improving one's perceived skills, managing one's affection as well as self-regulation. These students would benefit from receiving tools that empower them to solve problems interdependently. Workshops that hone students' time management skills and work-life

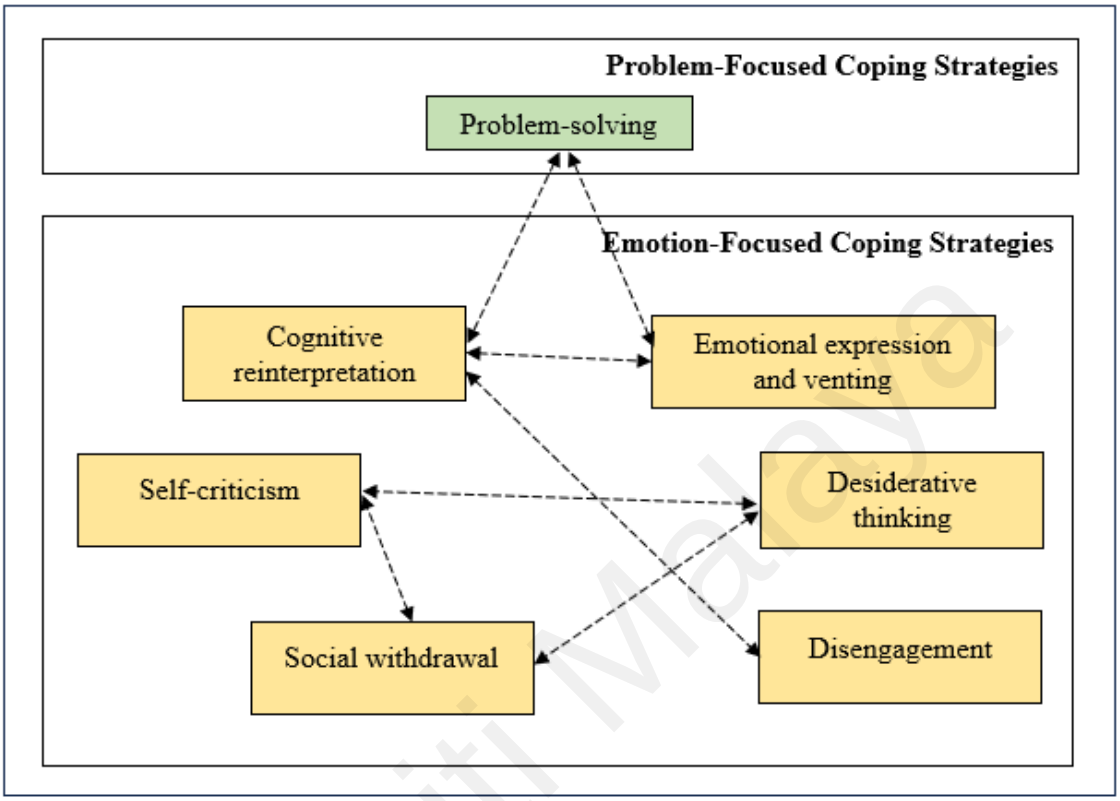
balance can help them leverage problem-solving to curtail techno-overload and techno-invasion.

Techno-overload is also associated with the emotion-focused coping strategy, emotional expression and venting, which falls within the domain of affection as conceptualized by Tsai (2009). Besides that, techno-overload is associated with the emotion-focused coping strategy, cognitive reinterpretation. Cognitive reinterpretation of technostressors lies within the domain of 'affection' because it relates to one's attitude as it pertains to the shifting of one's perception of e-learning. The study also found that techno-invasion is associated with the problem-focused coping strategy, problem-solving and emotion-focused coping strategy, cognitive reinterpretation. Finally, techno-complexity is associated with the emotion-focused coping strategy, cognitive reinterpretation. Mental health services and on-site counsellors provide an avenue for students to express their stressors and help them restructure these stressors as challenges within e-learning. Students can reframe stressors as challenges when they can regain control over the stressors. Counsellors can restore this sense of control by encouraging students to leverage ICT skill enhancement resources and time management workshops.

In addition to identifying the coping strategies students apply, the present study also discovered interplays between the strategies. Similar to technostressors, coping strategies also influence each other.

**Figure 5.4**

*The Interplay of Coping Strategies in e-Learning Environments*




Note. Affection

Multi-domain strategy

Correlation

Figure 5.4 shows how the coping strategies are related to each other. The breaking, bi-directional arrows indicate a correlation between the factors. Within problem-focused coping, there is no interplay or connections between the identified strategies. However, the study found associations between problem-focused and emotion-focused coping strategies. According to Morales-Rodríguez (2021), problem-solving (a problem-focused coping strategy) is positively correlated with emotional expression and cognitive reinterpretation (emotion-focused coping strategies). There are also some connections between the emotion-focused coping strategies identified. Morales-Rodríguez (2021) found cognitive reinterpretation to be positively correlated with disengagement and emotional expression. Morales-Rodríguez (2021) also identified other emotion-focused

coping strategies which students use to cope with technostress in e-learning environments such as desiderative thinking, self-criticism and social withdrawal. Although they are not directly related to any technostressor, they are proven to be interrelated to one another. Students apply desiderative or wishful thinking as a method for coping. Besides that, students criticize themselves as a way to cope with technostress. They recognized how their own actions led to their difficulties, blamed and criticized themselves and accepted that they should suffer the negative outcomes of their actions. Students also socially withdrew from their social environment as a manner of coping with technostress. Students socially isolated themselves and did not share their thoughts or feelings with those around them. Desiderative thinking, self-criticism and social withdrawal are positively correlated with each other.

The findings provide insight into the types of efforts and behaviours students engage in to cope with the stress they encounter. Coping strategies are not limited to traditionally productive endeavours such as academic planning and seeking instrumental support. Instead, students also engage in some maladaptive behaviours such as disengagement from studies and self-criticism as a manner of coping. Additionally, the findings highlight how the application of productive coping strategies is associated with the application of maladaptive coping strategies, illustrating the array of methods students use to cope. This provides learning administrators insight into the reasoning behind some of the behaviours observed among learners in e-learning settings. With this understanding, they can provide better support for students who engage in maladaptive coping behaviours. Self-management tools such as skill enhancement workshops and comprehensive technical support need to be provisioned in conjunction with emotional support platforms. Regular mental health surveys and close monitoring of in-class behaviour are practical ways to identify disengaged and withdrawn students. Instructors and on-site counsellors should

work hand-in-hand to detect students who lack the skills to leverage self-help resources. Early interventions can prevent students from indulging in maladaptive behaviours such as those identified by the present study.

### 5.3 Recommendations for Future Research

The present study clearly highlights a significant gap in technostress coping literature among students. The existing literature only tells us the ways in which students cope with three out of the 12 technostressors identified in e-learning environments. Future studies should explore how students cope with the nine other technostressors within the e-learning space. Besides that, more studies are needed to understanding the root cause of the technostressors students experience in e-learning environments. The present study shows that many of the factors are correlated with one another. Future studies should aim to understand the starting point of technostress as well as the spill-over effects it may have on other technostressors. This will enable students and learning administrators to identify the most ideal place to target their coping and support efforts.

Besides that, out of the 26 documents studied to identify technostressors, only one paper involved primary and secondary school students. Meanwhile none of the documents on coping strategies involved primary and secondary students. Most of the existing studies on technostress and coping in e-learning environments involve students in higher education institutions, limiting our understanding of its prevalence in children and adolescents. Younger learners are a population of interest because they are still undergoing psychosocial development and lack the competence to cope with the growing demands of ICTs (Li et al., 2019; Schmidt et al., 2021). Thus, future research should

explore the prevalence of technostress and coping among primary and secondary school students in-depth.

Furthermore, while this study explores the coping strategies students apply to cope with technostress, it does not indicate the short-term or long-term impact of the identified strategies. Some types of coping strategies such as disengagement and self-isolation are proven to lead to poor health and well-being (Kirby et al., 2022). The outcomes of coping strategies are complex and nuanced such that seemingly positive strategies like self-control can negatively impact one's emotional state as it is taxing on one's cognition, motivation and behavioural resources to exercise self-restraint (Brown et al., 2005). Future studies should examine the long and short-term outcomes of coping strategies students use to cope with technostress in e-learning environments.

While the systematic literature reviews conducted have identified several technostressors and coping strategies, several gaps in our understanding have prevailed. Systematic literature reviews pose a limitation in that they merely synthesize what has been discovered by prior studies. Future research should address these gaps by employing empirical studies to explore the phenomena of technostress and coping in primary and secondary students, the root causes of technostress, how specific technostressors are coped with and the short- and long-term effects of particular coping strategies.

## 5.4 Conclusion

To conclude, this study has identified the technostressors students experience in e-learning environments. Besides that, this study also identified the problem and emotion-

focused coping strategies students apply to cope with them. Through the use of systematic literature review, the study pinpoints how some technostressors are coped with, as well as highlights a significant gap in our understanding about how other technostressors are coped with. The present study provides insight to learning administrators on the types of support and resources they can provide to help prevent the onset of technostress in e-learning environments. It also provides insight into the areas in which learning administrators can provide support to further strengthen students' coping abilities and prevent maladaptive coping behaviours.

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